BioEM 2021

26 - 30 Sep 2021, Flanders Expo, Ghent, Belgium

The Joint Annual Meeting of
The Bioelectromagnetics Society and the
European BioElectromagnetics Association

Technical Program and General Information

The Bioelectromagnetics Society - Officers and Board of Directors

President	Rene De Seze	France
President-Elect	Marthinus Van Wyk	South Africa
Treasurer	Bennett Ibey	USA
Secretary	Azadeh Peyman	United Kingdom
Board Member	Guangdi Chen	China
Board Member	Satoshi Nakasono	Japan
Board Member	Lucas Portelli	Switzerland
Editor-In-Chief (ex-officio)	James C. Lin	United States

European BioElectromagnetics Association Council

President	Micaela Liberti	Italy
Past-President	Luc Martens	Belgium
Treasurer	Niels Kuster	Switzerland
Secretary	Isabelle Lagroye	France
Engineering/Physical Sciences	Maxim Zhadobov	France
Engineering/Physical Sciences	Philippe Leveque	France
Engineering/Physical Sciences	Antonio Sarolic	Croatia
Biological/Medical Sciences	Martin Röösli	Switzerland
Biological/Medical Sciences	Florence Poulletier De Gannes	France
Biological/Medical Sciences	Anke Huss	Netherlands
At Large	Wout Joseph	Belgium
At Large	Caterina Merla	Italy
At Large	Olga Zeni	Italy

Local Organizing Committee Belgium

Luc Martens
Chair BioEM 2021

Wout Joseph
Co-chair BioEM 2021
on-site conference

Arno Thielens
Co-chair BioEM 2021
online conference

Günter Vermeeren
Website responsible

Isabelle Van der Elstraeten
Congress coordinator

Leen Verloock
Procurement

Margot Deruyck
Administration support

Judith Pollet
Administration support

Melanie De Coster
Facility event
& corona coordinator

Sam Aerts
Student Responsible
& support online

Extended Local Organizing Committee BioEM 2021

Rich Nuccitelli
LOC BioEM 2021 US

Pam Nuccitelli
LOC BioEM 2021 US

Azadeh Peyman
LOC BioEM 2020

Sami Gabriel
LOC BioEM 2020

Jianqing Wang
LOC BioEM 2022

Niels Kuster
Treasurer EBEA

Bennett Ibey
Treasurer BEMS

Technical Program Committee 2021

Marnus van Wyk
BEMS co-chair

Olga Zeni
EBEA co-chair

Alexandre Legros
BEMS

Wout Joseph
EBEA

Bennett Ibey
BEMS

Maxim Zhadobov
EBEA

From the Co-chairs of the Local Organizing Committee

On behalf of the BioEM2021 Local Organizing Committee, I welcome you to Ghent, Belgium, or online for the Annual Joint Meeting of the Bioelectromagnetics Society (BEMS) and the European BioElectromagnetics Association (EBEA). I thank the two societies and the for the support and help with the organization.

The conference is held for the second time in Ghent. The city of Ghent is a compact, authentic city where the past and present co-exist in perfect balance. Ghent is one of the most beautiful historic cities in Europe and was given several pretty names: historic heart of Flanders, a city of all times, medieval Manhattan, Europe's best kept secret. On Sunday evening, the Opening Reception, and on Tuesday evening, the banquet, will be held in the Old Fish Market ("Oude Vismijn"). This beautiful building with its baroque facade from 1689 stands near to the old Gravensteen on the Saint Veerle square.

The conference will be held in Flanders Expo meeting center, easily reachable by tram from the historic center of Ghent. It is a modern meeting center that allow to implement the COVID-19 measures listed on the BioEM2021 website although no measures are anymore mandated by the Belgian government. We still keep these measures as we want to create a safe and healthy environment during the conference.

But we are also glad that we can offer for all our remote conference participants a platform that will enable online view of all posters, life attendance of all presentations, interactions through chat and Q&A and delayed playback of the presentations.

We are very grateful for the generous support of our sponsors, listed on the meeting website, the online platform and at the end of this booklet.

I look forward to seeing you throughout the week or meeting you on the online platform. And I wish you an interesting conference with a lot of networking moments in Ghent and on the online platform. And have a lot of fun!

Luc Martens
Chair
On behalf of the Local Organizing Committee

From the Co-chairs of the Technical Program Committee

On behalf of the Technical Program Committee (TPC), we are pleased to welcome you to BioEM 2021, the annual joint meeting of the Bioelectromagnetics Society (BEMS) and the European BioElectromagnetics Association (EBEA). Exceptionally this year, due to the COVID-19 Pandemic, the conference is in a hybrid format, with authors and participants attending the conference in person in Ghent, Belgium, and others attending remotely. The technical program includes physical sessions with on-site presentations and virtual (on-line) sessions for remote participants.

In addition to the opportunity to learn about research activities, progress and future challenges in the areas of bioelectromagnetics, this event provides a unique opportunity for the promotion and development of graduate students and their research.

We would like to thank the members of both societies and all contributors for the high quality proposals of plenaries, tutorials and workshops that allowed us to select four plenary talks, three tutorials and four workshops that address key issues and hot topics in bioelectromagnetics covered by distinguished speakers. This includes plenaries on health care applications of EM waves, on safety guidelines, on electrogenetransfer for DNA vaccine, and on millimeter waves for 5G/6G and beyond. The tutorials cover bioelectrically-mediated morphogenetic controls for regenerative medicine, quality and systematic reviews in bioelectromagnetics research. Four workshops will be on sensitivity to EMF, on effects of ultraweak field on biological systems, on effects of RF on thermal regulation and on local exposure in the context of risk assessment. We would like to especially acknowledge the invited speakers for accepting our invitation and the workshops organizers for their valuable contribution to the conference program.

219 abstracts were submitted this year, and many researchers from the BioEM community acted as external reviewers, whose dedication in assisting the TPC in the abstract review process are greatly acknowledged. The accepted abstracts were assigned into 13 oral sessions and one poster session preceded by the student flash poster session. The sessions cover health protection, from experimental studies to dosimetry and risk and safety standards, as well as clinical applications. We register a strong participation of students this year with 37 submitted abstracts demonstrating the ability of EBEA and BEMS societies to attract young researchers by providing them with a motivating research community.

According to the tradition of the BioEM conferences, we will be delighted to have as a part of the program the d'Arsonval Award Lecture and the Chiabrera Award Lecture. The Arthur Pilla Young Scientist Award and the Awards for the Best Student Presentations (poster and platform) will recognize the outstanding contributions from early career researchers.

We thank the members of the TPC for their valuable contribution and Astrid Chamson-Reig from Lawson Health Research Institute in Canada who worked particularly hard this year for managing the abstract submission website and the Book of Abstracts. Our special thanks go to the Chairs and the members of the Local Organizing Committee for their efforts in accommodating the BioEM 2021 Conference in the current unusual format.

We are looking forward to see you at BioEM 2021 and sincerely hope you will enjoy the meeting in Ghent or online!

Olga Zeni, Marnus Van Wyk, Maxim Zhadobov and Alexandre Legros (BioEM2021 TPC Co-chairs)

Technical Program Review Committee


Delia Arnaud-Cormos
France


Quirino Balzano
United States


Frank Barnes
United States

Geza Benke
Australia


John Bolte
Netherlands

Artem Boriskin
France


Christian Bornkessel
Germany

Nicolas Bouche
France


Kerry A. Broom
United Kingdom


Myles Capstick
Switzerland


Antonino Mario Cassara
Switzerland


Phil Chadwick
United Kingdom


Astrid Chamson-Reig
Canada


Indira Chatterjee
United States


C-K. Chou
United States


Michal Cifra
Czech Republic


Robert Cleveland
United States


Claudia Consales
Italy


Rodney Croft
Australia

Valerio De Santis
Italy


Rene De Seze
France

Dagmar Dechent
Germany


Stefan Dongus
Switzerland


Marloes Eeftens
Switzerland

Serena Fiocchi
Italy


Kenneth Foster
United States


Juerg Froehlich
Switzerland


Osamu Fujiwara
Japan

Tomas Garcia-Sanchez
France


Martin Gledhill
New Zealand


Jose Gomez-Tames
Japan


Ben Greenebaum
United States


Francis Hart
United States

Takashi Hikage
Japan


Peter Jeschke
Germany


Wout Joseph
Belgium

Jukka Juutilainen
Finland


Efthymios Karabetsos
Greece

Jolanta Karpowicz
Poland


Leeka Kheifets
United States


Mohsen Koohestani
France


Leena Korpinen
Finland


Stavros Koulouridis
Greece

Matej Kranjc
Slovenia


Ilkka Laakso
Finland


Alireza Lajevardipour
Australia


Hae-June Lee
Korea


Philippe Leveque
France


James C. Lin
United States


Mai Lu
China


Isabelle Magne
France

Andrew Marino
United States

Luc Martens
Belgium

Mats-Olof Mattsson
Austria

Robert McIntosh
Australia

Caterina Merla
Italy

Luciano Mescia
Italy

Gabor Mezei
USA

Hiroaki Miyagi
Japan

Alberto Modenese
Italy

Mihaela Morega
Romania

Denys Nikolayev
France

Alberto Nájera
Spain

Gunnhild Oftedal
Norway

Teruo Onishi
Japan

Andrei Pakhomov
United States

Azadeh Peyman
United Kingdom

Rosanna Pinto
Italy

Blanka Pophof
Germany

Florence Poulletier De Gannes
France

Mary Redmayne
New Zealand

Stefania Romeo
Italy

Jack Rowley
Australia

Giulia Sacco
France

Antonio Sarolic
Croatia

Gernot Schmid
Austria

Masaki Sekino
Japan

Asher Sheppard
United States

Myrtill Simko
Sweeden

Gabriella Tognola
Italy

Christer Tornevik

Shoogo Ueno
Japan

Eric Van Rongen
Netherlands

Leticia Verdugo-Diaz
Mexico

Jianqing Wang
Japan

Soichi Watanabe
Japan

Jonna Wilen
Sweden

Andrew Wood
Australia

Bo Xu
Canada

Kenichi Yamazaki
Japan

Shengyong Yin
China

Olga Zeni
Italy

Maxim Zhadobov
France

Schedule at a Glance

Monday, September 27, 2021

Time	Session	Name	Location
08:00 - 09:00		Opening and welcome	Einstein
09:00 - 10:00	P1	Plenary 1 - 5G Overview and what Next	Einstein
10:00 - 10:30		Coffee Break	
10:30 - 12:00	S01	Dosimetry 1 (Measurements)	Einstein
10:30 - 12:00	S02	Electroporation 1	Maxwell
12:00 - 13:00		Lunch	
13:00 - 14:00	M1	Merger General Meeting	Einstein
14:00 - 15:00	FS	Student Flash Poster Session	Einstein
15:00 - 16:30	PS	Poster Session	Flex Meet
16:30 - 17:00		Coffee Break	
17:00 - 19:00	W1	Workshop 1 - Local exposure in the context of risk assessment: Theory and practical demonstration	Einstein

Tuesday, September 28, 2021

Time	Session	Name	Location
08:00 - 09:45	S03	Dosimetry 2 (Computational)	Einstein
08:00 - 09:45	S04	In Vitro RF	Maxwell
09:45 - 11:00	S05	Dosimetry 3 (Measurements)	Einstein
09:45 - 11:00	S06	In Vivo	Maxwell
11:00 - 11:30		Coffee Break	

11:30 - 12:30	P2	Plenary 2 - Exploring the potentials of EM waves from body-scale to nano-communications for healthcare applications	Einstein
12:30 - 13:30	CA	Chiabrera Award	Einstein
13:30 - 15:00		Lunch	
13:30 - 15:00	M2	BEMS ABM	Einstein
15:00 - 16:30	W2	Workshop 2 - Effects of low-intensity RF on thermal regulation	Einstein
16:30 - 17:00		Coffee Break	
17:00 - 17:45	S07	Mechanistic / Theoretical	Einstein
17:00 - 17:45	S08	Human Studies	Maxwell
17:45 - 18:45	T1	Tutorial 1 - Endogenous bioelectric networks underlie embryogenesis, regeneration and cancer: from basic mechanisms to electroceuticals	Einstein

Wednesday, September 29, 2021

Time	Session	Name	Location
08:00 - 10:00	S09	Dosimetry 4 (Computational)	Einstein
08:00 - 10:00	S10	Clinical / Diagnosis / Therapy	Maxwell
10:00 - 10:30		Coffee Break	
10:30 - 12:00	S11	Dosimetry 5	Einstein
10:30 - 12:00	S12	Risk, Safety Standards and Policies	Maxwell
12:00 - 13:00	P3	Plenary 3 - A comparison between the recently released IEEE standard and ICNIRP radiofrequency guidelines: What are the differences, and do they make a difference?	Einstein

13:00 - 14:30		Lunch	
13:30 - 14:30	M3	EBEA GA	Einstein
14:30 - 16:30	W3	Workshop 3 - Ultraweak and weak static, ELF, and RF field effects on biological systems	Einstein
16:30 - 17:00		Coffee Break	
17:00 - 18:00	DA	d'Arsonval Award	Einstein

Thursday, September 30, 2021

Time	Session	Name	Location
08:00 - 09:45	S13	Electroporation 2	Einstein
09:45 - 10:45	T2	Tutorial 2 - Systematic reviews in Bioelectromagnetic research	Einstein
10:45 - 11:15		Coffee Break	
11:15 - 12:15	P4	Plenary 4 - Electrogene transfer: challenges and recent advances in DNA-based vaccines	Einstein
12:15 - 13:15	T3	Tutorial 3 - Study Quality and Reproducibility – Pillars for safety assessments and medical applications in Bioelectromagnetics	Einstein
13:15 - 14:30		Lunch	
14:00 - 14:30	M4	Merger Announcement	Einstein
14:30 - 16:00	W4	Workshop 4 - Sensitivity to EMF: The Present and The Future	Einstein
16:00 - 16:30		Coffee Break	
16:30 - 17:00		Student Award	Einstein
17:00 - 17:15		Young Scientist Award	Einstein
17:15 - 17:45		Closing session	Einstein

General Information

THE CONFERENCE VENUE

BioEM2021 will be held in “Flanders Expo”, It’s an event complex in Ghent (Sint-Denijs-Westrem) and one of the largest in Belgium. The total exhibition area is more than 54,000 m². Trade fairs, expositions, conferences and other large-scale gatherings are organized in the complex.

Ghent is a city and a municipality in the Flemish region of Belgium. It is the capital and largest city of the East Flanders province, and the third largest in the country, exceeded in size only by Brussels and Antwerp. It is a port and university city.

ACCESSIBILITY

By tram:

Catch tram 1 heading for Flanders Expo and jump off at the Flanders Expo stop.
Tram line 1 takes you from Evergem/Wondelgem via the center and Sint-Pieters station to Flanders Expo and back. You will be dropped off almost at the door of the halls.
The frequency varies between 5 and 23 minutes (depending on rush hours), the travel time between Sint-Pieters station and Flanders Expo is 7 to 8 minutes.
Starts at 05:42 and ends at 23:05

By Car:

Exit the E40 Brussels – Ostend motorway at junction 14
Parking A4 is at our disposal

REGISTRATION AND INFORMATION DESK

When you arrive at the location signs will guide you to the entrance of Flanders Expo

On Sunday, September 26, the registration and Information desk will be open at the location of the opening reception ‘De Oude Vismijn’ from 18:00 on.

From Monday, September 27 until Thursday, September 30, the Registration Desk will be open in the conference center from 8:00 until the end of the last meeting session of each day.

CONFERENCE BADGE

Badges must be worn at all times during the meeting and during all social events (registered guests as well). The badges will be delivered at the Registration desk.

CONFERENCE LUNCH AND COFFEE BREAKS

A buffet lunch will be provided every day during the conference.

Coffee breaks will take place in the morning and in the afternoon.

SOCIAL EVENTS

1. GENERAL INFORMATION

“Flanders Expo” is located in Ghent, easily accessible by tram, only an 8 minute ride will take you to the heart of Ghent. In the center you can enjoy our historic buildings but just as well have a drink in many beautiful bars.

There is also a lot inside or outside visits you can make, and you’ll be provided in your conference bag with a map and info of the city.

2. WELCOME RECEPTION, Sunday September 26

Sunday, September 26, 19:00 at “De Oude Vismijn” (Rekelingestraat 5, Ghent).
Expected end time: approximately 22:00.

3. STUDENT ICE BREAKER, Sunday September 26

The Student Ice Breaker will be held on Sunday September 26 at the Bar Mirwaar (Burgstraat 59, Ghent). This will be a great occasion for students to get to know each other sharing a few drinks. Let’s go to the bar at 21:00.

4. CONFERENCE DINNER, Tuesday September 28

Please join us Tuesday September 28 for the Conference dinner. We will expect you at the location “De Oude Vismijn” (Rekelingestraat 5, Ghent) at 19:00.
The Oude Vismijn' shelters event halls and was known, before its spectacular renovation as the oldest fish, meat and vegetable market in the city center of Ghent.
Begin with a cocktail before having the Gala dinner served in this beautiful environment. Of course you will need your dancing shoes on to properly end the night!

ORAL AND POSTER PRESENTATION GUIDELINES

Please find below some potentially useful material to assist you in preparing a presentation for BioEM2021. Papers are to be presented in two basic formats: Oral and Poster Presentations. Below you will find specific information concerning these two formats.

If for any reason you find yourself unable to personally present your paper, please try to arrange for someone else to present it. **If nobody is available to present your work, you must notify the TPC Chairs well ahead of time (at tpc@bioem.org). If the presentation does not take place, the corresponding abstract will be removed from the online abstract book.**

No photos or video recording are allowed during presentations.

Due to the current Covid situation, the BioEM2021 conference will be a hybrid conference, with some people physically attending in Ghent and other people attending online. We work together with the company Bitstream from Ghent who will deliver the onsite video streaming and online conference platform (further referred to online platform provider).

Guidelines for entries into the student and young scientist competitions are also given here.

1. Invited speakers presenting in Plenaries, Tutorials and Workshops

1.1 Authors attending physically in Ghent

Authors will present from the conference venue and the session streamed and recorded.

1.2 Authors attending remotely

Authors are requested to present online in real-time, if possible. As backup, speakers are requested to upload a pre-recorded talk. The online platform will provide a chat for questions and answers.

Instructions for remote talks in real-time:

- Software: Access to the video platform will be provided by the online platform provider (Zoom room)
- Broadband internet connection
- Preferable an HD webcam
- You will be contacted by the online platform administrator 10 min before the start of your presentation

Instructions for the pre-recorded talks:

- All files must be in MP4 H264 Format and HD 1080p resolution
- Video length: scheduled duration of the talk
- Slideshow with audio and recording of presenter in corner of the screen so that the material presented is not hidden behind the recording of the presenter
- Peak Bit Rate: 10 Mbps
- Aspect Ratio: 16:9 Landscape
- File name extension: mp4
- The online platform provider will provide a dropbox link for your uploads. It is important the title is clearly described (example: plenary_sessionnumber_firstname_lastname or tutorial_sessionnumber_firstname_lastname or workshop_sessionnumber_firstname_lastname)

Tips for remote live talks and recording audio/video:

- Use an area as quiet as possible.
- Avoid areas that have echo.
- A good headset with a microphone set close to your mouth BUT away from direct line of mouth to reduce “pops”. Try to avoid using default, built-in microphones on your computer, if possible.

2. Oral Presentations for speakers (excluding invited speakers)

All oral presentations have been allocated a 15-minutes time slot. These 15-minutes must include the presentation, questions, and transitioning to the next speaker. It is recommended that speakers plan on a 11 minute presentation to allow for questions, discussion and transition (4 minutes). **There will be an online platform for questions and answers.** It is important to strictly adhere to this schedule as most oral presentations are scheduled in parallel sessions. Arrive at least 10 minutes early prior to the start of the session and introduce yourself to the chair and familiarize yourself with the audio-visual equipment.

2.1 Authors attending physically in Ghent

Authors will present from the conference venue and the session streamed and recorded.

Each meeting room will be equipped with a personal computer to accommodate PowerPoint and PDF presentation formats. Technical support will be present in each meeting room to ensure flawless execution. Authors must upload their presentations onto the designated computer at the conference venue during the break before their session at the latest. Presenters will not be allowed to connect their own computer to the projection system. Presentations can be loaded via USB flash memory stick.

Authors are urged to try to minimize any potential problems by taking advantage of redundancy whenever possible: save and bring presentations in multiple formats (PowerPoint and Adobe PDF), store presentations in more than one media, and keep the media on your person during travel.

All oral presenters are expected to support their presentation with a corresponding slideshow. The slides should be prepared in either PowerPoint (PPT/PPTX) or PDF format to ensure maximum compatibility with the equipment available on-site. Videos should either be embedded into the slides, or, if linked, physically accompany the main presentation document.

There will be a designated contact person coordinating the upload of your file in your session room. Please coordinate with this person to upload your presentation preferably the day before.

Presenters are strongly encouraged to verify that their presentation materials uploaded properly on the

on-site equipment.

2.2 Authors attending remotely

Are required to upload a pre-recorded talk which will then be streamed at the correct time. Live presentations are not possible. We have decided that because we want to avoid problems with the remote internet connections during the talks.

Instructions for the pre-recorded talks:

- All files must be in MP4 H264 Format and HD 1080p resolution
- Video length: 11 minutes
- Slideshow with audio and recording of presenter in corner of the screen so that the material presented is not hidden behind the recording of the presenter
- Peak Bit Rate: 10 Mbps
- Aspect Ratio: 16:9 Landscape
- File name extension: mp4
- The online platform provider will provide a dropbox link for your uploads. It is important the title is clearly described (example: oral_sessionnumber_firstname_lastname)

Tips for recording audio/video:

- Use an area as quiet as possible.
- Avoid areas that have echo.
- A good headset with a microphone set close to your mouth BUT away from direct line of mouth to reduce “pops”. Try to avoid using default, built-in microphones on your computer, if possible.

3. Poster Presentations

Poster sessions are an important part of the BioEM2021 conference and allow for immediate and effective communication between all those interested in specific subjects, actions or programs. Posters should be carefully designed and prepared to ensure their full impact. The physical poster session will be on Monday September 27, 2021 at 15:00 - 16:30 in the "Flex Meet". **There will also be online versions of the posters due to the BioEM2021 format.** There will be an online platform for questions and answers on posters.

3.1 Poster presenters attending physically in Ghent

Presenters must present their poster during the poster session detailed above, as usual. Presenters must also upload a PDF of the poster to the online platform. Presenters are also invited (not mandatory) to upload a 3 minute flash presentation to the platform.

Instructions for posters uploaded to the online platform:

- PDF format
- Portrait orientation
- A4 size

Double-sided boards in portrait format (120 cm x 100 cm) will be available for each author to attach their poster. The authors are advised to limit their poster size to 120 cm (height) X 90 cm (width) – this includes format A0. Material will be provided by the organizers for mounting posters. The boards will be numbered to correspond with poster numbers in the Program and student posters will be clearly identified.

Authors should be present at their posters for the duration of their assigned session to discuss their work and answer questions, as there will be a flux of attendees.

Mounting: Posters can be mounted from Monday September 27, 9:00 am. Each board will be marked with the poster number, as indicated in the final program. Removal: Posters must be removed before Thursday September 30, 12:00 am.

All student posters will also be presented as poster flash presentation. The poster flash session will take place in “Einstein” room on Monday, September 27 from 2:00 pm to 3:00 pm. Authors should prepare their communication carefully (in English). Each presenter will have 3 minutes to present 4 slides

maximum for the flash presentation (discussions will follow afterwards at the poster). Authors should introduce themselves in the beginning of the presentation and point out the main findings of their work. Hence the presentation should not include new material that is not shown on your poster. The chairs will call up the next presenter after the 3 minutes are over and the current presenter must leave the podium.

3.2 Poster presenters attending remotely

Presenters must upload a PDF of the poster to the online platform. Presenters are also invited to upload a 3 minute flash presentation to the platform. Uploading a flash presentation is mandatory for students that are in the student competition and that attend remotely. Questions to these presenters will be done through the chat function of the online platform.

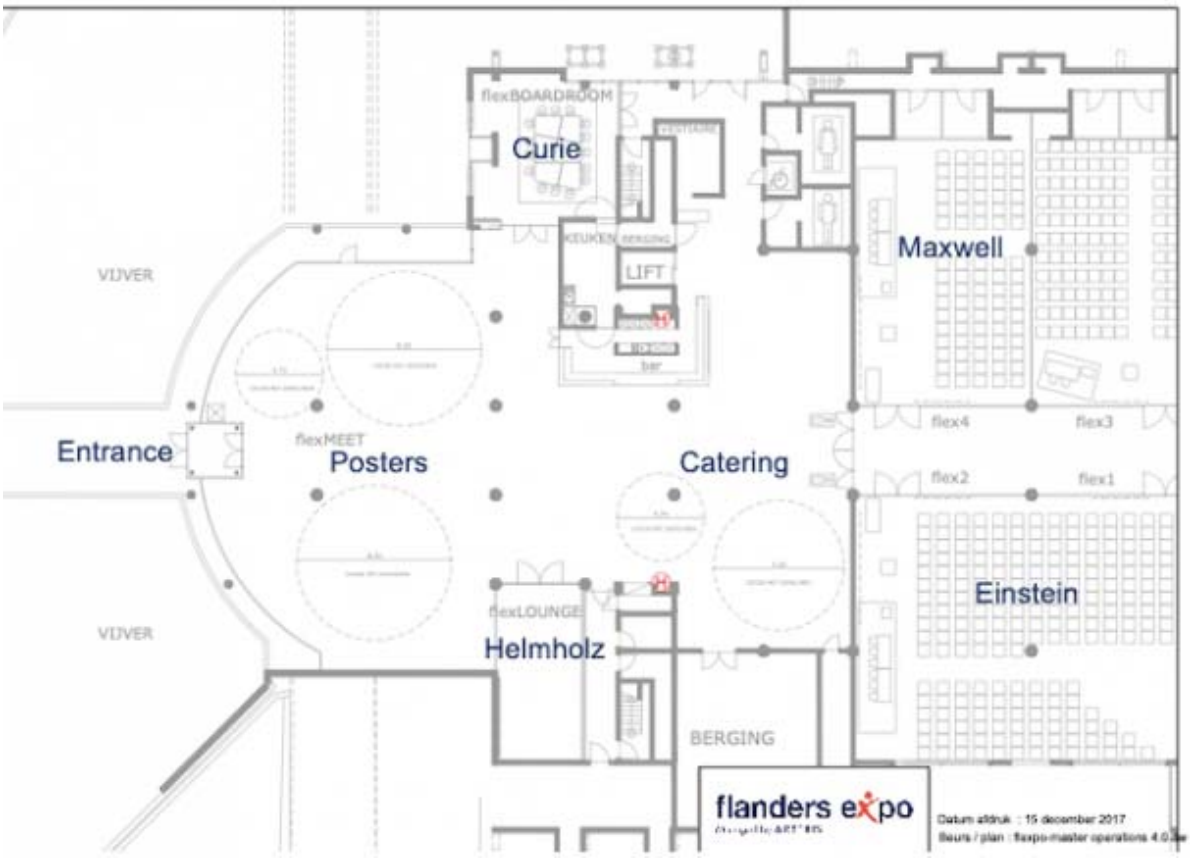
Instructions for posters uploaded to the online platform:

- PDF format
- Portrait orientation
- A4 size

Instructions for pre-recorded flash presentations:

- All files must be in MP4 H264 Format and HD 1080p resolution
- Video length: 3 minutes
- Slideshow with audio and recording of presenter in corner of the screen so that the material presented is not hidden behind the recording of the presenter
- Peak Bit Rate: 10 Mbps
- Aspect Ratio: 16:9 Landscape
- File name extension: mp4
- 4 slides maximum for the flash presentation.

Authors should introduce themselves in the beginning of the presentation and point out the main findings of their work. Hence the presentation should not include new material that is not shown on your poster.



MET DE WAGEN
EN VOITURE
BY CAR

flanders expo

CONFERENCE ORGANIZERS

Local organization by imec - Ghent University
Tel: +32-9-264 33 21 Fax: +32-9-264 99 69

imec (http://www.imec-int.com) GHENT UNIVERSITY

Lawson Health Research Institute
BioEM Website, Communication and Meeting Support

Abstract submission, abstract review and assignment, email campaigns, program and abstract books, Arthur Pilla and Student award judging, and meeting survey

Astrid Chamson-Reig, PhD
Jeffrey Carson, PhD

Lawson Health Research Institute
268 Grosvenor Street
London, Ontario,
Canada, N6A-4V2
office@bioem.org
office@bems.org

LAWSON
HEALTH RESEARCH INSTITUTE

Monday September 27, 2021

Opening and welcome
Monday September 27, 2021 • 08:00 - 09:00
Einstein

Session: P1
Plenary 1 - 5G Overview and what Next
Monday September 27, 2021 • 09:00 - 10:00
Einstein
Chairs: Micaela Liberti & Wout Joseph

P1-1 [09:00]

5G Overview and what Next

Rahim Tafazolli

[1]*Department of Electrical and Electronic Engineering, University of Surrey, Guildford, United Kingdom, GU2 7XH*

Biographical sketch

Rahim Tafazolli is Regius Professor of Electronic Engineering, Fellow of Royal Academy of Engineering, (FREng), FIET, Fellow of WWRF, Professor of Mobile and Satellite Communications, Founder and Director of 5GIC, 6GIC and ICS (Institute for Communication System) at the University of Surrey. He has over 30 years of experience in digital communications research and teaching. He has authored and co-authored more than 1000 research publications and is regularly invited to deliver keynote talks and distinguished lectures to international conferences and workshops. He was an Advisor to the Mayor of London in regard to the London Infrastructure Investment 2050 Plan. He has given many interviews to international media in the form of television, radio interviews, and articles in international press.

Abstract

5G vison started in 2015 and is currently being standardised and deployed in many countries. 5G is expected to serve the market needs until 2040 when it is expected to mature in terms of capacity. It will be able to support, in addition to mobile broadband, communications between machines of different capabilities with high reliability for mission critical applications and mass connectivity for large number of Internet of Things (IoT). These new capabilities together with guaranteed low latency are main differentiation between 5G and previous generation of mobile systems where main objectives was mainly provision of mobile communications. The talk will provide an overview of wireless/mobile system evolution from 1G to 5G, their justifications and use cases behind such evolution. In more details it will cover full 5G use cases and its key important capabilities, priority frequency bands of operation and technical specifications of New Radio (NR) as specified by 3GPP Release 15 and beyond. In the talk where appropriate 5G NR is compared with that of 4G. The 5G standardisation roadmap and the agenda on evolution and optimisation 5G will also be discussed . The talk will finish with what will be next in 2030 and beyond which is commonly referred to as 6G. New research challenges that 6G will bring about and some interesting use cases expected in 6G era will be presented.

Coffee Break
Monday September 27, 2021 • 10:00 - 10:30

Session: S01
Dosimetry 1 (Measurements)
Monday September 27, 2021 • 10:30 - 12:00
Einstein
Chairs: Gernot Schmid & Gunter Vermeeren

S01-1 [10:30]

Influence of beamforming on local exposure to massive MIMO 5G base stations

Thomas Kopacz[1], Christian Bornkessel[2], Matthias Wuschek[3], Sascha Schiessl[1], Anna-Malin Schiffarth[1] & Dirk Heberling[1, 4]

[1]*Institute of High Frequency Technology, RWTH Aachen University, Aachen, Germany, 52074*

[2]*RF & Microwave Research Laboratory, TU Ilmenau, Ilmenau, Germany*

[3]*Faculty of Electrical Engineering and Media Technology, Deggendorf Institute of Technology, Deggendorf, Germany*

[4]*Fraunhofer Institute for High Frequency Physics and Radar Techniques, Wachtberg, Germany*
Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Thomas Kopacz

This paper deals with the impact of beamforming antennas on the local downlink exposure in a 5G network. Field strength measurements show that the local exposure maximum in a 5G cell changes according to the location of a moving user equipment (UE). When carrying out a download, the local exposure mainly depends on the azimuth angle between UE and 5G antenna. The impact is the strongest in the main lobe of the beams and reduces in the side lobes. In contrast, a comparison to passive antennas of a 4G base station on the same site shows that the local exposure in the cell is independent of the current location of the active UE.

Session: S02
Electroporation 1
Monday September 27, 2021 • 10:30 - 12:00
Maxwell
Chairs: Richard Nuccitelli & Delia Arnaud-Cormos

S02-1 [10:30]
Young Scientist

Simulation and In-vitro study of nanosecond electric pulse effect on cancerous cells and normal cells

Xin Rao[1], Xiaodong Chen[1, 2], Lingling Sun[1], Jun Liu[1], Liyang Yu[1], Keqiang Yue[1], Guodong Su[1], Wen Dang[2], Jun Zhou[3] & Peidu Jiang[4]

[1]*Circuits and Systems Key Laboratory of the Ministry of Education, Hangzhou Dianzi University, Hangzhou, China, 310018*

[2]*School of Electronic Engineering and Computer Science, Queen Mary University of London, London, United Kingdom, E1 4NS*

[3]*School of Electronic Science and Engineering, University of Electronic Science and Technology of China, Chengdu, China, 610054*

[4]*School of Medicine, University of Electronic Science and Technology of China, Chengdu, China, 610054*
Keywords: In vitro, Pulsed, Completed (unpublished)
Presented by: Xin Rao

In order to address the possible side effects in this therapy, we have studied the selectivity ofnanosecond pulsed electric field (nsPEF)on cancer cells and normal cells by using 2D EM simulation and in-vitro experiments. The 2D EM simulation on two cell models is conducted for studying the distribution of nsPEF in the different sub-cell structures. Then, the nsPEF is applied toB16 cells andL929 cells, respectively. Thefluorescence-activated cell sorting shows the selectivity of nanosecond pulse stimulation on cancer cells and normal cells in terms of apoptosis. The obtained results could be helpful for designing future nanosecond pulse stimulation therapies and

avoiding serious side effects.

S01-2 [10:45]

RF Exposure levels from mobile phone base stations in outdoor environment and an underground mall in Japan

Teruo Onishi[1], Miwa Ikuyo[1], Kazuhiro Tobita[1], Sen Liu[1], Masao Taki[1] & Soichi Watanabe[1]

[1]*Electromagnetic Compatibility Laboratory, National Institute of Information and Communications Technology, Koganei, Japan, 1848795*

Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)

Presented by: Teruo Onishi

The new project of acquisition, accumulation, and applications of EMF exposure monitoring data in Japan was started in 2019. The aim of this study is to get the comprehensive picture of exposures to EMF in real daily lives in Japan. In 2019 and 2020, we measured the electric field strengths in the same areas as the measurements conducted in 2006 and 2007 and compared these data in order to investigate time-course of EMF environment. The results show that the overall tendency that the E-field strength is larger in the urban area including the mall than in the suburban area. It is also obvious that E-field strength increases from 2006/2007, especially in the underground mall.

S01-3 [11:00]
Young Scientist

Assessment of 5G NR base station RF-EMF exposure in a commercial network in Switzerland

Sam Aerts[1], Kenneth Deprez[1], Davide Colombi[2], Matthias Van Den Bossche[1], Leen Verloock[1], Luc Martens[1], Christer Tornevik[2] & Wout Joseph[1]

[1]*Department of Information Technology, Ghent University / imec, Ghent, Belgium, 9052*

[2]*Ericsson Research, Ericsson AB, Stockholm, Sweden, 16480*

Keywords: Dosimetry (measurements), RF/Microwaves, Completed (published)

Presented by: Sam Aerts

The results of a measurement campaign to assess

S02-2 [10:45]
Young Scientist

Nanosecond pulsed electric fields activate the inflammasome in macrophages: the role of potassium in this complex scenario

Flavia Mazzarda[1], Julia L. Pittaluga[1], Esin B. Sözer[1], Alexandra E. Chittams[1], P. Thomas Vernier[1] & Claudia Muratori[1]

[1]*Frank Reidy Research Center for Bioelectrics, Old Dominion University, Norfolk, VA, USA, 23508*

Keywords: Electroporation, Pulsed, Work in Progress

Presented by: Flavia Mazzarda

It is well known that electroporation is a potent tool for tumor ablation, but its impact on immunogenic response in the tumor microenvironment is still poorly understood. Our results showed that nanosecond pulsed electric fields (nsPEF) are able to activate the NLRP3 inflammasome, a multi-protein innate immunity platform, that promotes maturation of proinflammatory IL-1β upon detection of pathogens and dangerous signals evoked by cellular stress. Interestingly, the mechanisms of inflammasome activation mirror bio-effects of nsPEF (such as K^+ efflux). Studying the inflammasome activation in response to nsPEF will be crucial for developing new implementations of electroporation in cancer therapy.

S02-3 [11:00]

Histopathology of Nano-Pulse Stimulation treatment of porcine skin supports the findings of epidermal regeneration leading to acceptable healing within 30 days

Holly Hartman[1], Dave Danitz[1], Richard Connolly[1], Bill Stoffregen[2], William Knape[1] & Richard Nuccitelli[1]

[1]*Research and Development, Pulse Biosciences, Hayward, CA, USA, 94545*

[2]*Pathology, Northstar Preclinical and Pathology Services, Lake Elmo, MN, USA, 55052*

Keywords: Electroporation, Pulsed, Completed (unpublished)

Presented by: Richard Nuccitelli

We conducted two studies treating porcine skin with

radiofrequency (RF) electromagnetic field (EMF) exposure in a commercial 5G New Radio (NR) network in Bern, Switzerland, are presented. Four base station sites with massive MIMO antennas were surveyed, which operated at 3.6 GHz and used codebook-based beamforming. The present field levels were very low (< 0.05 V/m) due to low traffic load and low configured antenna powers. However, setting up a maximum downlink traffic stream towards a user device increased the time-averaged exposure level to up to 0.4 V/m. Finally, it was found that the contribution of the NR network to the environmental RF exposure was limited to an average of 2% with maximum downlink traffic.

S01-4 [11:15]

Design of a low specific absorption rate microstrip patch antenna for 5G (n78 band) smart devices applications

Md. Abu Sufian[1], Batchingis Bayarzaya[1], Jaemin Lee[1], Seong Gyoon Park[2] & Nam Kim[1]

[1]*Information and Communication Engineering, Chungbuk National University, Cheongju, Korea, 28609*

[2]*Information and Communication Engineering, Kongju National University, Cheongju, Korea*

Keywords: In vivo, RF/Microwaves, Work in Progress

Presented by: Md. Abu Sufian

A metasurface-based microstrip patch antenna with a low Specific Absorption Rate (SAR), has been presented for 5G sub-6 GHz applications. The aimed frequency band is n78 (3.4 – 3.8 GHz) because this range is the most used frequency range all over the world for sub-6 GHz 5G communications systems. The Specific Absorption Rate (SAR) is calculated for 1 g tissue at 0 mm distance from the human head instead of 10 mm, which is stricter than the international standard. Compared with the international standard SAR value (1.6 W / kg), the proposed antenna showed a 77.8% reduction in SAR_{1g} at 0 mm distance, without using any extra back reflector.

Nano-Pulse Stimulation (NPS) energy delivered by the CellFX® System (Pulse Biosciences, Hayward, CA) to characterize the histological response to reference two other ablation modalities, cryoablation and electrodessication. NPS treatment induces degeneration and necrosis of the cellular elements of the epidermis and dermis within 2 days followed by epidermal regeneration over the next 12 days. There was no evidence of thermal damage of the NPS treatment sites at any time point. Resolution of histological treatment effects of the epidermis, dermis, and subcutis occurs by 30 days after treatment consistent with complete and acceptable healing.

S02-4 [11:15]
STUDENT PAPER

High throughput electroporation microsystem using sine wave bursts to deliver biomolecules into cell spheroids

Pauline Bregigeon[1], Marie Frénéa-Robin[1], Charlotte Rivière[2], Laure Franqueville[1], Christian Vollaire[1] & Julien Marchalot[1]

[1]*Ampère, UMR5005, Ecole Centrale de Lyon, INSA Lyon, Université Claude Bernard Lyon 1, Ecully, France, 69130*

[2]*Institut Lumière Matière, Claude Bernard Lyon 1 University, CNRS, F-69622, Villeurbanne, France, 69100*

Keywords: Electroporation, Pulsed, Completed (unpublished)

Presented by: Pauline Bregigeon

Reversible electroporation (EPN) is a method for introducing molecules into cells without permanent damage based on the application of pulsed electric fields. The development of innovative in vitro assays exploiting 3D cell models such as spheroids can be of great help to assess the potential of cancer treatments based on EPN. The parallel treatment of tens of spheroids of similar characteristics (size, shape) is required to produce statistical data. To address this challenge, we designed a microfluidic platform enabling culture and electroporation of a large number of spheroids sharing similar characteristics without requiring any manipulation. Here, we demonstrate the delivery of an anti-cancer agent in spheroids using sine wave bursts.

S01-5 [11:30]

Numerical assessment of the spatiotemporal duty cycle of 5G Massive MIMO in an outdoor urban environment using radio-frequency Ray-Tracing

Sergei Shikhantsov[1], Arno Thielens[1], Gunter Vermeeren[1], Emmeric Tanghe[1], Piet Demeester[1], Guy Torfs[1], Luc Martens[1] & Wout Joseph[1]

[1]*Department of Information Technology, Ghent University/IMEC, Ghent, Belgium, 9000*

Keywords: Dosimetry (computational), RF/Microwaves, Completed (published)

Presented by: Sergei Shikhantsov

This work presents a numerical method of estimation a realistic time-averaged antenna array pattern of a massive MIMO base station (BS). The Ray-Tracing is used to calculate the propagation in a large number of stochastically generated environments modelling an outdoor urban scenario. The antenna patterns are averaged over a 6 and 30 minute intervals and evaluated for varying number of the BS antennas and active users, as well as different transmit precoding/beamforming schemes. It is shown that the realistic average maximum gain can be as low as 6% of the theoretical maximum when the interference-cancelling Massive MIMO precoding, and around 13% in case of a codebook beamforming, measured as a 95th percentile of the sample distribution.

S01-6 [11:45]
STUDENT PAPER

Protocol for 5G Personal RF-EMF Exposure assessment

Maarten Velghe[1], Sam Aerts[1], Luc Martens[1], Wout Joseph[1] & Arno Thielens[1]

[1]*Department of Information Technology, Ghent University/IMEC, Ghent, Belgium, 9052*

Keywords: Dosimetry (measurements), RF/Microwaves, Completed (published)

Presented by: Maarten Velghe

A new activity-based protocol for 5G microenvironmental measurements and survey studies for the assessment of personal RF-EMF assessment is proposed. This protocol provides a necessary update to reliably assess exposure in 5G

S02-5 [11:30]
STUDENT PAPER

Enhanced imaging of nanosecond electric pulse-evoked Ca^{2+} responses in adrenal chromaffin cells isolated from transgenic mice expressing the Ca^{2+} indicator GCaMP6f

Ciara Viola[1], Thomas Gould[2], Nicole Procacci[2], Normand Leblanc[1] & Gale Craviso[1]

[1]*Department of Pharmacology, University of Nevada, Reno, Reno, NV, USA, 89557*

[2]*Department of Physiology and Cell Biology, University of Nevada, Reno, Reno, NV, USA, 89557*

Keywords: In vitro, Pulsed, Work in Progress

Presented by: Ciara Viola

Exposing bovine adrenal chromaffin cells to a 5 ns, 5 MV/m pulse causes a rapid rise in intracellular Ca^{2+}due to voltage-gated Ca^{2+}channel-mediated Ca^{2+}influx. To work toward studying effects on cells in adrenal tissue slices, we generated transgenic mice expressing the genetically-encoded fluorescent Ca^{2+}reporter GCaMP6f in chromaffin cells. Ca^{2+}responses evoked by a 5 ns pulse or nicotinic receptor agonist were similar in bovine vs wild-type murine cells loaded with Calcium Green-1, and in dye-loaded wild-type vs GCaMP6f-expressing murine cells, except that Ca^{2+}responses were much more robust in GCaMP6f-expressing cells, an advantage for studying stimulus-evoked and spontaneous Ca^{2+}transients in isolated cells and in tissue.

S02-6 [11:45]
STUDENT PAPER

Numerically predicted irreversible electroporation ablation of hepatic tumors compared to MRI imaging – a retrospective study

Helena Cindric[1], Panchatcharam Mariappan[2], Lukas Beyer[3], Philipp Wiggermann[4], Michael Moche[5], Damijan Miklavčič[1] & Bor Kos[1]

[1]*Laboratory of Biocybernetics, Faculty of Electrical Engineering, University of Ljubljana, Ljubljana, Slovenia, 1000*

[2]*Department of Mathematics and Statistics, Indian Institute of Technology Tirupati, Tirupati, India, 517506*

technologies, as it addresses the main challenges to personal exposure measurements introduced by 5G NR. A systematic method to evaluate a user's auto-induced exposure is introduced by using an activity-based approach.

[3]*Department of Diagnostic and Interventional Radiology, Ernst von Bergmann Hospital, Potsdam, Germany, 14467*

[4]*Institute of Radiology and Nuclear Medicine, Hospital Braunschweig, Braunschweig, Germany, 38118*

[5]*Department for Interventional Radiology, Helios Park-Klinikum Leipzig, Leipzig, Germany, 04289*

Keywords: Electroporation, Pulsed, Completed (published)

Presented by: Helena Cindric

Irreversible electroporation (IRE) ablation is a relatively new modality for ablation of various deep-seated tumors such as in the liver. A previously developed numerical framework for planning of electroporation-based treatments was used to numerically reconstruct 18 clinical cases of IRE ablation of hepatic tumors. Computed treatment outcomes (ablation volumes) were compared to ablation volumes segmented from 6-week follow-up MRI. The aim of this retrospective study was to determine the threshold value of computed electric field that best fits the local response to IRE ablation of hepatic tumors as seen in follow-up MRI. A future prospective study can be effectively designed based on the findings of this study.

Lunch
Monday September 27, 2021 • 12:00 - 13:00

Session: M1
Merger General Meeting
Monday September 27, 2021 • 13:00 - 14:00
Einstein

Session: FS
Student Flash Poster Session
Monday September 27, 2021 • 14:00 - 15:00
Einstein
Chairs: Florence Poulletier De Gannes & Martin Röösli

Session: PS
Poster Session
Monday September 27, 2021 • 15:00 - 16:30
Flex Meet

Coffee Break
Monday September 27, 2021 • 16:30 - 17:00

Session: W1
Workshop 1 - Local exposure in the context of risk assessment: Theory and practical demonstration
Monday September 27, 2021 • 17:00 - 19:00
Einstein
Chairs: Ilkka Laakso & Gernot Schmid

W1-1 [17:00]

Workshop Introduction

Peter Jeschke[1], Klaus Schiessl[3], Carsten Alteköster[2], Benjamin Vatovez[5], Gernot Schmid[4] & Rene Hirtl[4]

[1]*Physical Agents, Federal Insititute for Occupational Safety and Health, Dortmund, Germany, 44149*

[2]*Institute for Occupational Safety and Health of the German Social Accident , St. Augustin, Germany, 53757*

[3]*Austrian Workers' Compensation Board (AUVA), Wien, Austria, 1200*

[4]*Seibersdorf Laboratories, Seibersdorf, Austria, 2444*

[5]*Scientific Institute of Public Service, Liege, Belgium, 4000*

This fundamentals workshop aims to provide an insight into sources with local exposure, the physics and physiology of near field exposure, regulative constraints, and assessment of local exposures in occupational as well as general public EMF settings. Up until a few years ago, localized exposure was of interest only to the domain of occupational EMF exposure. Only recently, with innovations around smartphones and smart body worn devices localized exposures are becoming a matter of interest to the general public as well. Participants of all backgrounds are invited to gain a good understanding of the topic of localized exposure.

W1-2 [17:05]

Fundamental aspects of localized EMF exposure

Carsten Alteköster[1]

[1]*Institute for Occupational Safety and Health of the German Social Accident , St. Augustin, Germany, 53757*

If an assessment is to be carried out with respect to risks arising from electromagnetic fields at the workplace, the requirements of the European Directive 2013/35/EU [1] or its national implementations must be applied in the EU. For this purpose, measured external field values can be compared to given action levels (ALs), which were again derived from internal exposure limit values (ELVs). ELVs must not be exceed in order to avoid adverse effects. It is assumed that the ELVs are met when it can be demonstrated that this is also true for the action levels.

W1-3 [17:20]

Worker's exposure close to sources of low-frequency magnetic fields: application of action levels

Klaus Schiessl[1], Rene Hirtl[2] & Gernot Schmid[2]

[1]*Austrian Workers' Compensation Board (AUVA), Wien, Austria, 1200*

[2]*Seibersdorf Laboratories, Seibersdorf, Austria, 2444*

In particular in metal & heavy industry, some technologies involve close human contact to strong low-frequency magnetic field sources. Work place assessment thus needs to account for exposure in close

vicinity or contact with such sources. This contribution focuses on the spatial characteristics of the magnetic field, gives some examples from industry and reviews the conditions under which an exposure assessment may still be relatively quickly performed by application of Action Levels. Some care is needed due to the finite spatial resolution of measurement equipment, particularly close to the source.

W1-4 [17:40]

International and European Regulation - occupational perspective

Peter Jeschke[1]

[1]*Physical Agents, Federal Insititute for Occupational Safety and Health, Dortmund, Germany, 44149*

In European member states, the European EMF-Directive 2013/35/EU regulates the assessment of EMF-exposure in occupational settings. Hereby, in the low frequency domain EMF-Directive builds upon ICNIRP [2010] where as in the radio frequency range upon ICNIRP [1998]. However, for special exposure situations like local exposure, both ICNIRP-Guidelines and EMF-Directive (including the related Non-Binding-Guide [EC, 2016]) have shortcomings. The shortcomings relate especially to the application of far field assumptions on actual near field exposure settings.

W1-5 [18:00]

International and European Regulation - general public perspective

Benjamin Vatovez[1]

[1]*Scientific Institute of Public Service, Liege, Belgium, 4000*

EMF exposure is a concern for a part of the population. As a result and in order to prevent possible adverse effects, international committees, such as ICNIRP [1998] and IEEE [1991], published guidelines for protecting health and safety in the case of occupational exposure and for limiting the general public exposure to EMF. Afterwards, the basic restrictions and reference levels of the 1998 ICNIRP guidelines have been adopted by the European Council to the 1999/519/EC Recommendation [European Council, 1999], with slight differences regarding the ICNIRP guidelines.

Session: S03
Dosimetry 2 (Computational)
Tuesday September 28, 2021 • 08:00 - 09:45
Einstein
Chairs: Emmanuelle Conil & Arno Thielens

S03-1 [08:00]
STUDENT PAPER

Modeling accuracy of transcranial current stimulation: Static and quasi-static approximations errors

Gabriel Gaugain[1], Lorette Quéguiner[1], Maxim Zhadobov[1], Ronan Sauleau[1], Julien Modolo[2] & Denys Nikolayev[1]

[1]*UMR-6164, IETR (Institut d'Électronique et des Technologies du numéRique), Rennes, France, 35000*

[2]*LTSI U1099, LTSI (Laboratoire de Traitement du Signal et de l'Image), Rennes, France, 35000*

Keywords: Dosimetry (computational), ELF/LF, Completed (unpublished)
Presented by: Gabriel Gaugain

Transcranial current stimulation is a non-invasive brain stimulation technique producing electric fields in the brain using scalp electrodes. Modeling of electric field induced by transcranial current stimulation has been studied with static, quasi-static (QS) approximations and the full set of Maxwell's equations (i.e., full-wave approach, FW) in order to quantify the error due to these approximations. This comparison helps to choose an appropriate approximation depending on stimulation modalities. The QS approximation shall be preferred to the static one, especially for the field analysis in high-permittivity tissues. The results also show that the error is less than 1% below 10 MHz when comparing the QS approximation to FW modelling.

Session: S04
In Vitro RF
Tuesday September 28, 2021 • 08:00 - 09:45
Maxwell
Chairs: Mats-Olof Mattsson & György Thuroczy

S04-1 [08:00]

Evaluation of inactivation of bovine coronavirus by low-level radiofrequency irradiation

Jody Cantu[1], Bennett Ibey[2], Joseph Butterworth[1], Kevin Mylacraine[2], Bryan Gamboa[2], Leland Johnson[2], Robert Thomas[3], Jason Payne[2], William Roach[4] & Ibtissam Echchgadda[2]

[1]*Air Force Research Laboratory, General Dynamics Information Technology, JBSA Fort Sam Houston, Texas, USA, 78234*

[2]*Air Force Research Laboratory, 711th Human Performance Wing, Airman Systems Directorate, Bioeffects Division, Radio Frequency Bioeffects Branch, JBSA Fort Sam Houston, Texas, USA, 78234*

[3]*Air Force Research Laboratory, 711th Human Performance Wing, Airman Systems Directorate, Bioeffects Division, JBSA Fort Sam Houston, Texas, USA, 78234*

[4]*Air Force Office of Scientific Research, AIr Force Research Laboratory, Arlington, VA, USA, 22203*

Keywords: In vitro, RF/Microwaves, Completed (unpublished)
Presented by: Jody Cantu

Previous studies showed inactivation of viruses by irradiation with radiofrequency (RF) energy at levels below IEEE safety thresholds, suggesting potential use of RF technology as an epidemic prevention strategy in open public space. The present study investigates inactivation of a coronavirus surrogate (bovine coronavirus, BCoV) by RF energy (6–12 GHz). Results showed an appreciable reduction in BCoV infectivity due to RF exposure to certain frequencies, suggesting that, while RF can partially neutralize BCoV, the specific conditions used in this study may not be effectively applicable for virus decontamination. Future studies will optimize the exposure conditions for complete neutralization.

S03-2 [08:15]
STUDENT PAPER

Numerical RF dosimetry in reverberation chamber exposure systems employed for in-vivo rodents bioassays

Antonio Di Francesco[1, 2], Valerio De Santis[1], Kenneth Foster[3], Giorgi Bit-Babik[4] & Antonio Faraone[4]

[1]*Department of Industrial and Information Engineering and Economics, University of L'Aquila, L'Aquila, Italy, 67100*

[2]*Department of Information Engineering, Computer Science and Mathematics, University of L'Aquila, L'Aquila, Italy, 67100*

[3]*Department of Bioengineering, University of Pennsylvania, Philadelphia, Pennsylvania, USA, PA 19104-6391*

[4]*Motorola Solutions Inc., Fort Lauderdale, Florida, USA, FL 33322-9947*

Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Antonio Di Francesco

A numerical approach for the characterization of whole-body SAR variability in large rodent cohorts exposed to RF energy in reverberation chambers is proposed. Such an approach involves the accurate synthesis of 3D electromagnetic fields fulfilling the Rayleigh scattering properties, the definition of homogeneous rodent models, over a predefined mass distribution, assuming varying postures and positions within individual plastic cages inside the chamber, and finally the derivation of whole-body SAR statistics. The proposed methodology is illustrated with reference to data available from the US National Toxicology Program rodent bioassay reports (adult male rats).

S03-3 [08:30]
STUDENT PAPER

Computational analysis of magneto- and electrophosphene thresholds

Janita Nissi[1] & Ilkka Laakso[1, 2]

[1]*Department of Electrical Engineering and Automation, Aalto University, Espoo, Finland*

[2]*Aalto Neuroimaging, Aalto University, Espoo, Finland*

Keywords: Dosimetry (computational), ELF/LF, Work in Progress

S04-2 [08:15]
STUDENT PAPER

Impact of environmental radiofrequency fields on the autophagic response of human colon carcinoma cells

Alexandre Joushomme[1], Mélody Dufossée[2], Delia Arnaud-Cormos[3], Annabelle Hurtier[1], Florence Poulletier De Gannes[1], Muriel Priault[2], Philippe Leveque[3], Isabelle Lagroye[1, 4] & Yann Percherancier[1]

[1]*Équipe de bioélectromagnétique, Laboratoire d'intégration du matériau au système, Bordeaux, France, 33400*

[2]*Mitochondria, Stress and Cell Death, Institut de Biochimie et Génétique Cellulaires, Bordeaux, France, 33000*

[3]*Équipe de Bioelectromagnétique, Institut de recherche XLIM, Limoges, France, 87060*

[4]*PLS rescherch Uninersty/EPHE, Paris, France, 75014*

Keywords: In vitro, RF/Microwaves, Completed (unpublished)
Presented by: Alexandre Joushomme

Whether exposure to environmental radiofrequency signals (RF) may impact cell stress response such as autophagy remains an open question. Here, we studied autophagy using Digital holographic microscopy (DHM). This imaging method allows for the measurement of cellular thickness, volume, and area in real-time on attached cell cultures. We show in this study that the cell area increases strongly following the induction of autophagy, then decreases over time. We also show that the continuous and GSM-modulated 1800 MHz signals at 1.5 and 6 W / kg have no impact on this autophagic response.

S04-3 [08:30]

Gene responses to GSM-1800 MHz electromagnetic field in microglia and bone marrow-derived macrophages

Julie Lameth[1], Delia Arnaud-Cormos[2], Philippe Leveque[2], Jean-Marc Edeline[3], Matthieu Ribon[1], Severine Boillée[1] & Michel Mallat[1]

[1]*Institut du cerveau-Paris Brain Institute - ICM, Sorbonne Universités, INSERM, CNRS, AP-HP, Paris, France, 75013*

Presented by: Janita Nissi

Phosphenes are visions of light produced without light entering the eye. When phosphenes are caused by time-varying magnetic fields or electric currents they are called magneto- or electrophosphenes. In this work, phosphene thresholds were approximated by simulating four phosphene threshold experiments. Retinal electric fields and currents induced by magnetic and electric stimulation were determined using the finite element method and anatomically realistic computational models of human heads.

S03-4 [08:45]
STUDENT PAPER

Theoretical analysis of electromagnetic exposure to wireless charging systems for deep-body implantable devices

Icaro Soares[1], Ronan Sauleau[1] & Denys Nikolayev[1]

[1]*IETR (Institut d'Électronique et des Technologies du numéRique) UMR–6164, Univ Rennes, CNRS, Rennes, France, 35700*

Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Icaro Soares

Wireless Power Transfer (WPT) techniques allow significant miniaturisation of implanted medical devices. However, the electromagnetic exposure of the body tissues must be accurately accessed to ensure safe operation. This study, therefore, analyses the exposure induced by the magnetic- and electric-type antenna transmitters over the frequency range of 100-MHz–5-GHz. The normalised power absorption, specific absorption rate (SAR) and WPT efficiency are analysed and presented. The results demonstrate the existence of an optimal operating frequency at which the

[2]*CNRS, XLIM, UMR 7252, Université de Limoges, Limoges, France, 87000*

[3]*Paris Saclay Institute of Neuroscience, Neuro-PSI , UMR 9197 CNRS, Université Paris-Sud, Orsay, France, 91405*

Keywords: In vitro, RF/Microwaves, Completed (unpublished)
Presented by: Michel Mallat

We report effects of GSM-1800 MHz in primary cultures of microglia or bone marrow-derived macrophages. Cells were activated before GSM exposure by treating cultures with proinflammatory lipopolysaccharide (LPS) or with an oncometabolite released by glioma cells, or by using cells expressing a mutated human SOD1 gene responsible for inherited form of amyotrophic lateral sclerosis. We found that a 15h exposure of cells to GSM signal at SAR values of 1.5 W/kg or 0.65 W/kg could alter the level of transcripts encoding proinflammatory mediators or epigenetic regulators. The pattern of GSM-responsive genes strongly varied according to SAR level, cell type or activation. LPS-activated microglia displayed the broadest gene responses to GSM signal.

S04-4 [08:45]

Bystander effect in SHSY-5Y cells exposed to radiofrequency fields

Olga Zeni[1], Stefania Romeo[1], Anna Sannino[1], Rosanna Palumbo[2] & Maria Rosaria Scarfi[1]

[1]*Institute for Electromagnetic Sensing of the Environment (IREA), National Researcj Council (CNR), Napoli, Italy, 80124*

[2]*Institute for Biostructures and Bioimaging (IBB), National Researcj Council (CNR), Napoli, Italy, 80134*

Keywords: In vitro, RF/Microwaves, Completed (published)
Presented by: Olga Zeni

This study aims to investigate the capability of the culture medium from SH-SY5Y neuroblastoma cells exposed to radiofrequency (RF, 1950 MHz, UMTS signal, 0.3 W/kg) to elicit, in recipient non-exposed cells, a reduction of menadione-induced DNA damage, indicating a bystander effect. This reduction was also detected in cultures directly exposed to the same conditions, confirming previous studies on the adaptive response. We also evidenced an increase of heat shock protein 70 in culture medium of RF-exposed cells. On the whole,

maximum efficiency, minimum power absorption, and low SAR are simultaneously observed.

S03-5 [09:00]
STUDENT PAPER

3D microdosimetric study on cells and organelles realistic models: spectral response at cellular and subcellular level

Laura Caramazza[1, 2], Annalisa De Angelis[2], Zain Haider[3], Maxim Zhadobov[3], Franck Andre[4], Lluis M. Mir[4], Francesca Apollonio[1, 2] & Micaela Liberti[1, 2]

[1]*DIET@Sapienza University of Rome, Sapienza University of Rome, Rome, Italy, 00184*

[2]*Center for Life Nano- & Neuro-Science, Fondazione Istituto Italiano di Tecnologia (IIT), Rome, Italy, 00161*

[3]*University of Rennes, CNRS, IETR, Rennes, France*

[4]*CNRS, Univ. Paris-Sud, Université Paris-Saclay, Gustave Roussy, Villejuif, Paris, France*
Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Laura Caramazza

Radio frequency electromagnetic fields (RF EMFs) are increasingly used in emerging telecommunication technologies such as wireless power transfer (WPT) and 5G millimeter-wave (mm-Wave) technologies, rising a consequent concern about safety. In the framework of health protection, microdosimetric studies provide the electric field local distribution on cells and intracellular structures. In this work authors give a quantitative evaluation of the EMFs interaction with cells, using a 3D microdosimetric model with a realistic shape of cell and organelles (i.e. endoplasmic reticulum and nucleus) and a dispersive behavior. As expected, cell response to EMFs exposure strictly depends on: (i) EMFs frequency; (ii) biological material shape and size.

S03-6 [09:15]

Evaluating optimal strategies for electric field dosimetry from intracranial electrodes

Borja Mercadal[1], Fabiola Alonso[2], Denys

RF seems to induce a protective effect in directly and non-directly exposed cells, and suggest hsp70 pathway as one of the potential candidates at the basis of the pbserved phenomena.

S04-5 [09:00]

Protocol and pilot study for a systematic review on genotoxicity of RF-EMF *in vitro*

Stefania Romeo[1], Olga Zeni[1], Anna Sannino[1], Loredana Poeta[1], Susanna Lagorio[2], Mauro Biffoni[2] & Maria Rosaria Scarfi[1]

[1]*Institute for Electromagnetic Sensing of the Environment (IREA), National Researcj Council (CNR), Napoli, Italy, 80124*

[2]*Department of Oncology and Molecular Medicine, National Institute of Health, Roma, Italy, 00161*
Keywords: In vitro, RF/Microwaves, Completed (published)
Presented by: Stefania Romeo

The objective of this study was to develop a protocol for a systematic review of in vitro studies on genotoxicity of radiofrequency electromagnetic fields (EMF). We followed the guidelines developed by the National Toxicology Program-Office of Health Assessment and Translation (NTP-OHAT), adapted to the peculiarities of in vitro investigations and EMF exposures. We piloted our approach on a subset of studies. To our knowledge, this is the first protocol for systematic reviews of mechanistic studies with an in vitro exposure regime, with predefined inclusion criteria and risk of bias assessment.

S04-6 [09:15]

Ambient magnetic fields within a standard incubator do not alter the antiproliferative effect of hepatocellular carcinoma-specific AM RF EMF

Nikolayev[3], Ricardo Salvador[1], Julien Modolo[2], Fabrice Bartolomei[4], Fabrice Wendling[2] & Giulio Ruffini[1]

[1]*Neuroelectrics, Barcelona, Spain, 08035*

[2]*Laboratoire de Traitement du Signal et de l'Image, Univ Rennes, Rennes, France, 35000*

[3]*IETR (Institut d'Électronique et des Technologies du numérique), Univ Rennes, Rennes, France, 35000*

[4]*Clinical Physiology Department, INSERM, UMR 1106 and Timone University Hospital, Aix-Marseille Université, Marseille, France*

Keywords: Dosimetry (computational), Static, Work in Progress

Presented by: Borja Mercadal

Intracranial electrodes are used clinically for diagnostic (e.g. in drug-refractory epilepsy) or therapeutic (deep brain stimulation, e.g. epilepsy) purposes. Electrical stimulation delivered through such electrodes is key to understand how the resulting electric fields modulate neuronal (hyper)excitability. However, quantifying such fields in a patient-specific way is challenging, since etiology impacts brain anatomy (morphology) and biophysical properties (e.g., conductivity). Here, we evaluate how to approximate the electric fields from intracranial electrodes used clinically. Those results are the first step towards computationally tractable, patient-specific models of electric fields generated during neuromodulation protocols.

S03-7 [09:30]
Young Scientist

Combining TMS, MRI and computational dosimetry: the effective navigated (En-)TMS

Micol Colella[1], Alessandra Paffi[1], Letizia Bellizzi[2], Filippo Carducci[3], Francesca Apollonio[1] & Micaela Liberti[1]

[1]*Department of Information Engineering, Electronics and Telecommunications, University of Rome La Sapienza, Rome, Italy, 00184*

[2]*Sentech S.r.l, Rome, Italy, 00188*

[3]*Laboratorio di Neuroimmagini, University of Rome La Sapienza, Rome, Italy*

Keywords: Dosimetry (computational), Pulsed, Completed (unpublished)

Presented by: Micol Colella

Hugo Jimenez[1, 2], Kimberly Sheffield[1, 2], Preeya Achari[1, 2], Callum Mcgrath[1, 2], Alexandre Barbault[3], Ivan Brezovich[4], Carl Blackman[1, 2] & Boris Pasche[1, 2]

[1]*Department of Cancer Biology, Wake Forest Baptist Medical Center, Winston-Salem, North Carolina, USA, 27157*

[2]*Comprehensive Cancer Center, Wake Forest Baptist Medical Center, Winston-Salem, North Carolina, USA, 27157*

[3]*TheraBionic GmbH, Ettlingen, Germany*

[4]*Department of Radiation Oncology, University of Alabama at Birmingham, Birmingham, Alabama, USA, 35294*

Keywords: In vitro, RF/Microwaves, Work in Progress

Presented by: Hugo Jimenez

We have shown that 27.12 MHz amplitude modulated (AM) electromagnetic fields (EMF) inhibit proliferation of tumor growth in patients, in tumor xenografts, and in cancer cell lines. We tested the hypothesis that environmental EMFs alter tumor-specific AM RF EMF antiproliferative effects on Huh7, Hep3B, and SNU-423 hepatocellular carcinoma cell lines. We placed cells in an incubator (Forma Scientific incubator, model# 3110, Marietta, OH) with either no special shielding or with shielding by a Mu-metal box that blocked environmental EMFs. We found that the Mu-metal box (MMB) did not alter AM RF EMF antiproliferative effects.

S04-7 [09:30]

An *In Vitro* exposure system for 5G mm-wave experiments

Myles Capstick[1] & Niels Kuster[1, 2]

[1]*Foundation for Research on Information Technologies in Society (IT'IS), Zurich, Switzerland, CH-8004*

[2]*Department of Information Technology and Electrical Engineering, Swiss Federal Institute of Technology (ETH Zurich), Zurich, Switzerland, CH-8092*

Keywords: In vitro, RF/Microwaves, Work in Progress

Presented by: Myles Capstick

This paper details our development of a 5G mm-wave exposure system at 27.5 GHz for experiments

We developed an electromagnetic simulation software for future navigated (n-)TMS applications that take into account an anatomically shaped, patient-specific, volumetric head model with anistropic brain tissue. Such model can be obtained from MRI and DTI information. The software was tested considering a commercial figure-8 coil placed over M1 and results showed that considering the anisotropic properties of the brain can influence the induced E-field calculation, with differences between the isotropic and anisotropic solution up to 30%.

Session: S05
Dosimetry 3 (Measurements)
Tuesday September 28, 2021 • 09:45 - 11:00
Einstein
Chairs: Marco Zahner & Wout Joseph

S05-1 [09:45]

Assessing exposure to low frequency magnetic fields in a broad frequency range using fft-based personal exposimeters: The issue of spectral noise

Jens Kuhne[1], Andreas Deser[1], Peter Hofmann[1] & Dirk Geschwentner[1]

[1]*Department effects and risks of ionizing and non-ionizing radiation, Federal Office for Radiation Protection, Oberschleißheim, Germany*

Keywords: Dosimetry (measurements), ELF/LF, Work in Progress
Presented by: Jens Kuhne

The exposure of the general public to low frequency magnetic fields can be assessed using body worn personal exposimeters (PEM). In Germany, a large study with 1952 participants in Bavaria has been conducted 1996/1997 with PEM capable of measuring magnetic fields at two distinct frequencies, namely 16.7 and 50 Hz [Brix et al, 2001]. In order to update this low frequency exposure data and to generate data that is representative for the German population a new study is planned.

in cell cultures. The system comprises a custom lens antenna with circular polarization and gain profile designed to provide excellent incident field homogeneity across six 25cm^2 cell culture flasks for adhered cells. By illuminating the flasks from below, the system achieves state of the art specific absorption rate (SAR) homogeneity in the adhered cells, close to the best performance achieved for systems below 3 GHz while being small enough to have exposed and control cell cultures in the same incubator.

Session: S06
In Vivo
Tuesday September 28, 2021 • 09:45 - 11:00
Maxwell
Chairs: Rene De Seze & Florence Poulletier De Gannes

S06-1 [09:45]
STUDENT PAPER

Influence of extremely low frequency magnetic fields on the development of childhood leukemia – An experimental study in a susceptible mouse model

Dmitrij Sachno[1], Saskia Carstensen[1], Franziska Dahlmann[1], Thomas Tillmann[1], Achim Bahr[2], Michael Wleklinski[2], Dirk Schaudien[1], Susanne Rittinghausen[1], Katherina Sewald[1], Meike Mueller[1], Clemens Dasenbrock[1] & Annette Bitsch[1]

[1]*Fraunhofer Institute for Toxicology and Experimental Medicine, Hannover, Germany, 30625*

[2]*IMST GmbH, Kamp-Lintfort, Germany, 47475*

Keywords: In vivo, ELF/LF, Work in Progress
Presented by: Dmitrij Sachno

Childhood leukemia arises from interactions between genetic susceptibility and exogenous, environmental exposures. To elucidate a possible effect of 50 Hz magnetic fields on the developing immune system of Sca1-ETV6-RUNX1 mice, exposure was started during pregnancy and continued after birth. On postnatal day 7, 14 or 28 animals were sacrificed for a deep immunophenotyping of major lymphatic organs. A first evaluation of the flow cytometry data revealed alterations in the expression of the TCR-β chain on

αβ-TCR-expressing $CD4^+CD8^+$ double positive cells in the thymus. Although, the effect was varying over time points and sexes, this finding points towards a modulatory effect of ELF-MF on T cell maturation in the juvenile organism.

S05-2 [10:00]

What has been the impact of Covid-19 on the environmental exposure to RF-EMF?

Sam Aerts[1], Shanshan Wang[2], Luis Díez[3], Christos Apostolidis[4], Serafeim Iakovidis[4], Athanasios Manassas[4], Ramón Agüero[3], Joe Wiart[2], Wout Joseph[1] & Theodoros Samaras[4]

[1]*Department of Information Technology, Ghent University / imec, Ghent, Belgium, 9052*

[2]*Chaire C2M, Télécom Paris, Palaiseau, France, 91120*

[3]*Department of Communications Engineering, Universidad de Cantabria, Santander , Spain, 39005*

[4]*CIRI - Center for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki, Thermi, Greece, 57001*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress

Presented by: Sam Aerts

Mid-March 2020, nation-wide lockdowns were instated in several European countries to reduce the spread of the COVID-19 pandemic. In this study, the impact of these lockdowns on the environmental radiofrequency (RF) electromagnetic field (EMF) exposure is investigated, using data from EMF monitoring networks in four European countries: Belgium, France, Greece, and Spain. It was generally observed that sensors positioned in a distinct type of microenvironment (e.g. residential) measured EMF exposure patterns that followed the mobility trends of that microenvironment. However, this correlation also depended on the frequency band and the country.

S05-3 [10:15]

Development of a web-based assessment tool for occupational magnetic field exposure in the vicinity of resistance spot welding devices

Michael Kubocz[1], Kai Jagielski[1], Pia Schneeweiss[1], Thomas Kraus[1], Pedro A.M.G.P. Bamberg[2], Jonas

S06-2 [10:00]
STUDENT PAPER

The effect of extremely low-frequency electromagnetic field exposure on circadian rhythms in constant conditions

Pippa Gleave[1, 2], Simon Bouffler[1], Daniel C Anthony[2] & Kerry A. Broom[1]

[1]*CRCE, Public Health England, Chilton, United Kingdom, OX11 0RQ*

[2]*Department of Pharmacology, University of Oxford, Oxford, United Kingdom, OX1 3QT*

Keywords: Behavioural, Static, Work in Progress

Presented by: Pippa Gleave

Disruptions to circadian rhythms can have adverse health effects. The ubiquitous exposure of the public to extremely low-frequency electromagnetic fields (ELF-MF) has raised health concerns, and the long-term impact of this exposure is not fully understood. Previous studies have shown that ELF-MF modulates the expression of core clock genes in vitro and in vivo. Using male C57BL/6J mice, we investigated the effect of exposure to 50 Hz 573 uT fields in constant conditions on the circadian expression of core clock genes and on behaviour. ELF-MF exposure had no impact on the circadian expression of core clock genes or on the behaviour of the mice in the exposure cages.

S06-3 [10:15]

Browning of white adipose tissue after repeated low power RF exposure

Rene De Seze[1, 2], Amandine Pelletier[2] & Thi-Cuc Mai[1, 2]

[1]*TEAM/PERITOX UMR I-01, INERIS, Verneuil en*

Klussmann[2] & Alexander Schiebahn[2]

[1]*Research Center for Bioelectromagnetic Interaction (femu), Uniklinik RWTH Aachen University, Aachen, Germany, 52074*

[2]*Welding and Joining Institute (ISF), RWTH Aachen University, Aachen, Germany, 52062*

Keywords: Occupational, Pulsed, Work in Progress

Presented by: Michael Kubocz

Resistance spot welding (RSW) is a welding method to join metal parts in contact by heating them with a high current for a short duration (seconds or less), which is typically accompanied by intense and pulsating magnetic fields (MF) generated around the equipment. Operators of RSW devices are inevitably exposed to these MF in which the legally permissible health protection limits (see European Directive 2013/35/EU) are often exceeded. This work presents the first results of an ongoing project to develop a non-commercial web-based tool to assess occupational exposure to MF in the vicinity of RSW devices.

S05-4 [10:30]
STUDENT PAPER

Electrical conductivity of the human leg in the frequency range from 5 kHz to 1 MHz

Otto Kangasmaa[1] & Ilkka Laakso[1, 2]

[1]*Department of Electrical Engineering and Automation, Aalto University, Espoo, Finland*

[2]*Aalto Neuroimaging, Aalto University, Espoo, Finland*

Keywords: Dosimetry (measurements), ELF/LF, Work in Progress

Presented by: Otto Kangasmaa

Little data exists on the conductivity values of human tissues in vivo. The purpose of this work is to estimate the conductivity values in the intact human body at frequencies from 5 kHz to 1 MHz. The electrical impedance of ten subjects' legs was measured in the longitudinal and transverse directions with different electrode configurations. T1-and T2-weighted MR-images were obtained after the impedance measurements to create anatomically realistic models of the subjects' legs. Finally, the MRI-based models and measured impedance data from each test subject were used to determine the tissue conductivity by solving an inverse problem. New data on human tissue conductivity will be useful for dosimetry modelling

Halatte, France, 60550

[2]*PERITOX UMR I-01, UPJV - Université Picardie Jules Verne, AMIENS, France, 80000*

Keywords: In vivo, RF/Microwaves, Completed (unpublished)

Presented by: Rene De Seze

After a repeated exposure to low power radiofrequency electromagnetic fields (RF), mice and rats showed thermoregulatory changes mimicking reactions to cold. Body temperature patterns in mice, measured by telemetry transmitters, changed synchronously with the RF exposure periods after 3 days. The shown episodes of quick temperature increase lead us to consider brown adipose tissue as an effector, but inguinal white adipose tissue was also analyzed for comparison. Strikingly, like responses to cold stimuli, both exposed rats and mice showed changes in the morphology of white and brown adipocytes. Exposure also led to a larger plasma concentration of non-esterified fatty acids (NEFA), a marker of lipolysis in non-shivering thermogenesis.

S06-4 [10:30]

Low-level radiofrequency exposure to 900 MHz induces vasoconstriction in rats

Amandine Pelletier[1], Thi-Cuc Mai[1, 2], Anne Braun[1, 2], Véronique Bach[1] & Rene De Seze[1, 2]

[1]*Peritox Laboratory, UMR-I 01 INERIS, Picardie Jules Verne University, AMIENS, France, 80025*

[2]*Experimental Toxicology Unit , National Institute of Industrial Environment and Risks (INERIS), VERNEUIL-EN-HALATTE, France, 60670*

Keywords: In vivo, RF/Microwaves, Completed (unpublished)

Presented by: Amandine Pelletier

Recent studies have revealed that rodents' physiological responses to low intensity radiofrequency electromagnetic fields (RF) were similar to thermoregulatory responses to cold conditions. We investigated the effects of 900 MHz RF at a low level (0.35 $W.kg^{-1}$) on tail skin temperature (T_{tail}) in rats at ambient temperature (Ta) between 24 and 34°C. We showed that rats exposed to RF had lower T_{tail} than control rats at Ta between 27 and 31 °C. This difference in T_{tail} was suppressed after the injection of a vasodilator, confirming the vasoconstriction in exposed rats.

studies.

Moreover, like a response to cold stimuli, RF exposure led to a higher plasma concentration of factors involved in response to cold: noradrenaline and fatty acids.

S05-5 [10:45]

Estimation of exposure levels from crowdsourcing-based smartphone measurements

Sascha Schiessl[1], Thomas Kopacz[1], Anna-Malin Schiffarth[1] & Dirk Heberling[1, 2]

[1]*Institute of High Frequency Technology, RWTH Aachen University, Aachen, Germany*

[2]*Fraunhofer Institute for High Frequency Physics and Radar Techniques, Wachtberg, Germany*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress

Presented by: Sascha Schiessl

A crowdsourcing-based approach relying on signal strength measurements from common smartphones could potentially be used to monitor EMF exposure in the downlink of mobile radio. In this paper, for the first time, field strength values are derived from the signal strength measurements of smartphones. All the radio cells in the LTE network of a German network operator that can be detected in the area under investigation are considered. At 106 measurement points, the maximum total exposure from the LTE network is determined from smartphone measurements and compared with results of a field strength meter. In addition, signal strength measurements of neighboring cells are included to improve the coverage of all radio cells and frequency bands.

S06-5 [10:45]

Superficial damage to skin from 8.2 and 95 GHz microwave exposures in swine

William Voorhees[1], James E Parker[3], Christine Kowalczewski[2], Gordon Kennedy[4], Jason Payne[1], Andrew Kowalczewski[2], Anthony Durkin[4], Robert Christy[2] & Jeffrey Whitmore[1]

[1]*Radio Frequency Bioeffects Branch, Air Force Research Laboratory, JBSA Fort Sam Houston, San Antonio, Texas, USA, 78234*

[2]*US Army Institute of Surgical Research, JBSA Fort Sam Houston, San Antonio, Texas, USA, 78234*

[3]*General Dynamics Information Technology, JBSA Fort Sam Houston, San Antonio, Texas, USA, 78234*

[4]*Beckman Laser Institute & Medical Clinic, University of Irvine, CA, USA, 92612*

Keywords: In vivo, RF/Microwaves, Completed (unpublished)

Presented by: William Voorhees

The 711th Human Performance Wing, Radio Frequency Bioeffects Branch (711 HPW/RHDR) is undertaking a multi-disciplinary research effort to improve estimates of damage thresholds across the Radio Frequency (RF) spectrum. We have chosen to start with the region of the RF spectrum simplest to assess for damage, the upper microwave band (greater than 5 GHz), because energy is absorbed superficially; and thus, typically damage would be limited to the skin (Ziskin et al., 2018). This presentation details experiments that investigate skin burn thresholds for 8.2 GHz and 95 GHz exposures in the Yorkshire pig.

Coffee Break
Tuesday September 28, 2021 • 11:00 - 11:30

Session: P2
Plenary 2 - Exploring the potentials of EM waves from body-scale to nano-communications for healthcare applications
Tuesday September 28, 2021 • 11:30 - 12:30
Einstein
Chairs: Maxim Zhadobov & Denys Nikolayev

P2-1 [11:30]

Exploring the potentials of EM waves from body-scale to nano-communications for healthcare applications

Akram Alomainy[1]

[1]*Department of EECS, Queen Mary University of London, London, UK, E1 4NS*

Biographical sketch

Akram Alomainy received the M.Eng. degree in communication engineering and the Ph.D. degree in electrical and electronic engineering (specialized in antennas and radio propagation) from Queen Mary University of London (QMUL), U.K., in July 2003 and July 2007, respectively. He joined the School of Electronic Engineering and Computer Science, QMUL, in 2007, where he is a Reader in Antennas & Applied EM. His current research interests include small and compact antennas for wireless body area networks, radio propagation characterisation and modelling, antenna interactions with human body, computational electromagnetic, advanced antenna enhancement techniques for mobile and personal wireless communications, nano-scale networks and communications, THz material characterisation and communication links and advanced algorithm for smart and intelligent antenna and cognitive radio system. He has authored and co-authored four books, 6 book chapters and more than 350 technical papers (8200+ citations and H-index 41) in leading journals and peer-reviewed conferences. Dr Alomainy won the Isambard Brunel Kingdom Award, in 2011, for being an outstanding young science and engineering communicator. He was selected to deliver a TEDx talk about the science of electromagnetic and also participated in many public engagement initiatives and festivals. He is an elected member of UK URSI (International Union of Radio Science) panel to represent the UK interests of URSI Commission B (1 Sept 2014 until 31 Aug 2021).

Abstract

With the advent of commercial products, such as Apple iWatch and Samsung Galaxy Gear, body-centric communication has increasingly garnered the public attention and smoothly translated state-of-the-art research work into reality. However, challenges still remains and these are often fundamental physical hurdles that need to be further explored and investigated to come up with efficient and scalable solutions applicable to many fields and areas. This becomes an important research area when you look at the scale or rather the multiple scales it needs to work at from body-size or larger networks to the nano-scale where there have been lots of interest recently on how to get nano-devices inside tissues and even inside intelligent materials around us. The lecture will present recent development in the area of antennas, RF devices and electromagnetic solutions for applications such as health care and biomedical engineering. It will look at the challenges from theoretical, numerical and experimental prospective to ensure that proposed concepts and outcomes are of benefit not only to those domains but other beyond such as agricultural technology and smart home and cities.

Session: CA
Chiabrera Award
Tuesday September 28, 2021 • 12:30 - 13:30
Einstein
Chair: Niels Kuster

CA-1 [12:30]

Understanding electroporation using model systems

Lea Rems[1]

[1]*University of Ljubljana, Ljubljana, Slovenia*

Biographical sketch

Lea Rems is an assistant professor at the University of Ljubljana in Slovenia. Her research is focused on understanding basic biophysical mechanisms of electroporation with the aim of creating theoretical models that will help design new and better electroporation-based technologies and treatments. As an essential prerequisite for this aim she recognized the bridging between electroporation models on different scales, including molecular dynamics simulations of cell membrane components, models representing entire cells, and tissue models. She finished her PhD in 2016 at the University of Ljubljana, Faculty of Electrical Engineering, supervised by Damijan Miklavčič and Mounir Tarek. Afterwards, she became a postdoc in the group of Pouyan Boukany at the Delft University of Technology in the Netherlands. In 2018 she continued her postdoctoral training in the groups of Lucie Delemotte and Ilaria Testa at KTH Royal Institute of Technology in Sweden. In 2021 she returned to the University of Ljubljana as a Marie Skłodowska-Curie Fellow.

List of selected publications:

1. Rems L, Kasimova MA, Testa I, Delemotte L: Pulsed Electric Fields Can Create Pores in the Voltage Sensors of Voltage-Gated Ion Channels. Biophys. J. 2020, 119: 90-205. doi: 10.1016/j.bpj.2020.05.030
2. Kotnik T, Rems L, Tarek M, Miklavčič D: Membrane electroporation and electropermeabilization: Mechanisms and models. Annu Rev Biophys 2019, 48: 63-91. doi: 10.1146/annurev-biophys-052118-115451
3. Perrier DL, Rems L, Boukany PE: Lipid vesicles in pulsed electric fields: Fundamental principles of the membrane response and its biomedical applications. Adv Colloid Interface Sci. 2017, 249:248-271. doi: 10.1016/j.cis.2017.04.016.
4. Rems L, Viano M, Kasimova MA, Miklavčič D, Tarek M: The contribution of lipid peroxidation to membrane permeability in electropermeabilization: A molecular dynamics study. Bioelectrochemistry 2019, 125:46-57. doi: 10.1016/j.bioelechem.2018.07.018
5. Rems L, Tarek M, Casciola M, Miklavčič D: Properties of lipid electropores II: Comparison of continuum-level modeling of pore conductance to molecular dynamics simulations. Bioelectrochemistry 2016, 112:112–124. doi: 10.1016/j.bioelechem.2016.03.005

Abstract

Exposure of cells to intense electric pulses can trasiently disrupt the integrity of the plasma membrane via the phenomenon of electroporation. Despite being used in many applications in medicine and biotechnology, the molecular mechanisms underlying electroporation continue to be an exciting research puzzle, largely owing to the complexity of the molecular organization of the cell membrane. This lecture will summarize our understanding of electroporation that has been built based on bottom-up approaches using experimental and computational model systems.

Lunch
Tuesday September 28, 2021 • 13:30 - 15:00

Session: M2
BEMS ABM
Tuesday September 28, 2021 • 13:30 - 15:00
Einstein

Session: W2
Workshop 2 - Effects of low-intensity RF on thermal regulation
Tuesday September 28, 2021 • 15:00 - 16:30
Einstein
Chairs: Rene De Seze & György Thuroczy

W2-1 [15:00]

Workshop Introduction

Rene De Seze[1]

[1]*TEAM/PERITOX UMR I-01, INERIS, Verneuil en halatte, France, 60550*

Presently, the dominant paradigm is that radiofrequency waves with energy levels far under the thermal noise cannot produce biological or physiological effects. Although it is known that the signal/noise ratio can be used to detect repeated signals that would else not be perceived, like for example in magnetic resonance imaging, the same can happen for an efficient action of a signal on biological systems, provided there is a receptor mechanism that can be stimulated at such low levels. There is from the literature more and more evidence of such effects at low RF intensity on the thermal system, that all converge to show “responses to cold”. Sharing those studies with other researchers and confronting mechanisms with eminent biophysicists could help further progress in their understanding and in future experiments. At this stage, humility has to predominate, and confrontation of experimental results with different researchers will help check their level of proof, comfort or decrease the confidence level, or help design more probing studies, and elaborate tracks for understanding of involved mechanisms.

W2-2 [15:05]

Rats exposed to chronic low-level 900 MHz radiofrequency feel cold

Amandine Pelletier[1]

[1]*Peritox Laboratory, UMR-I 01 INERIS, Picardie Jules Verne University, AMIENS, France, 80025*

In our studies, we showed that rats exposed to radiofrequency at a low level (5 weeks long, 900 MHz, 1 V/m, 10 mW/kg) are cold: they maintained vasoconstriction, they ate more compare to controls and they chose higher ambient temperatures compare to control animals. Sleep was modified when the animals could not move to find a more favourable environment for RF exposure or ambient temperature. All these studies showed that thermoregulation was modified with a possible origin of thermal peripheral sensitivity.

W2-3 [15:20]

Effects of low-level RF exposures on the thermoregulatory system

Rene De Seze[1]

[1]*TEAM/PERITOX UMR I-01, INERIS, Verneuil en halatte, France, 60550*

Only acute effects of RF fields have been confirmed to represent a health hazard and they are attributed to non-specific heating. The dominant paradigm is then that radiofrequency waves with energy levels under

thermal noise cannot produce biological or physiological effects.Although the mechanism has not been discovered, some studies show a paradoxical reaction to repeated RF exposures at low intensity, such as peripheral temperature decrease, or internal temperature increase which cannot be produced by the low field level. These effects represent reactions to cold, and first insights in their molecular targets can be addressed through exploration of thermal receptors. These effects and their possible mechanisms will be discussed.

W2-4 [15:40]

Which effects of low-level RF exposures on the thermoregulatory system?

Kenneth Foster[1]

[1]*Department of Bioengineering, University of Pennsylvania, Philadelphia, PA, USA, 19104*

This Workshop considers effects of low-level RF exposures on the thermoregulatory system. In principle, given the high temperature sensitivity of biological systems including thermal receptors in the human body, modest heating of tissue from an external source can elicit a range of subtle physiological effects in the body. Determining thresholds for such effects raises the usual “signal to noise” problems in measuring small effects. The physiological significance of such effects may be difficult to establish in the face of normal variability in body temperature. The Workshop will discuss “paradoxical reactions to repeated RF exposures at low intensity”. The present speaker will take the role of an ”opposing expert” that is traditionally used in thesis defenses by some Scandinavian universities, whose job is to challenge, in a friendly and constructive manner, the thesis being defended while encouraging further work on an important topic.

W2-5 [16:00]

Thermal biological effects in humans by low-level RF exposures?

Gunnhild Oftedal[1]

[1]*Department of Electronic Systems, Norwegian University of Science and Technology , Trondheim, Norway*

Introduction

While interaction mechanisms at low-level radio frequency (RF) electromagnetic fields (EMF) remain to be understood, some biological effects have been observed in human experimental studies. Changes in the EEG has been observed in a number of studies, for example with increased EEG power in the spindle frequency range after mobile phone handset related exposures (Huber et al., 2002; Loughran et al., 2005; Schmid et al., 2012). Authors of EEG studies perform under sleep with focus on sleep stages (Danker-Hophe et al., 2016) or under awake conditions (Marino et al., 2017; Loughran et al., 2019), have suggested that thermal mechanisms may be involved despite of the low exposure levels, e.g. by trigging neurones located close to the surface (Marino et al., 2017). While such findings are not sufficient to confirm mechanisms behind observed biological changes, they motivate exploring temperature changes in published human experimental studies with RF EMF exposure to low levels, to see whether the results are consistent with the suggested mechanisms. Despite of somewhat different thermal regulation in humans and animals, also of interest are results from animal studies that will presented at this workshop (Pelletier et al., 2013, 2014), which may indicate that the thermal sensitivity of the skin surface are of importance even at low exposure levels.

Coffee Break
Tuesday September 28, 2021 • 16:30 - 17:00

Session: S07
Mechanistic / Theoretical
Tuesday September 28, 2021 • 17:00 - 17:45
Einstein
Chairs: Micaela Liberti & Florence Poulletier De Gannes

S07-1 [17:00]
STUDENT PAPER

Monocytic THP1 cells and PBMC show field strength dependent anti-oxidative responses to pulsed EMF

Silvia Groiss[1], Roland Lammegger[2] & Dagmar Brislinger[1]

[1]*Gottfried Schatz Research Center, Medical University of Graz, Graz, Austria, 8010*

[2]*Institute of Experimental Physics, Graz University of Technology, Graz, Austria, 8010*

Keywords: Mechanistic/Theoretical, ELF/LF, Work in Progress
Presented by: Silvia Groiss

Increasing exposure to electromagnetic fields (EMF) fosters health concerns primarily for medically ill patients. We investigated a potential susceptibility of the human monocytic cell line THP-1 derived from a leukemia patient and freshly isolated PBMC to EMF based on the exposure level. Stimulated THP1 cells showed an increased generation of ROS levels after 1h of EMF exposure, while levels in PBMC seemed unaffected. NAD(P)H levels declined slower after exposure to weak EMF in THP1 but not PBMC. We found several antioxidant enzymes to be upregulated after EMF exposure in both THP1 and PBMC including some involved in lipid metabolism. Together, these results suggest a diverging effect of EMF on monocytic cells dependent on field strength.

S07-2 [17:15]

Investigational current source and personalized *In-Silico* modelling for temporal interference brain stimulation research

Antonino Mario Cassara[1], Esra Neufeld[1], Myles Capstick[1], Nir Grossman[2], Sabine Regel[3] & Niels Kuster[1, 4]

[1]*Foundation for Research on Information*

Session: S08
Human Studies
Tuesday September 28, 2021 • 17:00 - 17:45
Maxwell
Chairs: Gunnhild Oftedal & Maryse Ledent

S08-1 [17:00]

CohoRte: post-professional follow-up of employees exposed to the 50 Hz magnetic field. Protocol and results for year 0

Martine Souques[1], Anne Duburcq[2], Isabelle Bureau[2], Laurène Courouve[2], Carole Babin[3], Isabelle Magne[1] & Pierre-André Cabanes[1]

[1]*Service des Etudes Médicales, EDF, Paris, France, 75017*

[2]*Epidemiology, Cemka-Eval, Bourg La Reine, France, 92340*

[3]*Service de médecine et santé au travail, RTE, Lyon, France, 69003*

Keywords: Occupational, ELF/LF, Work in Progress
Presented by: Martine Souques

The objective of this study is to follow up the health status of workers retired from RTE who were occupationally exposed to 50-Hz magnetic fields by tracking mortality and morbidity through the French National Health Insurance Data. The cohort is made up of all workers whose retirement date is between January 1, 1995 and December 31, 2020s: a first subjects retired between 1995 and 2015, a second stage, with those who left between 2016 and 2020, will be included in 2021. 1848 subjects was selected in the first stage, of whom 1782 men were potentially eligible but only those with a complete career history were included in the study: 1479 subjects. The 2016 mortality and morbidity results are presented for the first part of the cohort.

S08-2 [17:15]

Do methodological limitations explain findings of experimental studies on symptoms in individuals with idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF)? – A systematic review

Kristina Schmiedchen[1], Sarah Driessen[1] & Gunnhild Oftedal[2]

Technologies in Society (IT'IS), Zurich, Switzerland, 8003

[2]*Department of Brain Sciences, Imperial College London, London, UK*

[3]*TI Solutions AG, Zurich, Switzerland*

[4]*Department of Information Technology and Electrical Engineering, Swiss Federal Institute of Technology (ETHZ), Zurich, Switzerland*

Keywords: Human, ELF/LF, Work in Progress

Presented by: Antonino Mario Cassara

Here, we report the development of a novel investigational device for temporal interference stimulation (TIS) with four (8) fully differential current sources that enable flexible delivery of customizable current waveforms. We also report on the development of a computational framework that enables personalized modeling of TIS to facilitate and guide experiments both in humans and animals, while outlining the challenges for realistic modelling of TIS, identifying the TI dose, and estimating the associated uncertainty. Finally, we propose modeling requirements identified in the context of ongoing TIS-fMRI studies in human volunteers.

S07-3 [17:30]

Modeling dielectric response of biological structures at cellular level

Annalisa De Angelis[1], Laura Caramazza[1, 2], Franck Andre[3], Lluis M. Mir[3], Francesca Apollonio[1, 2] & Micaela Liberti[1, 2]

[1]*Center for Life Nano- & Neuro-Science, Fondazione Istituto Italiano di Tecnologia (IIT), Rome, Italy, 00161*

[2]*DIET@Sapienza University of Rome, Sapienza University of Rome, Rome, Italy, 00184*

[3]*CNRS, Univ. Paris-Sud, Université Paris-Saclay, Gustave Roussy, Villejuif, Paris, France*

Keywords: Mechanistic/Theoretical, RF/Microwaves, Work in Progress

Presented by: Micaela Liberti

In this work preliminary results of the numerical study performed on dielectric response of biological structures at cellular level are provided. The aim is to demonstrate the ability of these microdosimetric models to show a spectrum of capacitive and conductive contrast in frequency domain quantitatively in line with published experimental

[1]*Research Center for Bioelectromagnetic Interaction, RWTH Aachen University, Aachen, Germany*

[2]*Department of Electronic Systems, Norwegian University of Science and Technology , Trondheim, Norway*

Keywords: Human, RF/Microwaves, Completed (published)

Presented by: Gunnhild Oftedal

In a systematic review we assessed whether methodological limitations explain why experimental studies have not supported claims that symptoms experienced among individuals with IEI-EMF are caused by exposure to EMF. We rated methodological limitations in 28 studies by using a customized tool. Our analyses did not explain why some studies reported an effect of exposure, while others did not. However, the overall evidence points towards no relation between the exposures and the symptoms. Therefore, further research should also explore alternative explanations of the symptoms. If additional provocation studies are conducted, these should be high-quality studies using novel approaches and preferably analyses at individual level.

S08-3 [17:30]

Impact of extremely low frequency magnetic fields on the human vestibulo-ocular reflex: a pilot study

Nicolas Bouisset[1, 2], Jessica Peng[3], Andres Carvallo Pecci[4], François Deschamps[5], Martine Souques[6], Isabelle Magne[6], Pierre-André Cabanes[6], Michel Plante[7], Genevieve Ostiguy[7] & Alexandre Legros[1, 2, 3, 4, 8]

[1]*Human Threshold Research Group, Lawson Health Research Institute, London, On, Canada*

[2]*Department of Kinesiology, Western University, London, On, Canada*

[3]*Department of Medical Biophysics, Western University, London, On, Canada*

[4]*EuroMov Digital Health in Motion, Univ Montpellier, IMT Mines, Montpellier, France*

[5]*RTE, Cœur Défense, Département Concertation et Environnement, Paris-La Défense, France*

[6]*Service des Études médicales, EDF, Levallois-Perret Cedex, France*

[7]*Hydro-Québec , Montréal, Québec, Canada*

results as in Tamra et al. 2017.

[8]*Department of Medical Imaging , Western University, London, On, Canada*
Keywords: Human, ELF/LF, Work in Progress
Presented by: Nicolas Bouisset

Extremely low-frequency magnetic fields (ELF-MF) induce electric fields (E-Fields) and currents within the human body. These E-Fields can modulate neurophysiology. The vestibular system is sensitive to small E-Fields and could be impacted by ELF-MF. However, although there is evidence showing that direct and alternating E-Fields modulate the vestibular system, it is still unclear if and how it is equally impacted by ELF-MF. Since the vestibular system is linked to gaze stabilization, we chose to investigate the impact of vestibular specific ELF-MF stimulations at powerline frequencies and below on eye movements. ELF-MF results were compared with those obtained with electrical currents at the same frequencies.

Session: T1
Tutorial 1 - Endogenous bioelectric networks underlie embryogenesis, regeneration and cancer: from basic mechanisms to electroceuticals
Tuesday September 28, 2021 • 17:45 - 18:45
Einstein
Chairs: Richard Nuccitelli & Micaela Liberti

T1-1 [17:45]

Endogenous bioelectric networks underlie embryogenesis, regeneration and cancer: from basic mechanisms to electroceuticals

Michael Levin[1]

[1]*Allen Discovery Center, Tufts University, Medford, MA, USA, 02155*

Biographical sketch

Michael Levin's original training was in computer science. He then received a PhD in Genetics from Harvard Medical School and started his independent lab in 2000 at the Forsyth Institute in Boston. In 2009 he moved his group to Tufts University, where he is currently Distinguished Professor and Vannevar Bush chair. He directs the Allen Discovery Center (allencenter.tufts.edu), where his group works at the intersection of developmental biology, computer science, and biophysics. The Levin lab works to understand how cellular collectives use endogenous bioelectric signals to form computational networks that control growth and form. Developing molecular tools for reading and writing the endogenous bioelectric pattern memories in living tissue, they develop applications in the repair of birth defects, induction of organ regeneration, and tumor normalization, as well as bioengineer synthetic living organisms to understand the morphogenetic code. All of his work can be found at http://www.drmichaellevin.org and on Twitter at @drmichaellevin.

Abstract

I will give a presentation on the targeting of endogenous bioelectric networks for the control of growth and form during embryogenesis, regeneration, and cancer. I will talk about new tools and computational modeling platforms for the targeting of bioelectrically-mediated morphogenetic controls for the purpose of regenerative medicine.

Cells must communicate in order to form complex structures during embryogenesis, repair them during adult regeneration, and resit cancer throughout the lifespan. As in the brain, the scaling of individual cell behaviors into organ-level anatomical decisions occur via computation in bioelectrical networks. Ion channels enable cells to drive specific resting potentials, which can be communicated to other cells via versatile electrical synapses known as gap junctions. We developed molecular-resolution tools to read and write the bioelectric information in somatic cellular networks by targeting these ion channels and gap junctions in vivo. In this talk, I will introduce the experimental and computational modeling tools now available for developmental bioelectricity and show applications in the control of complex organ growth, induction of limb regeneration, repair of birth defects of the brain, and cancer detection and normalization. Together with new information on the bioelectric code, simulation platforms are enabling the repurposing of known channel drugs as electroceuticals for many applications in regenerative medicine.

Session: S09
Dosimetry 4 (Computational)
Wednesday September 29, 2021 • 08:00 - 10:00
Einstein
Chairs: Myles Capstick & Sam Aerts

S09-1 [08:00]
STUDENT PAPER

Computational absorption and reflection studies of human cornea exposed to Millimetre Wave radiation

Negin Foroughimehr[1, 2], Zoltan Vilagosh[1, 2], Alireza Lajevardipour[1, 2] & Andrew Wood[1, 2]

[1]*Department of Health Sciences, Swinburne University of Technology, Melbourne, Australia, 3122*

[2]*Australian Centre for Electromagnetic Bioeffects Research, Melbourne, Australia, 3122*

Keywords: Dosimetry (computational), THz, Work in Progress
Presented by: Negin Foroughimehr

The Millimetre Wave (MMW) region of Electromagnetic (EM) radiation is defined as radiation in the 30-300 GHz range. Given the increasing use of the MMW band in emerging telecommunication systems, it is crucial to determine the likelihood of adverse impacts on the human cornea. In this study, the propagation and interaction of MMWs with the cornea are simulated using a three-dimensional numerical software based on the Finite Difference Time Domain (FDTD) method. The temperature distribution in the cornea is measured and the results are compared with exposure limits set by international guidelines. This research develops a better understanding of the distribution of thermal changes, which could result in a refinement of MMW damage thresholds.

S09-2 [08:15]
STUDENT PAPER

Radio-Frequency Absorption of a Western Honey Bee in the Near Field of an Antenna

David Toribio[1], Wout Joseph[1] & Arno Thielens[1]

[1]*Information Technology, Ghent University, Ghent, Belgium, 3018*

Session: S10
Clinical / Diagnosis / Therapy
Wednesday September 29, 2021 • 08:00 - 10:00
Maxwell
Chairs: Alexandre Legros & Maxim Zhadobov

S10-1 [08:00]
STUDENT PAPER

A stream function-based coil design method capable of creating a contiguous coil for transcranial magnetic stimulation

Hikaru Yoshioka[1], Liu Shuang[1], Motofumi Fushimi[3], Akihiro Kuwahata[2] & Masaki Sekino[3]

[1]*Department of Electrical Engineering and Information Systems, The University of Tokyo, Bunkyo,Tokyo, Japan, 113-8656*

[2]*Department of electrical engineering, Tohoku University, Sendai,Miyagi, Japan, 980-8579*

[3]*Department of Bioengineering, The University of Tokyo, Bunkyo,Tokyo, Japan, 113-8656*

Keywords: Clinical (therapy), Pulsed, Completed (unpublished)
Presented by: Hikaru Yoshioka

An inverse problem-based approach is attracting attention as a new method of designing local stimulation coils for transcranial magnetic stimulation. However, the coil designed by this method is not realized as a single contiguous path, and it needs to be reconfigured during the actual manufacturing process, which complicates the process and could alter the coil's performance. In this paper, a new path-generation scheme was incorporated into this method to realize the design of practically manufacturable coils. In the result, it was found that the contiguous coil that has focality close to that of coils created by conventional method can be designed by the proposed scheme.

S10-2 [08:15]
STUDENT PAPER

Can electrical impedance tomography be used for monitoring temperature and perfusion during hyperthermia treatment?

Redi Poni[1, 2], Esra Neufeld[1, 2], Myles Capstick[2], Stephan Bodis[3], Theodoros Samaras[4] & Niels

Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: David Toribio

It has been shown that the wireless network evolution to smaller carrier wavelengths (from 2G to 5G) will increase radio-frequency electromagnetic field (RF-EMF) absorption in Western Honey Bees (Apis mellifera). It is unknown whether the radiation performance of antennas is stable when an insect appears in their vicinity. The numerical simulations in this research showed that in the near field, the bee's absorbed power can increase by a factor of 53, in the range of 6-240 GHz. Furthermore, it was found that the antennas' gain pattern depends on the separation distance between the bee and the antenna, with a stronger dependency for higher frequencies.

S09-3 [08:30]
STUDENT PAPER

Radio-frequency exposure of adult yellow fever mosquito

Eline De Borre[1], Wout Joseph[1], Reza Aminzadeh[1], Pie Müller[2, 3], Matthieu Boone[4], Iván Josipovic[4], Sina Hashemizadeh[5], Niels Kuster[5], Sven Kuehn[5] & Arno Thielens[1]

[1]*Department of Information Technology, Ghent University, Ghent, Belgium, 9000*

[2]*Swiss Tropical and Public Health Institute, Basel, Switzerland, 4002*

[3]*University of Basel, Basel, Switzerland, 4001*

[4]*Department of Physics and Astronomy, Ghent University, Ghent, Belgium, 9000*

[5]*Foundation for Research on Information Technologies in Society (IT'IS), Zurich, Switzerland, 8004*

Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Eline De Borre

Kuster[1, 2]

[1]*Department of Information Technology and Electrical Engineering, Zurich, Switzerland*

[2]*Foundation for Research on Information Technologies in Society (IT'IS), Zurich, Switzerland*

[3]*Center of Radiation Oncology KSA-KSB, Kantonsspital Aarau, Aarau, Switzerland*

[4]*Department of Physics, Thessaloniki, Greece*

Keywords: Clinical (therapy), ELF/LF, Completed (unpublished)
Presented by: Redi Poni

In this study we investigated the feasibility of electrical impedance tomography (EIT) as a non-invasive, low-cost, temperature- and perfusion-monitoring tool during loco-regional hyperthermia (HT) treatment. We propose a reconstruction method that exploits prior information from HT treatment planning and improves reconstruction across highly heterogeneous tissue environments. The method was tested on two HT treatment scenarios and high-resolution anatomical models with realistic heating pattern. The results show that EIT can be a promising tool for non-invasive 4D perfusion and temperature monitoring during HT treatment application.

S10-3 [08:30]

Localization of cardiac source based on lead field matrix and filtering

Yuki Nakano[1], Essam Rashed[1], Ilkka Laakso[2] & Akimasa Hirata[1]

[1]*Electrical and Mechanical Engineering, Nagoya, Japan, 466-8555*

[2]*Electrical Engineering and Automation, Espoo, Finland, 02150*

Keywords: Clinical (diagnostics), ELF/LF, Work in Progress
Presented by: Yuki Nakano

This study proposes a localization method for cardiac sources by combining an electrical analysis with a volume conductor model of the human body as a forward problem, and a sparse reconstruction method to solve inverse problem. Our formulation estimates not only the current source location but also the current direction. A time-series source localization with Kalman filtering indicated that source mislocalization could be compensated, suggesting the effectiveness of the source estimation using the current direction and location

Power absorption of far field radio frequency (RF) electromagnetic fields (EMF) of the yellow fever mosquito (Aedes aegypti) was examined between 2 and 240 GHz using Finite Difference Time Domain (FDTD) simulations for six different adult mosquito models. The 3D models were created from micro-CT scans of real mosquitoes. The dielectric properties used in the simulation were measured from a mixture of homogenized A. aegypti. The absorption increases with increasing frequency between 2 and 90 GHz with a maximum between 90 and 240 GHz. For the same incident field strength, the power absorption by the mosquito is 16 times higher at 60 GHz than at 6 GHz.

S09-4 [08:45]

Continuous subthreshold IF exposure increases neural excitability

Antonio Sarolic[1, 2], Marin Peric[1] & Damir Sapunar[2]

[1]*Chair of Applied Electromagnetics, University of Split, FESB, Split, Croatia, HR-21000*

[2]*University of Split, School of Medicine, Split, Croatia, HR-21000*

Keywords: Dosimetry (computational), IF, Work in Progress

Presented by: Antonio Sarolic

Human exposure guidelines in the low frequency range are based on the ability of internally induced electric fields to excite a silent nerve. We are now broadening the scope from analyzing just the silent resting state of the neuron, towards analyzing also the modulation of the ongoing innate neural activity by the external electric or magnetic field exposure. Our model shows that the subthreshold continuous IF exposure could modulate the innate neurological activity by facilitation, leading to the increase in neural excitability.

S09-5 [09:00]

Computational analysis of TMS coil orientation targeting lower limb

Kazuya Hayashi[1], Jose Gomez-Tames[1, 2], Toshiaki Wasaka[1] & Akimasa Hirata[1, 2]

simultaneously.

S10-4 [08:45]

Evaluating the complex dielectric parameters of water and gel using reflectance and transmission at 1.0 THz and 2.0 THz

Zoltan Vilagosh[1], Alireza Lajevardipour[1] & Andrew Wood[1]

[1]*Department of Health Sciences and Biostatistics , Swinburne University of Technology , Hawthorn , Australia, 3122*

Keywords: Mechanistic/Theoretical, THz, Work in Progress

Presented by: Zoltan Vilagosh

A new method is presented which extends the capabilities of attenuated total reflection (ATR) apparatus to a partial reflection/partial transmission mode, which also delivers the complex dielectric values of samples. The method is well suited to biological samples in the terahertz radiation frequency band range around 2.0 THz, with a diamond crystal ATR. The 2.0 THz range data is poorly represented in literature, since most THz data on biological tissues has 1.2 to 1.5 THz as the upper limit. A demonstration of the technique was performed using water and water based gel. Since many cancers have higher water content than normal tissue, this method promises to establish a new diagnostic modality.

S10-5 [09:00]

Multi-goal and time-multiplexed steering optimization for hyperthermia treatment

Redi Poni[1, 2], Esra Neufeld[1, 2], Myles Capstick[2], Stephan Bodis[3] & Niels Kuster[1, 2]

[1]*Electrical and Mechanical Engineering, Nagoya Institute of Technology, Nagoya, Japan, 466-8555*

[2]*Center of Biomedical Physics and Information Technology, Nagoya Institute of Technology, Nagoya, Japan, 466-8555*

Keywords: Dosimetry (computational), Pulsed, Work in Progress

Presented by: Kazuya Hayashi

Transcranial Magnetic Stimulation (TMS) is a non-invasive neuromodulation scheme that induces an electric current in the brain below the stimulating coil. Computational methods have been adopted for estimating the stimulation intensity level and location in particular for the hand motor area of the brain. However, no previous studies have investigated the TMS-induced electric field characteristics in the primary motor area of the lower limb. In this study, electromagnetic dosimetry based on experimental measurements of TMS was used to calculate the induced electric field. The experimental and computational results show the most effective TMS coil orientation for lower limb stimulation.

S09-6 [09:15]

Computed WEASAR and absorbed power density in the human eye in response to a smart contact lens

Afzaal Ahmad[1], Gunter Vermeeren[1], Luc Martens[1] & Wout Joseph[1]

[1]*Department of information technology, Ghent University/imec, Ghent, Belgium, 9000*

Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)

Presented by: Afzaal Ahmad

This paper presents a numerical study of radio-frequency (RF) electromagnetic exposure of the eye tissue with and without a smart contact lens when exposed to a dipole at 2.4 GHz and 60 GHz. At 2.4 GHz, with an input power of 1W, whole-eye averaged specific absorption rate (WEASAR) increases from 18 W/kg to 43 W/kg when the distance between the eye tissue and dipole is varied from 5mm to 1mm respectively. For the 60 GHz model, peak spatial average absorbed power density is calculated for an input power of 10 dBm with peak value of 75 W/m^{2}at d/λ=0.1. The International Commission on Non-Ionizing Radiation

[1]*Department of Information Technology and Electrical Engineering, Zurich, Switzerland*

[2]*Foundation for Research on Information Technologies in Society (IT'IS), Zurich, Switzerland*

[3]*Center of Radiation Oncology KSA-KSB, Kantonsspital Aarau, Aarau, Switzerland*

Keywords: Clinical (therapy), RF/Microwaves, Completed (unpublished)

Presented by: Redi Poni

Hotspots in healthy tissue are one of the main limiting factors in the application of therapeutic temperatures in deep hyperthermia (HT) cancer therapy. In this paper, we propose a rapid multi-goal time-multiplexed steering (TMPS) specific absorption rate (SAR) optimization to minimize hotspots and while improving thermal dose homogeneity at the tumor. The method was compared to a multi-goal genetic algorithm (GA) SAR optimization in simulated treatments of bladder tumors and showed a reduction of peak temperatures in healthy tissue. The results suggest that this method can improve delivered thermal dose and, thanks to its speed, is suitable for online treatment adaptation.

S10-6 [09:15]

Comparison of induced fields in deep brain tissues by H-coil and its two separate coil sets

Mai Lu[1] & Shoogo Ueno[2]

[1]*Key Lab. of Opt-Electronic Technology and Intelligent Control of Ministry of Education, Lanzhou Jiaotong University, Lanzhou, China, 730070*

[2]*Department of Applied Quantum Physics, Graduate School of Engineering, Kyushu University, Fukuoka, Japan, 812-8581*

Keywords: Clinical (therapy), Pulsed, Work in Progress

Presented by: Mai Lu

The H-coil was considered high efficient for deep transcranial magnetic stimulation. The H-coil with complicated winding configuration was composed with two separate coil sets, i.e. blue-coil and yellow-coil as shown in Figure 1 in the abstract. This work presents the numerical study to compare the magnetic field and the induced electric field in realistic head model by H-coil and its two separate coil sets by employing the impedance method. It was found the yellow coil makes major contribution for the electric fields in deep brain regions, while the blue coil only stimulate the superficial cortical

Protection (ICNIRP) guidelines for general public and occupational exposure are met for distances ≥ λ/5 and ≥ λ/10 respectively.

S09-7 [09:30]

EXPOAUTO – An international research project on cumulative exposure of people of different ages to radiofrequency electromagnetic fields from new technologies in automotive services and connected objects

Gabriella Tognola[1], Barbara Masini[1], Marta Bonato[1], Emma Chiaramello[1], Sam Aerts[2], Wout Joseph[2], Joe Wiart[3] & Paolo Ravazzani[1]

[1]*IEIIT - Institute of Electronics, Information Engineering and Telecommunications, CNR - Italian National Research Council, Sites of Milan and Bologna, Italy, 20133*

[2]*Department of Information Technology, Ghent University/IMEC, Ghent, Belgium, 9052*

[3]*Chaire C2M, LTCI, TPT - Télécom Paris, Palaiseau, France, 91120*

Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress

Presented by: Gabriella Tognola

The paper presents the objectives, the architecture, and the partnership of the international Project EXPOAUTO ‘Cumulative real smart car exposure to radiofrequency electromagnetic fields in people of different ages from new technologies in automotive services and connected objects” financed by the French National Research Program for Environmental and Occupational Health of Anses (2020/2 RF/05).

S09-8 [09:45]

Evaluation of temperature rise for multiple antennas at different frequencies: A computational study

Norika Miura[1], Sachiko Kodera[1], Junji Higashiyama[2], Yasunori Suzuki[2] & Akimasa Hirata[1]

[1]*Dept. of Electrical and Mechanical Engineering, Nagoya Institute of Technology, Nagoya, Japan, 466-8555*

[2]*Dept. of 6G Laboratories, NTT DOCOMO, INC, Kanagawa, Japan, 239-8536*

Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress

regions with improved focality.

S10-7 [09:30]

Initial assessment of a microwave imaging system for continuous monitoring of liver tumor ablation

Mengchu Wang[1, 2], Rosa Scapaticci[1], Marta Cavagnaro[1, 2] & Lorenzo Crocco[1]

[1]*Institute for the Electromagnetic Sensing of the Environment, National Research Council of Italy, Napoli, Italy, 80124*

[2]*Department of Information Engineering, Electronics and Telecommunications, Sapienza University of Rome, Rome, Italy, 00184*

Keywords: Clinical (diagnostics), RF/Microwaves, Completed (unpublished)

Presented by: Mengchu Wang

In this work, the in-silico assessment of a microwave imaging device specifically designed for liver ablation monitoring is presented. The outcomes of this study show the designed device is capable of providing 3D images of the ablated region, paving the way for the next stage in which the device will be implemented and experimentally assessed in the same conditions as those simulated in this study.

Presented by: Norika Miura

Temperature rise in human body is a dominant effect for exposure at frequencies higher than 100 kHz. The 5th generation wireless communication systems may simultaneously use the frequency ranges above and below 6 GHz. This study evaluates the effect of superposition of SAR, APD, and resultant temperature rise for simultaneous exposures at different frequencies for the first time. The results suggested that the effect of superposition would be marginal at least for the cases considered here.

Coffee Break
Wednesday September 29, 2021 • 10:00 - 10:30

Session: S11
Dosimetry 5
Wednesday September 29, 2021 • 10:30 - 12:00
Einstein
Chairs: Emmanuelle Conil & Jürg Fröhlich

S11-1 [10:30]

Fast antenna characterization using a phaseless-based source-reconstruction algorithm

Kristian Cujia[1], Arya Fallahi[1, 2] & Niels Kuster[1, 2]

[1]*ITIS Foundation, Zurich, Switzerland, 8004*

[2]*Information Technology and Electrical Engineering, ETH Zurich, Zurich, Switzerland, 8092*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress

Presented by: Niels Kuster

Exposure assessment (EA) of wireless devices requires power density (PD) measurements over the near-field to far-field regions. PD evaluation demands knowledge about the field phasors, thus EA through brute-force field measurements becomes a burdensome process. Here, we present a strategy based on a multiple multipole expansion for accurate PD evaluation in all field regions out of sparse phaseless measurements. We construct an equivalent source in terms of pairs of elementary electric or magnetic dipoles and evaluate their amplitudes such that the measured fields are reproduced with minimal error. This enables accurate field reconstruction from the (reactive) near field to the far field regions within an uncertainty budget (0.6 dB).

S11-2 [10:45]

Frequency dependence of peripheral nerve threshold for magnetic field exposure

Yosuke Suzuki[1], Yinliang Diao[1], Jose Gomez-Tames[1] & Akimasa Hirata[1]

[1]*Electrical and Mechanical Engineering, Nagoya, Japan, 466-8555*

Keywords: Dosimetry (computational), IF, Work in Progress

Presented by: Yosuke Suzuki

International guidelines/standards for human protection have set limits where electrostimulation is

Session: S12
Risk, Safety Standards and Policies
Wednesday September 29, 2021 • 10:30 - 12:00
Maxwell
Chairs: Martin Röösli & John Bolte

S12-1 [10:30]

Evaluation of non-sinusoidal magnetic fields: Comparing the weighted peak method with a new method using the Spatially Extended Nonlinear Node electrostimulation model

Florian Soyka[1]

[1]*Institute for Occupational Safety and Health, German Social Accident Insurance, Sankt Augustin, Germany, 53757*

Keywords: Occupational, Pulsed, Completed (unpublished)

Presented by: Florian Soyka

As stated by ICNIRP and IEEE the evaluation of non-sinusoidal magnetic fields is an important research topic. The weighted peak method (WPM) is often used for such evaluations. Here, a new method (called SENN EI) is proposed which provides an exposure index (EI) for the high action levels based on the Spatially Extended Nonlinear Node (SENN) electrostimulation model. The exposure indices of both methods are directly comparable. Since SENN EI uses detailed SENN model calculations, it can be seen as ground truth to which the WPM can be compared. Comparisons show that the WPM evaluations are conservative and do not underestimate the exposure with the tested waveforms.

S12-2 [10:45]

SAR origin and safety/reduction factors of radio frequency exposure limits

C. K. Chou[1]

[1]*C-K. Chou Consulting, Dublin, CA, USA, 94568*

Keywords: Standards, RF/Microwaves, Completed (unpublished)

Presented by: C-K. Chou

This presentation reviews the origin of SAR (Specific Absorption Rate) and explains how exposure limits for the current two-tier exposure limits were derived. Based on expert judgement,

the primary effect for exposure up to 5–10 MHz. However, additional evaluation for limits is needed to clarify the experimental and computational uncertainty. This study evaluated the external magnetic field strength threshold for activation of peripheral nerve in conservative conditions. The results show that computed thresholds of external magnetic field are conservative concerning permissible values from the international guidelines/standards.

S11-3 [11:00]

Assessment of brief exposure to radiofrequency electromagnetic fields emitted from a smart meter operating at 920 MHz based on revised ICNIRP guideline

Takeo Shiina[1] & Kenichi Yamazaki[1]

[1]*Central Research Institute of Electric Power Industry, Yokosuka, Japan, 240-0196*

Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress

Presented by: Takeo Shiina

We assessed brief exposure to radiofrequency (RF) electromagnetic fields emitted from a smart meter based on the revised guideline published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Although the low-power wireless communication device used for the smart meter inherently complies with exposure guidelines, the exposure assessment is useful to deepen our understanding of human safety. We calculated the SA values using anatomical human model in vicinity of a smart meter at 920 MHz. The spatially averaged SA in the head was calculated to be 29.9 mJ/kg for an input power of 20 mW. It was shown that RF fields around the smart meter were much lower than the basic restriction in the ICNIRP guideline.

S11-4 [11:15]

Modelling of daily radiofrequency electromagnetic field dose for a prospective adolescent cohort

Martin Röösli[1, 2], Jana Sönksen[1, 2], Claudia Schmutz[1, 2], Steven C. Shen[3, 4], Mireku MO[3, 4], Darren Addison[6], Myron Maslanyj[6], Mireille

safety factors or reduction factors provide safety margins below established adverse health effects levels. These factors vary with basis of the protection threshold (cataracts or tissue heating), frequency range, body size, ground conditions, etc. Current IEEE standard and ICNIRP guidelines differ in interpretation of the safety factors or reduction factors for local exposures but do not differ for whole-body exposure.

S12-3 [11:00]

Review of health effects from WLAN radiation: quality matters

Stefan Dongus[1, 2], Hamed Jalilian[3], David Schuermann[4] & Martin Röösli[1, 2]

[1]*Department of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Basel, Switzerland, 4002*

[2]*University of Basel, Basel, Switzerland, 4051*

[3]*Department of Occupational Health Engineering, Research Center for Environmental Pollutants, Faculty of Health, Qom University of Medical Sciences, Qom, Iran*

[4]*Department of Biomedicine, University of Basel, Basel, Switzerland, 4058*

Keywords: Public Health Policy, RF/Microwaves, Review, Commentary, Recommendation, Evaluation

Presented by: Stefan Dongus

This review study aimed at evaluating biological and health effects of realistic WiFi exposure. We systematically assessed epidemiological, human experimental, in vivo and in vitro studies that fulfilled basic quality criteria. More than 1000 articles published between 1997 and 2020 were identified by the literature search. Based on the 23 publications fulfilling the basic quality criteria, we found little evidence that WiFi exposure in the everyday environment is a health risk.

S12-4 [11:15]

Phosphene perception thresholds during transcranial alternating current stimulation (tACS) at extremely low frequencies in humans

Andres Carvallo[1], Maorie Laporte[1], Nicolas Bouisset[2, 4], François Deschamps[6], Martine Souques[7], Isabelle Magne[7], Pierre-André

Toledano[3, 4, 5] & Marloes Eeftens[1, 2]

[1]*Swiss Tropical and Public Health Institute, Basel, Switzerland*

[2]*University of Basel, Basel, Switzerland*

[3]*MRC Centre for Environment and Health, Imperial College, London, United Kingdom*

[4]*National Institute for Health Research, Health Protection Research Unit in Chemical and Radiation Threats and Hazar, London, United Kingdom*

[5]*Mohn Centre for Children's Health and Wellbeing, Imperial College, London, United Kingdom*

[6]*Centre for Radiation, Chemical, and Environmental Hazards, Public Health England, Oxon, United Kingdom*

Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)
Presented by: Martin Röösli

In the framework of the prospective cohort study SCAMP (Study of Cognition, Adolescents and Mobile Phones), we aimed at describing radiofrequency electromagnetic field (RF-EMF) dose development over a 2-year period. Mean daily whole body RF-EMF dose was 170 mJ/kg/day in a sample of 6,152 children aged 12.1 year. Two years later whole body RF-EMF dose was virtually the same (176 mJ/kg/day), whereas RF-EMF dose absorbed by the temporal lobe increased by 32% owned to increase in mobile phone call duration. Main dose contributors were calls on the 2G network. Dose estimated at baseline and follow-up for various organs showed correlations between 0.25 und 0.35 among the 3,241 children who completed both assessments.

S11-5 [11:30]

Transmit RF power calibration of the personal EM exposimeter DEVIN

Serge Bories[1], David Dassonville[1], Emmanuelle Conil[2], Joe Wiart[3] & Isabelle Deltour[4]

[1]*CEA,, Grenoble, France, 38054*

[2]*ANFR, Paris, France*

[3]*Telecom ParisTech, Paris, France*

S12-5 [11:30]

Environmental protection: adapting the ICNIRP approach to frequencies above 6 GHz

Andrew Wood[1, 3], Zoltan Vilagosh[1, 3], Alireza Lajevardipour[1, 3] & Ken Karipidis[2]

[1]*Swinburne University of Technology, Hawthorn, Australia, Vic 3122*

[2]*Australian Radiation Protection and Nuclear Safety Agency, Yallambie, Australia, Vic 3085*

Cabanes[7], Genevieve Ostiguy[8], Michel Plante[8] & Alexandre Legros[1, 2, 3, 4, 5]

[1]*EuroMov Digital Health in Motion, Univ Montpellier, IMT Mines, Montpellier, France, 34090*

[2]*Human Threshold Research Group, Lawson Health Research Institute , London, Ontario, Canada, N6C2R5*

[3]*Department of Medical Biophysics, Western University, London, Ontario, Canada, N6C2R5*

[4]*Department of Kinesiology, Western University, London, Ontario, Canada, N6C2R5*

[5]*Department of Medical Imaging, Western University, London, Ontario, Canada, N6C2R5*

[6]*RTE, Departement Concertation et Environment, Paris-La Defence, France, 92060*

[7]*Service des Etudes Medicales, EDF, Levallois-Perret Cedex, France, 92300*

[8]*Hydro-Quebec, Montreal, Quebec, Canada, H2Z 1A4*

Keywords: Public Health Policy, ELF/LF, Completed (unpublished)
Presented by: Andres Carvallo

OBJECTIVE: Estimating phosphene thresholds at Extremely Low Frequencies (ELF). METHODS: Twenty participants completed the experimental study. Phosphene thresholds were calculated using logistic regressions on perception responses resulting from non-invasive transcranial Alternating Current Stimulation (tACS) between 0-2 mA delivered at 20-50-60-100 Hz. RESULTS: Thresholds were lower at 20 than 50 and 60 Hz. The 100 Hz did not reveal significant phosphene perceptions for the delivered currents. SIGNIFICANCE: These results further consolidate the literature regarding how locally induced electric fields impact specific cells of the central nervous system, and could contribute reducing uncertainties identified in international guidelines.

[4]*IARC, Lyon, France*
Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Serge Bories

The population EM exposure and its long-term evolution is strongly dependent of the wide diversity of usages, of telecom standards but also of the network infrastructure deployment choices. The miniature personal exposimeter DEVIN is attached to the user's smartphone to log both the effective transmitted RF power and to classify the user activities along the day. Details and limitations of the transmitted RF power calibration process are presented in this paper. WiFi bands and cellular bands have their specific calibration. The former relies on a priori knowledge of transmitted power, whereas the latter is calibrated with a base-station emulator which can control the RF power transmitted by the smartphone that carries the DEVIN.

S11-6 [11:45]

Continuous subthreshold ELF exposure is able to modulate the physiological neural activity?

Antonio Sarolic[1, 2], Filip Repac[1] & Damir Sapunar[2]

[1]*Chair of Applied Electromagnetics, University of Split, FESB, Split, Croatia, HR-21000*

[2]*University of Split, School of Medicine, Split, Croatia, HR-21000*
Keywords: Dosimetry (computational), ELF/LF, Completed (published)
Presented by: Antonio Sarolic

Human exposure guidelines in the ELF frequency range are based on the ability of internally induced electric fields to excite a silent nerve and produce the adverse reaction. However, the nervous system is not silent, but an active network of afferent and efferent signals. Therefore, it is only logical to broaden the view from analyzing just the silent resting state of the neuron, towards analyzing also the modulation of the ongoing innate neural activity by the external electric or magnetic field exposure. Our model shows that the modulation of the innate neurological activity might occur even with subthreshold continuous power frequency exposure.

[3]*Australian Centre for Electromagnetic Bioeffects Research, Hawthorn, Australia, Vic 3122*
Keywords: Standards, RF/Microwaves, Work in Progress
Presented by: Andrew Wood

Basic restrictions above 6 GHz in the 2020 ICNIRP Guidelines assume that absorption is occurring in human skin or eye. When considering possible effects on environmental flora and fauna a different approach is needed to allow for different morphology and electrical properties. This presentation covers modelling and theoretic approaches we have made in providing advice to a local government authority and will outline further work we intend to do.

S12-6 [11:45]

The Precautionary Principle in the domain of extreme low frequency electromagnetic fields: a theoretical investigation

Els De Waegeneer[1] & Lutgart Braeckman[1]

[1]*Public Health, Ghent University, Ghent, Belgium, 9000*
Keywords: Public Health Policy, ELF/LF, Work in Progress
Presented by: Els De Waegeneer

The Precautionary Principle is often called upon when dealing with possible environmental hazards, despite being under a lot of criticism. Pros and cons of the application of the Precautionary Principle will be considered and discussed in the light of ELF-EMF. The theoretical investigation on this particular concept could clarify the possible gaps and shortcomings of the principle and its application. Furthermore, this study could offer alternative or supplementary concepts and applications of the precautionary principle in the domain of ELF-EMF.

Session: P3
Plenary 3 - A comparison between the recently released IEEE standard and ICNIRP radiofrequency guidelines: What are the differences, and do they make a difference?
Wednesday September 29, 2021 • 12:00 - 13:00
Einstein
Chairs: Martin Röösli & Myles Capstick

P3-1 [12:00]

New IEEE C95.1-2019 standard and ICNIRP 2020 guidelines

C. K. Chou[1]

[1]*C-K. Chou Consulting, Dublin, CA, USA, 94568*

Biographical sketch

Dr. C-K. Chou received his Ph.D. degree from the University of Washington, in 1975. From 1976 to 2013, he worked at the University of Washington, City of Hope National Medical Center, and Motorola. He is retired and currently an Independent Consultant on EMF safety issues. He continues to serve as Chairman of Technical Committee 95 of the IEEE International Committee on Electromagnetic Safety, responsible for exposure standards from 0 to 300 GHz (2006 to present). Dr. Chou received the d'Arsonval Medal from the Bioelectromagnetics Society in 2006 and received the IEEE Standards Association Lifetime Achievement Award in 2020.

Abstract

In the BioEM 2019 Workshop: "Differences of exposure limits between the new ICNIRP Guidelines and IEEE C95.1 Standard", we discussed various differences between the two exposure limits before they were published. Now that both IEEE and ICNIRP have published their standard and guidelines in 2019 and 2020, respectively. EMF exposure limits have been developed independently by the two international committees. Even based on the same literature and both protect against established or substantiated adverse health effects, there are still differences in exposure limits between the two groups. For high frequencies, most limits are the same. At lower frequencies, there are some discrepancies in exposure limits between ICNIRP 2010 low frequency guidelines and IEEE C95.1-2019. In future revisions, harmonization of exposure limits continually is the goal for a global standard.

P3-2 [12:30]

Difference of exposure restrictions between new IEEE C95.1 standard and ICNIRP guidelines

Akimasa Hirata[1]

[1]*Department of Electrical and Mechanical Engineering, Nagoya Institute of Technology, Nagoya, Japan, 466-8555*

Biographical sketch

Akimasa Hirata received the Ph.D. degree in communications engineering from Osaka University, Suita, Japan, in 2000. In 2001, he joined Osaka University as an Assistant Professor. In 2004, he moved to Nagoya Institute of Technology, where he is currently a full professor and a director of research center. His research interests include public health engineering (human protection from electromagnetic field and environmental heat), methods in neuroscience, and related computational techniques. He is a member of the main commission and a project group chair of International Commission on Non-Ionizing Radiation Protection (ICNIRP). He received several awards including IEEE EMC-S Technical Achievement Award (2015), and the Japan Academy Medal (2018). He is a Fellow of Institute of

Physics, IEEE and IEICE.

Abstract

The ICNIRP radiofrequency guidelines and IEEE C95.1 standard have been revised in 2020 and 2019, respectively. One of the primary differences between them is the difference of the permissible field strength (power density), which are named reference level or exposure reference level (ERL), respectively. Specifically, the permissible field strength in the MHz range and that for local exposure are different even based on the same basic restriction or dosimetric reference limit (DRL). In addition, the (exposure) reference levels are different for intense (brief) exposure and contact current. The differences of these limits are summarized to clarify the research need.

Lunch
Wednesday September 29, 2021 • 13:00 - 14:30

Session: M3
EBEA GA
Wednesday September 29, 2021 • 13:30 - 14:30
Einstein

Session: W3
Workshop 3 - Ultraweak and weak static, ELF, and RF field effects on biological systems
Wednesday September 29, 2021 • 14:30 - 16:30
Einstein
Chairs: Myrtill Simko & Rene De Seze

W3-1 [14:30]

Workshop Introduction

Frank Barnes[1] & Ben Greenebaum[2]

[1]*Electrical, Computer and Energy Engineering, Boulder, Colorado, USA, 80309*

[2]*Department of Physics, Kenosha, Wisconsin, USA, 53144*

Experiments from many laboratories using magnetic field strengths well below the ambient Earth's field, including intensities very close to zero, have shown interesting and somewhat unexpected effects. Papers in this workshop present results on a sampling of biological systems of weak and ultra-weak static, alternating, and RF fields, Thepapers also explore some possible affected biological pathways or other explanations of how fields of this intensity are affecting the biological systems.

W3-2 [14:30]
Young Scientist

Multiple pathways involve in bio-response to the hypomagnetic field

Ying Liu[1, 2], Wei-chuan Mo[2], Jing-peng Fu[2], Hai-tao Zhang[2], Zi-jian Zhang[2], Bing-jun Liu[1], Jie Ren[1] & Rongqiao He[2]

[1]*School of Life Sciences, Beijing University of Chinese Medicine, Beijing, China, Beijing 102488*

[2]*State Key Laboratory of Brain and Cognitive Science, Institute of Biophysics, CAS, Beijing, China, Beijing 100101*

To reveal the role of geomagnetic field (GMF) and the mechanisms of biomagnetosensation, an extensive analysis of the effects of hypomagnetic field (HMF), a GMF elimination condition, have been conducted both in vivo and in vitro. The results indicate impairment of brain functions and general activities of mice, altered cell activities including proliferation and movement, repression of CuZn-SOD and mitochondrial activities, as well as actin assembly. These data indicate multiple pathways involved in the bio-responses to the HMF.

W3-3 [14:45]
STUDENT PAPER

Weak magnetic fields: A quantum approach to controlling stem cells

Luke Kinsey[1], Alanna Van Huizen[1] & Wendy Beane[1]

[1]*Department of Biological Sciences, Western Michigan University, Kalamazoo, MI, USA, 49009*

Recent advances in quantum biology have highlighted potential advantages for quantum approaches as therapies. Our prior work identified weak magnetic fields (WMFs) as one such approach. Here we investigate the ability of WMFs to modulate stem cell activity during planarian regeneration. We exposed regenerates to different field strengths and analyzed reactive oxygen species (ROS) levels and Hsp70-mediated stem cell proliferation. We show WMFs can manipulate stem cells to either promote or inhibit new growth (dependent on field strength), consistent with theoretical models indicating WMFs alter radical formation through electron spin state changes. Our data suggest quantum approaches to controlling stem cells are an emerging research area.

W3-4 [15:00]

The impact of combined Static magnetic fields and RF fields on HT-1080 fibro sarcoma cells and role of Iron Sulphur complexes on ROS production

Hakki Gurhan[1] & Frank Barnes[1]

[1]*Electrical, Computer and Energy Engineering, Boulder, Colorado, USA, 80309*

This research advances the argument that Iron Sulphur proteins inside the electron transport chain of mitochondria are one of the important molecules interacting with externally applied Static and RF magnetic fields. A model was introduced based on radical pair mechanism and resonance effect of applied Radio Frequency (RF) Fields were investigated on cell growth, intracellular pH, membrane potential, hydrogen peroxide and mitochondrial calcium at frequencies between 1 MHz and 10 MHz in combination with SMFs.

W3-5 [15:15]

Extremely low-frequency electromagnetic field interactions with biological systems

Sahithi Kandala[1], Mark Hernandez[2], Ben Greenebaum[3] & Frank Barnes[1]

[1]*Electrical, Computer and Energy Engineering, University of Colorado, Boulder, Colorado, USA, 80309*

[2]*Civil, Environmental and Architectural Engineering, University of Colorado , Boulder, Colorado, USA, 80309*

[3]*Department of Physics, University of Wisconsin, Kenosha, wisconsin, USA, 53144*

There have been numerous studies detailing the effects of low frequency fields with biological systems. Here, we explore the mechanism behind the interaction between biological systems and extremely kow frequency fields. The exploration is two fold, we look at how changes in both the cell type of the biological systems and how changes in the characteristics of the fields change this interaction. The theory of mechanism of response and interaction will also be presented with data that supports the hypothesis.

W3-6 [15:30]

A static magnetic field inhibits the migration and telomerase function of mouse breast cancer cells

Zhu Fan[1], Pingdong Hu[2, 3], Guomi Wang[1, 3], Ying Liu[1], Rongqiao He[2] & Tao Lu[1]

[1]*School of Life Sciences, Beijing University of Chinese Medicine, Beijing, China, Beijing 100029*

[2]*State Key Laboratory of Brain and Cognitive Science, Institute of Biophysics, CAS, Beijing, China, Beijing 100101*

[3]*University of Chinese Academy of Sciences, Beijing, China, Beijing 100101*

In this study, we evaluated the effects of moderate static magnetic field (SMF) (~150 mT) on 4T1 breast cancer cells. The results showed that SMF treatment accelerated cell proliferation but inhibited cell migration and telomerase function, which indicates that the telomerase network is responsive to SMF and may function as a target in magnetic therapy of cancers.

W3-7 [15:45]

Weak RF and magnetic fields as intercellular communication mechanism

Frank Barnes[1], Hakki Gurhan[1], Sahithi Kandala[1], Mark Hernandez[2] & Ben Greenebaum[3]

[1]*Electrical, Computer and Energy Engineering, Boulder, Colorado, USA, 80309*

[2]*Civil, Environmental and Architectural Engineering, Boulder, Colorado, USA, 80309*

[3]*Department of Physics, Kenosha, Wisconsin, USA, 53144*

We and others have shown that both weak radio frequency fields and magnetic fields can change the growth rates of fibrosarcoma and other cells. These fields can provide a rapid short-range communications system within and between cells that is not inhibited by membrane resistances. In this talk we will present a model showing the emission of weak magnetic fields resulting from nuclear spins and nerve cell pulses can affect chemical reaction rates and that signals as small as on nT have been shown to change cell growth rates.

W3-8 [16:00]

Effects of a weak static magnetic field on the production of reactive oxygen species by neutrophils. Comparison with the effects of combined static and ELF magnetic fields

Igor A. Shaev[1], Vadim V. Novikov[1] & Elena V. Yablokova[1]

[1]*Institute of Cell Biophysics RAS, Federal Research Center, Pushchino, Russian Federation, 142290*

We have shown that exposure of murine peritoneal neutrophils to magnetic shielding in hypomagnetic conditions (HMC) causes the decrease of intracellular ROS production recorded by change of fluorescence intensity of the products of 2,7-dichlorodihydrofluorescein and dihydrorhodamine 123. In these experiments, we found that the effect of the hypomagnetic field is apparent on neutrophils without their additional stimulation by the chemical activators of respiratory burst, and, consequently, the mechanism of such action can be not related to the impairment of the response of neutrophils to these stimuli.

Coffee Break
Wednesday September 29, 2021 • 16:30 - 17:00

Session: DA
d'Arsonval Award
Wednesday September 29, 2021 • 17:00 - 18:00
Einstein
Chair: Rene De Seze

DA-1 [17:00]

Answers and Questions: 40 Years in Bioelectromagnetics

Ben Greenebaum[1]

[1]*Physics Department, University of Wisconsin-Parkside, Kenosha, WI, USA, 53141*

This D'Arsonval Lecture presents an overview of attempts over my research career in collaboration with a variety of others to help answer the basic question of bioelectromagntics: What's going on here? It begins with early research exposing the sliime mold Physarum polycephalum to ELF fields and continues with a variety of types of cells and fields, mostly static and ELF, as well as to some attempts at basic theoretical explanations. As with all such attempts, each new piece of information raises more questions than it answers.

I am most appreciative to the Bioelectromagnetics Society for the 2020 D'Arsonval Award, which as someone trained in experimental physics I must share with all of the other scientists, students and technicians, mostly biologists and chemists, with whom I have collaborated over the years.

The work began in 1972 when three young assistant professors used a slime mold to see if electromagnetic fields would affect them. They did, though the effects were small and hard to tease out of the noise. The cell cycle was lengthened and there were changes in respiration. So, the next question was "how and why?" and that has led to a long and interesting research life. Further changes were seen using these and then other bacterial and eukaryotic cells in respiration, in ATP, in the protein replication chain, and so forth. Changes occurred even in cell extracts that lacked an intact plasma membrane. Nerve cells showed changes in leakage of neurotransmitters and in neurite outgrowth from excised ganglia. For each succeeding type of experiment, I sometimes had to devise new ways of applying the fields without upsetting the normal functioning of the cells or subdividing the data to try to tease out another answer. In all of this work, an interdisciplinary group of collaborators was helpful in designing the experiments before we started, as well as thinking about the procedures, the data and the conclusions, covering gaps in my knowledge as I helped cover gaps in theirs. Based on some of the experiments with nerve cells, I also did some computer calculations, modeling the internal electric and magnetic fields and current densities in simplified representations of bone fractures and also of spinal cords in vertebrae. More recently, I have collaborated on some theoretical models of what fields might be doing at the cellular and molecular level, particularly with reference to the radical model. With each piece of research, I and my collaborators generally found a small piece of information about fields and biological systems; and each answer raised another set of questions, which is the way of science. Though bioelectromagnetic scientists have learned much and can say much at greater depth about what happens when an organism is exposed to a field, the fundamental question still remains: What exactly is going on here?

Session: S13
Electroporation 2
Thursday September 30, 2021 • 08:00 - 09:45
Einstein
Chairs: Philippe Leveque & Lluis M. Mir

S13-1 [08:00]

Quantitative phase microscopy monitors sub-cellular dynamics in single cells exposed to nanosecond pulsed electric fields

Zachary Steelman[1], Bennett Ibey[2], Allen Kiester[2] & Joel Bixler[2]

[1]*National Research Council Research Associateship Program, Washington , DC, USA, 20001*

[2]*Air Force Research Laboratory, JBSA Fort Sam Houston, Texas, USA, 78234*

Keywords: Electroporation, Pulsed, Completed (unpublished)
Presented by: Zachary Steelman

Quantitative phase imaging (QPI) is a label-free imaging modality which uses the optical pathlength of a thin sample as a contrast mechanism.In this work, we introduce QPI as a useful tool for the study of nsPEF-induced biophysical change. Single cells exposed to a variable number of nsPEF pulses are monitored using QPI for changes in cytoskeletal organization and intracellular material distribution.

S13-2 [08:15]

Modelling transmembrane potential and mechanical stress in contactless cell permeabilization by time-varying magnetic fields

Emma Chiaramello[1], Serena Fiocchi[1], Marta Bonato[1], Silvia Gallucci[1, 2], Martina Benini[1, 2], Gabriella Tognola[1], Paolo Ravazzani[1] & Marta Parazzini[1]

[1]*Istituto di Elettronica e di Ingegneria dell'Informazione e delle Telecomunicazioni, Consiglio Nazionale delle Ricerche, Milano, Italy, 20133*

[2]*Dipartimento di Elettronica, Informazione e Bioingegneria (DEIB), Politecnico di Milano, Milano, Italy, 20133*

Keywords: Electroporation, ELF/LF, Completed (unpublished)
Presented by: Emma Chiaramello

The use of time-varying magnetic fields was proposed as a non-invasive membrane permeabilization method, and, although the feasibility of the approach was proved by experimental results, the underlying mechanism is still poorly understood. This study focused on a numerical analysis of the transmembrane potential at cell membranes induced by time-varying magnetic fields and on a quantification of mechanical stress on the cell membrane induced by the magnetic and electric fields. TMP values were far below those needed for membrane permeabilization, with a strong dependence on distance of the cell from the coil. The preliminary assessment of the mechanical pressure showed stress values high enough to influence the pore opening mechanisms.

S13-3 [08:30]

High-speed strobe photography for direct observation of the charging dynamics caused by pulsed electric field effects

Allen Kiester[1], Zachary Coker[1], Bennett Ibey[1] & Joel Bixler[1]

[1]*711 HPW RHDO/R, Air Force Research Laboratory, san antonio, TX, USA, 78234*

Keywords: Electroporation, Pulsed, Completed (unpublished)

Presented by: Allen Kiester

A high performance strobe laser microscopy system has been developed for use in conjunction with FlouVolt™ voltage sensitive dye for imaging variations in cell membrane potential during the application of electric pulses. The system allows flexible variation of trigger timing in order to image any time point of a cell-electric pulse interaction. Potential applications for the system include resolving the charging and discharging times of a cell membrane and estimation of cell membrane electro-physical constants to improve the cell circuit model for membrane charging.

S13-4 [08:45]

Nanosecond electric pulses trigger a rise in intracellular Ca^{2+} in GCaMP6f-expressing adrenal chromaffin cells in intact mouse adrenal slices

Nicole Procacci[1], Josette Zaklit[2], Vasilii Mansurov[2], Normand Leblanc[3], Gale Craviso[3] & Thomas Gould[1]

[1]*Department of Physiology and Cell Biology, University of Nevada, Reno , Reno, NEVADA, USA, 89509*

[2]*Department of Electrical and Biomedical Engineering, University of Nevada, Reno , Reno, NEVADA, USA, 89509*

[3]*Department of Pharmacology, University of Nevada, Reno , Reno, NEVADA, USA, 89509*

Keywords: In vitro, Pulsed, Work in Progress

Presented by: Thomas Gould

Exposing dissociated adrenal chromaffin cells to nanosecond electric pulses (NEP) causes an instantaneous rise in intracellular Ca^{2+} due to Ca^{2+} influx via voltage-gated Ca^{2+} channels. The goal of this study was to test whether NEPs could similarly activate chromaffin cells in intact slices of the adrenal gland. For this purpose, adrenal slices were obtained from mice expressing the genetically-encoded Ca^{2+} indicator GCaMP6f in chromaffin cells. We characterized Ca^{2+} transients that occurred spontaneously as well as those induced by treatment with cholinergic agonists or stimulation with NEPs. These studies represent an important step toward developing NEP-based technologies to modulate excitable peripheral organ tissue noninvasively.

S13-5 [09:00]

Novel features of bipolar cancellation of Ca^{2+} influx via voltage-gated Ca^{2+} channels into adrenal chromaffin cells by ultrashort nanosecond electric pulses

Vasilii Mansurov[1], Gale Craviso[2], Normand Leblanc[2] & Josette Zaklit[1]

[1]*Department of Electrical and Biomedical Engineering, University of Nevada, Reno, Reno, NV, USA, 89557*

[2]*Department of Pharmacology, University of Nevada Reno School of Medicine, Reno, NV, USA, 89557*

Keywords: Electroporation, Pulsed, Work in Progress

Presented by: Josette Zaklit

Exposing adrenal chromaffin cells to a 2 ns bipolar pulse (BP) cancels Ca^{2+} entry via voltage-gated Ca^{2+} channels evoked by a unipolar pulse as long as the interval between the two phases of the BP does not exceed 10 ns. Here we report cancellation of Ca^{2+} influx by a 3 and 5 ns BP, requiring shorter interphase intervals for cancellation than for a 2 ns BP. For a 12 ns BP cancellation occurred in some cells and for a 25 ns BP it was never achieved. In cells in which Ca^{2+} responses were not cancelled by the BP, the response was often preceded by a small Ca^{2+} pre-peak and when cancellation occurred, Ca^{2+} transients were sometimes observed several seconds after BP delivery. Thus BP elicit multifaceted effects in this excitable cell type.

S13-6 [09:15]

Microsecond pulsed electric fields: an effective way to selectively target and radiosensitize medulloblastoma cancer stem cells

Mirella Tanori[1], Arianna Casciati[1], Alessandro Zambotti[1], Rosanna Pinto[1], Isabella Gianlorenzi[2], Alessandro Pannicelli[3], Paola Giardullo[1], Barbara Benassi[1], Carmela Marino[1], Mariateresa Mancuso[1] & Caterina Merla[1]

[1]*Department of Sustainability, Italian National Agency for Energy New Technologies and Sustainable Economi, Rome, Italy, 00123*

[2]*Department of Ecological and Biological Sciences, University of Tuscia, Viterbo, Italy, 01100*

[3]*Energy Efficiency Department, Italian National Agency for Energy New Technologies and Sustainable Economi, Rome, Italy, 00123*

Keywords: Electroporation, Pulsed, Completed (published)

Presented by: Mirella Tanori

New therapeutic strategies are necessary to target cancer stem cells. Microsecond pulsed electric fields have been used to expose a cell model of human medulloblastoma, rich in cancer stem cells, and normal human astrocytes, representing healthy tissues surrounding the tumor. Our in vitro results showed irreversible membrane permeabilization, apoptosis and senescence processes via upregulation of GADD45A exclusively in medulloblastoma cancer stem cells. In the surviving cells reactive oxygen species generation was observed together with a cell cycle alteration. In vivo results demonstrated a significant tumor volume reduction after exposure and a complete inhibition of the tumor growth combining electric pulses with ionizing radiations.

S13-7 [09:30]

Analysis and control of calcium oscillations in differentiating mesenchymal stem cells using pulsed electric fields

Leslie Vallet[1], Franck Andre[1] & Lluis M. Mir[1]

[1]*Université Paris-Saclay, CNRS, Institut Gustave Roussy, Metabolic and systemic aspects of oncogenesis (METSY), 94805, Villejuif, France*

Keywords: Electroporation, Pulsed, Work in Progress

Presented by: Leslie Vallet

Mesenchymal Stem Cells (MSCs) are adult stem cells able to differentiate into many cell types such as osteoblasts, adipocytes, or chondrocytes. For this reason, these cells have become very promising candidates for cell-based therapies these last decades. In another respect, calcium is a ubiquitous cellular second messenger, known to encode important information in the form of oscillations. MSCs exhibit spontaneous calcium oscillations, whose frequency is varying over the course of differentiation processes. The main question addressed in this work is to assess whether, by manipulating the frequency of calcium oscillations, using short high voltage pulsed electric fields, we could influence proliferation or differentiation events in MSCs.

Session: T2
Tutorial 2 - Systematic reviews in Bioelectromagnetic research
Thursday September 30, 2021 • 09:45 - 10:45
Einstein
Chairs: Myrtill Simko & Gunnhild Oftedal

T2-1 [09:45]

Assessing health risks from exposure to RF-EMF: The WHO approach

Emilie van Deventer[1]

[1]*Department of Environment, Climate Change and Health, World Health Organization, Geneva, Switzerland, 1211*

Biographical sketch

Dr Emilie van Deventer is the Team Lead of the Radiation and Health Unit in the Department of Environment, Climate Change and Health at the World Health Organization headquarters in Geneva, Switzerland. This Unit covers public health aspects of ionizing and non-ionizing radiation safety and provides information and guidance to national authorities on radiation protection and health. She is responsible, inter alia, for topics related to electromagnetic fields, optical radiation and radon. Before joining WHO in 2000, she was a tenured professor of Electrical and Computer Engineering at the University of Toronto, Canada. She holds a PhD from the University of Michigan, USA and an honorary doctorate (doctor honoris causa) from the University of San Marcos, Lima, Peru.

Abstract

The World Health Organization (WHO) has a long-standing history in reviewing the findings of research on the health effects of exposure to electromagnetic fields (EMF) [1,2]. In 2012, the WHO Radiation Programme initiated an update of the 1993 Environmental Health Criteria document on radiofrequency (RF) EMF [3]. A narrative review of the scientific literature was developed, and a draft made available for expert consultation in 2014, which provided valuable feedback for its update.

In parallel to this work, WHO adopted internationally recognized methods and standards for guideline development to ensure that its guidelines are of the highest quality [4], requiring that all WHO health guidelines be based on a systematic review of the literature.

In the case of environmental exposures, such process starts with the formulation of a clear question that defines the targeted population (P), the exposure (E) under consideration, a comparator (C) and the outcome (O) of interest, namely a PECO question. Often, exposure to a specific agent may lead to several adverse health effects or, as in the case of RF research, to the study of many health outcomes. The narrative review highlighted studies related to over 30 outcomes. In view of the time and resources needed to complete such review, it was deemed important to restrict the questions to those dealing with the areas of greatest controversy or uncertainty. Thus, WHO conducted a broad international survey in 2018 to prioritize potential adverse health outcomes from RF exposure. Ten major topics were identified for which WHO has commissioned systematic reviews to analyze and synthesize the available evidence [5]. The systematic reviews follow explicit methods that minimize bias to identify, select, and critically appraise relevant research, and extract and analyse data from the studies included in the review.

References

1. World Health Organization. Static Fields. Geneva, Switzerland: WHO, International Programme on Chemical Safety; 2006.
2. World Health Organization. Extremely Low Electromagnetic Fields. Geneva, Switzerland: WHO, International Programme on Chemical Safety; 2007.
3. World Health Organization. Electromagnetic fields (300 Hz to 300 GHz). Geneva, Switzerland: WHO, International Programme on Chemical Safety; 1993.

4. World Health Organization. WHO Handbook for guideline development. Geneva, Switzerland; 2014.
5. Verbeek, J.; Oftedal, G.; Feychting, M. et al. Prioritizing health outcomes when assessing the effects of exposure to radiofrequency electromagnetic fields: A survey among experts. Environ Int 2021;146. https://doi.org/10.1016/j.envint.2020.106300

T2-2 [10:15]

Introducing COSTER: recommendations for conducting systematic reviews of environmental health questions

Paul Whaley[1]

[1]*Lancaster Environment Centre, Lancaster University, Lancaster, UK, LA1 4YQ*

Biographical sketch

Paul Whaley researches systematic methods for mapping and reviewing scientific evidence of human health risks posed by exposure to chemical substances and other environmental challenges. He is an experienced specialist editor of environmental health systematic reviews, having handled over 300 manuscripts and worked with the US EPA, US National Toxicology Program, and World Health Organization, among others. He also has a strong interest in approaches to improving the quality of published environmental health research, both primary and secondary. This extends to making research methods and findings FAIR (findable, accessible, interoperable, and reusable), understanding how ontologies, knowledge databases, and artificial intelligence can help us deliver fast, systematic syntheses of evidence.

Abstract

Guidance and standards for research can play an important role in helping scientists plan, conduct, and report high quality studies. Published in 2020, the COSTER (Conduct of Systematic reviews in Toxicology and Environmental health Research) recommendations represent the first formal guidance for planning and conducting systematic reviews of environmentalhealth research. A draft version of the recommendations informed the systematic reviews underpinning the recent WHO and ILO estimates burden of disease from occupational environmental exposures, they have been adopted by the journal Environment International in their guidance to authors, and the final published version is being used by the research teams conducting the new WHO systematic reviews of health effects from exposure to electromagnetic frequency radiation. This presentation will explain the genesis of COSTER and the methods for its development, compare it to other systematic review guidance, describe the core recommendations that are specific to or particularly important for the environmental health context, and discuss how it can best be utilised by researchers looking to conduct high quality systematic reviews.

Coffee Break
Thursday September 30, 2021 • 10:45 - 11:15

Session: P4
Plenary 4 - Electrogene transfer: challenges and recent advances in DNA-based vaccines
Thursday September 30, 2021 • 11:15 - 12:15
Einstein
Chairs: Olga Zeni & Lluis M. Mir

P4-1 [11:15]

Electrogene transfer: challenges and recent advances in DNA-based vaccines

Simona Salati[1]

[1]*IGEA Biophysics Laboratory, Carpi, Italy, 41012*

Biographical sketch

Simona Salati received her Doctorate degree in Biotechnology and Molecular Medicine in 2007 from the University of Modena and Reggio Emilia. She carried out her postdoctoral training in the lab directed by Dr. Bhatia, at the Stem Cell and Cancer Research Institute, Canada. Her research activity has been focused on the study of the molecular mechanisms regulating self-renewal and differentiation of normal and leukemic hematopoietic stem cells.

She is currently research coordinator of pre-clinical studies at IGEA, Italy. Her research interest is now focused on the application of the electroporation technology for Electro Gene Transfer and on the study of effects of pulsed electromagnetic fields on biological systems, such as bone, articular cartilage and neurons.

She is co-author of 35 peer-reviewed papers.

Abstract

Since the identification of the SARS-CoV-2 virus, an exceptional effort by the scientific community has led to the development of hundreds of vaccine projects. Over 40 are now undergoing clinical evaluation, and four have been approved for emergency use. The technologies exploited are diverse, each of which being associated with advantages and disadvantages. The different candidate vaccines can be grouped based on the technological platform exploited to elicit a protective immune response. Genetic vaccines (RNA or DNA) are based on nucleic acids coding for the Spike protein carried out by liposomes, adenoviruses or electroporation. Classical vaccines are either based on attenuated/inactivated SARS-CoV-2 viruses or on recombinant viral protein(s).

DNA-based vaccines offer a number of potential advantages over traditional approaches, including the activation of both cellular and humoral responses, the absence of any infectious agent, the relative ease of large-scale manufacture, rapid adaptation to antigenic variants, and the potential to be used in settings devoid of a cold chain. In the past, the effectiveness of DNA vaccine has been dampened by inefficient delivery systems of the plasmid DNA into mammalian cells and nuclei in vivo. Electroporation (EP) has been shown to overcome this issue. EP increases the permeability of the cell membrane to molecules that scarcely penetrate into the cell, such as DNA and RNA molecules. On this basis, EP has been applied for non-viral mediated electrogenetransfer (EGT) in either gene therapy or DNA vaccination settings. The first reports showing that the direct injection of plasmid DNA carrying eukaryotic genes into the mammalian muscle leads to endogenous expression of the encoded protein and to a specific immune response against that protein, were published in the early 90s and provided the basis for the development of DNA-vaccines. Nowadays, DNA-based vaccines represent a promising tool for the fight against many important challenges to human and animal health, including infectious diseases and cancer.

The thrust of the pandemic has pushed several DNA vaccine candidates into clinical trials, so far demonstrating a remarkable degree of immune potency and tolerability.

The Cliniporator technology is currently applied in three different clinical programs (one in the US and two in Europe) for the development of DNA-based vaccines against SARS-Cov-2, showing so far promising pre-

clinical results.

DNA vaccines represent an important tool in the fight against the COVID-19 pandemic thanks to their rapid adaptability to newly emerging variants and to their ability to accommodate more than one viral antigen, nurturing the hope of developing a universal COVID-19 vaccine immunizing towards evolutionary conserved SARS-CoV2 antigens.

Session: T3
Tutorial 3 - Study Quality and Reproducibility – Pillars for safety assessments and medical applications in Bioelectromagnetics
Thursday September 30, 2021 • 12:15 - 13:15
Einstein
Chairs: Mats-Olof Mattsson & Niels Kuster

T3-1 [12:15]

Quality analysis in EMF research, where are we and why does quality matters?

Myrtill Simko[1, 2]

[1]*SciProof International AB, Östersund, Sweden, 83132*

[2]*Institute for Advanced Studies, Strömstad Akademi, Strömstad, Sweden, 45280*

Biographical sketch

Myrtill Simkó is professor of cell and molecular biology and is scientific director at SciProof International AB in Östersund, Sweden. Her research focuses on the mode of action of cell reactions after exposure to physical agents such as EMF, and physicochemical agents such as nanomaterials. The research in bioelectromagnetics includes beside mechanistic studies also the use of diagnostics and therapeutics based on EMF. She pioneered the idea that ELF-MF positively modulates the immune system, an area where she has published numerous publications, book chapters, and review articles. Her focus is also on high quality experimental work including exposure conditions and biological studies.

She is and has been an invited expert for several health risk assessment expert groups, such as the WHO and SCENIHR, as well as other national and international scientific committees.

She studied Biology in Giessen, Germany, made her Doctoral thesis in the German Cancer Research Center in Heidelberg, and was Postdoc in Munich at the LMU-University. She made her academic career at the University of Rostock, Germany where she scrutinized the effects of EMF in vitro. In Vienna, Austria she worked also with Nanotechnology Risk Assessment at the Austrian Academy of Sciences and at the Austrian Institute of Technologies.

Abstract

The goal of this Tutorial is to provide practical information and tips how to perform good quality experimental work for EMF research if you want to make a difference. Furthermore it tries to answer and discuss some relevant open questions.

The question regarding electromagnetic fields (EMF) at environmentally relevant levels and health related effects is still able to give rise to controversy. EMF research is ongoing since many decades and has produced numerous publications showing uncountable results with or without findings, by applying different (from static to high frequency) electromagnetic fields as the exposure source, using different living systems, exposure durations etc. By using the search term ”electromagnetic fields and health effects” in PubMed the number of available publications is 2,858. By changing the word “health” to “biological” the number changes to 4,165 publications (see figure 1).

So, why can we not once and for all answer the question whether there is a health related or a biologically

relevant effect caused by any kind of EMF exposure at levels that are below exposure guidelines? Why are certain research groups identifying an “effect” whereas other groups are not able to reproduce them? Why do different commissions/expert groups or institutions sometimes interpret the available publications differently?

This list of questions can be expanded, however we want to get at least some answers instead of more questions. A very frequently cited answer is: “The available biological studies do not provide sufficient and adequate information for a meaningful safety assessment”. What can we do to obtain and/provide sufficient information for safety assessment?

It is known that many studies are of poor quality regarding the exposure conditions but also regarding the experimental procedures, which is the main reason for the lack of reproducibility and the conflicting results. Therefore the most relevant improvement is to employ standard operation protocols (SOPs) for both the biological and for the physical conditions in EMF research. Such protocols must be based on meaningful criteria. For biological/toxicological investigations SOPs already exist in different settings. Regarding the exposure conditions/controls etc. many publications have stated and determined the importance of standards, however this is often not considered. Furthermore, scientists must have hypothesis-based studies, putting the obtained results into the right perspective. By a “finding” it is especially important to understand whether a “result” is biologically relevant or possible, “just” a statistically significant difference from the (right) controls.

Another and not less important element of data interpretation is the statistical analysis of the data. Scientists must know that this is a mathematical aspect of the data – must not mix it up with real effects. A statistically significant difference does not necessarily imply a real effect!

In addition, we have to distinguish the importance and usefulness of in vivo and in vitro studies. We need to know what type of study that can be used for which aspect of a risk assessment? Many scientists summarize their in vitro studies with the conclusion that "the results show that EMF can cause e.g. cancer". In vitro studies do not answer complex in vivo effects/conditions, but are very useful to examine the hazard potential and/or the mode of action of the exposure! For completeness, in vivo studies tests whole, living organisms, and epidemiological studies provide information of the distribution of diseases and other health-related conditions in populations in context of an exposure. All three kinds of studies, epidemiological, in vivo and in vitro are needed for risk assessment.

Therefore the goal of this Tutorial is to provide practical information and tips how to perform good quality experimental work for EMF research if you want to make a difference. Furthermore it tries to answer and discuss some of the above-mentioned questions.

Figures

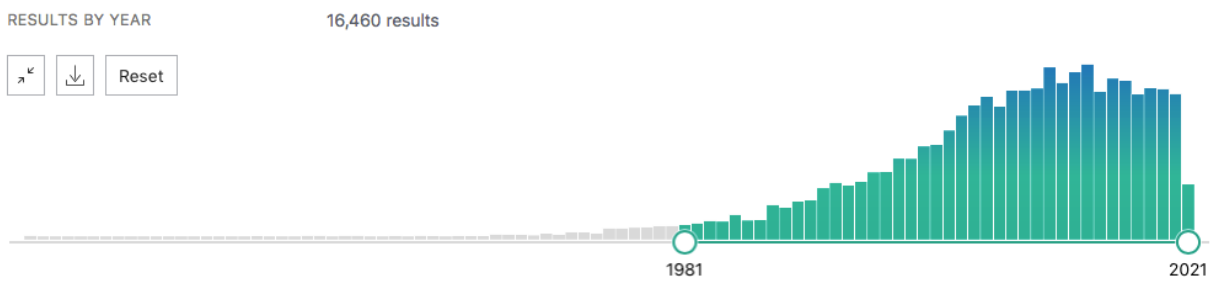


Figure 1. EMF related publications on PubMed between 1981 und 2021 using the search terms “electromagnetic fields and effects”.

T3-2 [12:45]

Implications of "metascience" research to improve the quality of bioelectromagnetics research

Vijayalaxmi[1] & Kenneth Foster[2]

[1]*Department of Radiology, San Antonio, TX, USA, 78229*

[2]*Department of Bioengineering, University of Pennsylvania, Philadelphia, PA, USA, 19104*

Biographical sketch

Dr. Kenneth R. Foster received the Ph.D. degree in physics from Indiana University, Bloomington, IN, USA, in 1971. He was with the U.S. Navy, Naval Medical Research Institute, Bethesda, MD, USA, from 1971 to 1976. Since 1976, he has been with the Department of Bioengineering, University of Pennsylvania, Philadelphia, PA, USA, where he is currently Professor Emeritus. He has been involved in studies on the interaction of nonionizing radiation and biological systems, including mechanisms of interaction and biomedical applications of radio frequency and microwave energy. In addition, he has written widely about scientific issues related to possible health effects of electromagnetic fields. He has authored approximately 170 technical papers in peer-reviewed journals, numerous other articles, and two books related to technological risk and the law. In 2016 he received the d'Arsonval Award from the Bioelectromagnetics Society for contributions to the field of bioelectromagnetics. He is a longtime member of TC 95 of the IEEE International Committee on Electromagnetic Safety (which sets safety limits for radiofrequency energy) and a member of the Physical Agents Committee of the American Conference of Industrial Hygienists, among many other professional activities.

Abstract

This Workshop presentation will review implications of "metascience" (a new research area that seeks to improve the quality of scientific research) for RF bioeffects studies. The presentation will discuss topics that can lead to false discovery: misuse of null hypothesis significant testing (NHST) and p-value to identify effects, and undisclosed flexibility in data collection and analysis and weaknesses in study design that can compromise internal validity of studies. Many of these issues can be addressed by more careful study design and fuller reporting of results; others (e.g., improved RF dosimetry) may require expensive instrumentation and numerical modeling of exposure.

The 2005 publication of Ioannidis' famous paper "Why most published research findings are false" [i] led to the development of a new scholarly field, metascience [ii], and to efforts such as the Open Science Foundation that seek to increase the reliability of scientific research. Two issues with particular relevance to RF bioeffects studies: (a) misuse of null hypothesis significance testing (NHST) and p-value to identify biological effects of exposure, and (b) low statistical power and deficiencies in study design and execution that introduce high risk of bias (RoB). Numerous statisticians have shown that NHST with $p<0.05$ is a highly unreliable approach to identify new phenomena, and some journal editors now discourage use of "p-values" or at least urge authors to accompany NHST with a more compete descriptive analysis with fuller reporting of results and methods. The talk will briefly review three recent reviews of RF bioeffects studies in which each was assessed using the same set of five RoB criteria (adequate dosimetry and temperature control, blinded design, use of sham and positive controls). Only a tiny fraction of the studies satisfied all five criteria. The studies were all quite small, typically involving comparisons of groups of 5 or fewer exposed animals. In many cases, the analysis appeared to be post-hoc, without prespecified hypotheses and methods of analyzing data. A majority of the studies reported statistically significant effects of some sort or other, over very wide ranges of exposure and frequency. The present authors suggest that the quality of such studies could be improved considerably by improved study design and better reporting of results, at modest cost. The present authors suggest a "carrot and a stick" approach to improving the quality of RF bioeffects papers: adequate support for high-quality RF exposure and dosimetry by funding agencies, and risk of bias assessments of papers submitted to journals and being considered for systematic review by health agencies.

[i] Ioannidis JP. Why most published research findings are false. PLoS Med. 2: e124, 2005.

[ii] Fidler, Fiona and John Wilcox, "Reproducibility of Scientific Results", The Stanford Encyclopedia of

Philosophy (Winter 2018 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/win2018/entries/scientific-reproducibility/>.

Lunch
Thursday September 30, 2021 • 13:15 - 14:30

Session: M4
Merger Announcement
Thursday September 30, 2021 • 14:00 - 14:30
Einstein

Session: W4
Workshop 4 - Sensitivity to EMF: The Present and The Future
Thursday September 30, 2021 • 14:30 - 16:00
Einstein
Chairs: Dariusz Leszczynski & Maryse Ledent

W4-1 [14:30]

Workshop Introduction

Dariusz Leszczynski[1]

[1]*University of Helsinki, Helsinki, Finland*

The ongoing deployment of 5G wireless communications together with the expansion of the internet social media has led to galvanization of the anti-5G activist movement. Activists are concerned that their health will be affected by the radiation emitted by the 5G networks where base stations will be densely distributed and in close proximity to dwellings and placer of work. Currently available research, predominantly based on psychological provocation studies, does not provide sufficiently reliable evidence of the lack of causality link between health and exposures to EMF.

The proposed EHS workshop will address a number of unresolved questions concerning the EHS:

How certain we are that EHS exists?

What could be the mechanism of how EHS develops in population?

What role in developing EHS plays the density of EMF emitters and what chemical polluters?

Are current ICNIRP safety guidelines sufficient to protect persons with self-declared EHS?

How reliable and how useful, for setting health policies, is the to-date published EHS research?

What additional impact may have 5G on EHS, or will it remain the same as with 3G and 4G?

What new research should be done to get more insight into EHS physiology and psychology?

W4-2 [14:35]

Hypersensitivity and vulnerable populations in environmental epidemiology

Martin Röösli[1, 2]

[1]*Swiss Tropical and Public Health Institute, Basel, Switzerland*

[2]*University of Basel, Basel, Switzerland*

Individuals are reacting to environmental stressors differently owned to various factors such as genetic predisposition, metabolism, co-exposures, socioeconomic status, health literacy etc. In public health,

protection of vulnerable populations has received substantial attention in the last few decades. On the top of this natural variation, the existence of so-called hypersensitivity phenomenon has been suggested for various environmental exposures such as chemicals, noise or electromagnetic fields. The basic idea behind is that affected individuals react to substantially lower exposure levels outside the typical variation in the population, similar to individuals with an allergy. Implications for research and therapy are discussed.

W4-3 [15:00]
Young Scientist

How did EHS became a public issue? The case of France

Maël Dieudonné[1]

[1]*Departement of Public Health, University Hospital of Lyon, Lyon, France, 69003*

EHS is characterized by the attribution of symptoms to EMF exposure, which has proven impossible to corroborate and is biologically implausible. How can EHS persons identify as such nonetheless? This question was already addressed at the individual level. It is tackled here at a collective level, by studying how EHS spread and eventually became a public problem in France, using qualitative data consisting in interviews with various stakeholders and a corpus of documents. Results show that EHS emerged as a spin-off from a larger controversy around cell sites, making it easier for people with unexplained symptoms to self-diagnose as EHS, then to fight for the recognition of their condition. Implications of this account are discussed.

W4-4 [15:25]

An urgent necessity for overhaul of electromagnetic hyper-sensitivity (EHS) research

Dariusz Leszczynski[1]

[1]*University of Helsinki, Helsinki, Finland*

Part of the population considers themselves as sensitive to the man-made electromagnetic radiation (EMF). Sensitivity is characterized by a broad variety of non-specific symptoms. While symptoms are currently considered as a real life impairment, the factor causing them remains unclear. The to-date published scientific studies are of insufficient methodology to reliably examine the cause of sensitivity to EMF. There is a need for a new research direction by combining psychological provocation with physiological biochemistry approach. I will present inadequacies of the past research and propose direction for the new sensitivity research.

W4-5 [15:45]

Discussion

Coffee Break
Thursday September 30, 2021 • 16:00 - 16:30

Student Award
Thursday September 30, 2021 • 16:30 - 17:00
Einstein

Young Scientist Award
Thursday September 30, 2021 • 17:00 - 17:15
Einstein

Closing session
Thursday September 30, 2021 • 17:15 - 17:45
Einstein

Session: FS
Student Flash Poster Session
Monday September 27, 2021 • 14:00 - 15:00
Einstein
Chairs: Florence Poulletier De Gannes & Martin Röösli

FS-1 [14:00]
STUDENT PAPER

Use of a detailed anatomical model in electrochemotherapy applied to spinal metastasis

Federico Rossano[1], Micol Colella[1], Alessandra Paffi[1], Roberta Fusco[2], Francesca Apollonio[1], Matteo Cadossi[2] & Micaela Liberti[1]

[1]*Department of Information Engineering, Electronics and Telecommunications (DIET), University of Rome "La Sapienza", Rome, Italy, 00184*

[2]*IGEA Biophysics Laboratory, Carpi, Italy, 41012*

Keywords: Electroporation, Pulsed, Work in Progress
Presented by: Federico Rossano

Electrochemotherapy (ECT) combines the principle of electroporation with chemotherapy drug in order to treat localized tumors by using a single administration of the chemotherapeutic drug. This study proposes the numerical evaluation of the treatment of a spinal metastasis in the T12 vertebra in a detailed anatomical model (Duke), using four needle electrodes inserted within the tumor, through the vertebra pedicles, as performed in spinal surgery.

FS-2 [14:03]
STUDENT PAPER

Basic study on non-thermal effects in electro-sterilization using 500kHz burst current for *Streptococcus mutans*

Futa Okido[1], Masatake Akutagawa[1], Hiromichi Yumoto[2], Takahiro Emoto[1], Hiroo Tarao[3], Toshihiko Tominaga[4], Kouji Hirao[2], Toshitaka Ikehara[5], Emiko Yasuno[6] & Yohsuke Kinouchi[1]

[1]*electrical and Electronic Engineering, Tokushima, Japan, 770-8506*

[2]*Periodontology and Endodontology, Tokushima, Japan, 770-0042*

[3]*Electrical & Computer Eng., Takamatsu, Japan, 761-8058*

[4]*Tominaga Dental Clinic, Naruto, Japan, 771-0360*

[5]*Institute for Health Sciences, Tokushima, Japan, 770-8514*

[6]*Department of Creative Technology, Anan, Japan, 774-0017*

Keywords: In vitro, IF, Work in Progress
Presented by: Futa Okido

The major current treatment of the apical periodontitis had been cleaning of the root canal with chemicals and specialized equipment. Recently electro-magnetic apical treatment called EMAT have been proposed. However, optimal conditions and sterilization mechanisms in treatment have not been clarified sufficiently. In this study, comparative experiment was carried out by both heat sterilization(hs) and electro-sterilization(es) to examine non-thermal effect by electro-sterilization. As results of experiments, it was not observed that electro-magnetic stimulation promote sterilization effect by non-thermal effect.

FS-3 [14:07]
STUDENT PAPER

Effect of gyrus folding angle on peak electric field in cerebral cortex

Lorette Quéguiner[1], Gabriel Gaugain[1], Julien Modolo[2] & Denys Nikolayev[1]

[1]*IETR (Institut d'Électronique et des Technologies du numéRique) UMR 6164, CNRS, Rennes, France, 35000*

[2]*LTSI (Laboratoire de Traitement du Signal et de l'Image) U1099, INSERM, Rennes, France, 35000*

Keywords: Dosimetry (computational), All Frequencies, Completed (unpublished)

Presented by: Lorette Quéguiner

Reported transcranial current stimulation (tCS) effects on cerebral activity leave numerous questions open regarding the involved mechanisms of action. A number of studies have identified clear physiological effects, however it remains to be understood how to take into account interindividual variability to tCS: For example, to what extent does individual brain geometry, such as cerebral tissues morphology, impact this prediction? Here, we aimed at evaluating how the geometry of cortical tissue surfaces impacts the charge distribution and therefore the electric fields induced by tCS.

FS-4 [14:10]
STUDENT PAPER

Sensitivity study of tumor and tissue properties on electroporation-based treatments in oncology

Prashanth Lakshmi Narasimhan[1, 2], Zoi Tokoutsi[1], Davide Baroli[3], Marco Baragona[1], Karen Veroy[2] & Ralph Maessen[1]

[1]*Philips Research, Eindhoven, the Netherlands, 5656 AE*

[2]*Centre for Analysis, Scientific computing, and Applications, Eindhoven University of Technology, Eindhoven, the Netherlands, 5612 AZ*

[3]*Aachen Institute for Advanced Study in Computational Engineering Science, RWTH Aachen University, Aachen, Germany, 52062*

Keywords: Electroporation, Static, Work in Progress

Presented by: Prashanth LakshmiNarasimhan

This work talks about a global sensitivity analysis for Electroporation-based cancer treatments (EBTs). The various treatment parameters (like the relative tumor positions w.r.t electrodes and the tissue properties) in EBT are commonly associated with uncertainties and these can influence the outcome in treatment planning. One approach to screen the significance of the parameters on the treatment outcome is a one-step-at-a-time method called Morris analysis. The results estimate the relative significance of the parameters for different treatment outcomes. This study can be a foundation towards incorporating uncertainties in the treatment planning strategies.

FS-5 [14:14]
STUDENT PAPER

Age-dependent SAR assessment based on the accuracy of tissue mass density values

Fatima Alzaabi[1], Yasir Alfadhl[1], Xiaodong Chen[1] & Azadeh Peyman[2]

[1]*Antennas & Electromagnetics Research Group, Queen Mary University of London, London, United Kingdom*

[2]*Radiation Dosimetry Department, Public Health England, Didcot, Oxfordshire, United Kingdom*

Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress

Presented by: Fatima Alzaabi

This paper evaluates potential effects of age-dependent properties related to tissue mass density on SAR values within a child model. Exposure scenariosplane waves at two frequency points of 868 MHz and 2450 MHz were considered to evaluate SAR changes (peak SAR and WBSAR) using the volume tissue average (10 g). Preliminary results show that certain percentage variation in the mass density as a function of age has

a direct effect on the calculated SAR and WBSAR figures. Further work involves realistic and accurate evaluation of age-dependant tissue mass densities, along other model dimensions and dielectric properties to increase the confidence in the computed SAR values.

FS-6 [14:17]
STUDENT PAPER

Design of a low-cost modular 5G RF-EMF exposure sensor

Kenneth Deprez[1], Sam Aerts[1], Arno Thielens[1], Gunter Vermeeren[1], Luc Martens[1] & Wout Joseph[1]

[1]*Department of Information Technology, Ghent University/IMEC, Ghent, Belgium, 9052*
Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Kenneth Deprez

Spatio-temporal radiofrequency (RF) electromagnetic field (EMF) exposure assessment is currently of great interest as concerns about RF-EMF exposure of the public and governmental bodies arise. To perform long-term spatio-temporal EMF exposure assessment in current and future telecommunications networks, low-cost RF-EMF exposure sensors have been designed to measure up to four frequency bands, which are determined based on the project and/or environment specifications, that are used by current telecom technologies (2G up to 4G) and in the upcoming 5G New Radio (NR) networks. Sufficiently high sampling rates for the targeted application are feasible and thus highly detailed temporal exposure assessment over a long period is possible.

FS-7 [14:21]
STUDENT PAPER

Challenges in four-electrode probe measurement – Data acquisition system and probe hardware for low frequency dielectric spectroscopy

Cindy Karina[1], Nishtha Chopra[2], Myles Capstick[1], Azadeh Peyman[2], Sina Hashemizadeh[1] & Niels Kuster[1, 3]

[1]*IT'IS Foundation, Zürich, Switzerland*

[2]*Radiation Dosimetry, Public Health England, London, United Kingdom*

[3]*Departments of Information Technology and Electrical Engineering, ETH Zürich, Zürich, Switzerland*
Keywords: Electrochemistry, ELF/LF, Work in Progress
Presented by: Cindy Karina

This paper presents experimental evaluation of dielectric properties using a four-electrode probe and a commercial impedance analyser in measuring high loss samples at frequencies < 1MHz. The study also attempts to overcome the electrode polarisation effect using equivalent circuit modelling. Finally, feasibility of a probe with embedded electronic circuits is studied as an approach to eliminate the need for commercial impedance analysers and to minimize stray capacitance and electrode polarization effects at extremely low frequencies.

FS-8 [14:24]
STUDENT PAPER

Study protocol to continuously monitor extremely low-frequency and radiofrequency electromagnetic fields exposure in Switzerland: the SwissNIS project

Nicolas Loizeau[1, 2], Marco Zahner[3, 4], Jürg Fröhlich[3, 4], Erik Bühlmann[5], Christa Stephan[5], Markus Gugler[6], Marloes Eeftens[1, 2], Stefan Dongus[1, 2], Alexander Reichenbach[7], Sebastian Egger[7], Toni Ziegler[5] & Martin Röösli[1, 2]

[1]*Department of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Basel,*

Switzerland, 4051

[2]*University of Basel, Basel, Switzerland, 4051*

[3]*Fields at Work GmbH, Zürich, Switzerland, 8032*

[4]*Institute of Electromagnetic Fields (IEF), ETH Zürich, Zürich, Switzerland, 8092*

[5]*Grolimund + Partner AG Environmental Engineering, Bern, Switzerland, 3006*

[6]*NED-TECH AG, Wangen an der Aare, Switzerland, 3380*

[7]*Federal Office for the Environment (FOEN), Swiss Confederation, Bern, Switzerland, 3003*
Keywords: Epidemiology, RF/Microwaves, Concept
Presented by: Nicolas Loizeau

Exposure to electromagnetic fields (EMF) is continuously changing in our daily environment due to the constant development of technology. The Federal Office for the Environment (FOEN) has commissioned the SwissNIS consortium to assess the extremely low frequency magnetic fields (ELF-MF) and radiofrequency (RF) EMF exposure of the Swiss population in their everyday life from 2021 to 2025. The SwissNIS study protocol describes yearly mobile microenvironmental measurements, home visits and continuous fixed site measurements in Switzerland. Yearly spatial and temporal trends of ELF-MF and RF-EMF exposure will be evaluated during the course of the project.

FS-9 [14:28]
STUDENT PAPER

Model based conception of microelectrodes for High Frequency Oscillations Recording and Detection

Gautier Dauly[1], Gabriel Dieuset[1], Seyedeh-Hajar Mousavi[2], Esma Ismailova[2], Pascal Benquet[1], Fabrice Wendling[1] & Mariam Al-harrach[1]

[1]*LTSI U1099, F-35000, INSERM, Rennes, France, 35042*

[2]*Bioelectronics, CMP-EMSE, MOC, Gardanne, France, 13541*
Keywords: Mechanistic/Theoretical, All Frequencies, Work in Progress
Presented by: Gautier Dauly

High Frequency Oscillations (HFO, 40-600 Hz) and particularly Fast Ripples (FR, 200-600 Hz) are short transient events that appear on intracerebral EEG. They are considered as a rieliable biomarker of the Epileptogenic Zone. Microelectrodes used for FRs recording posses a high impedance which leads to attenuation and distortion in the signals. This paper presents a model-guided approach in the conception of microelectrodes optimized for the recording of FRs. In particular, the coating the metal microelectrodes with a conducting polymer such as poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS).

FS-10 [14:31]
STUDENT PAPER

The numerical approach for the validation of a risk assessment under low-frequency electric field exposures

Mengxi Zhou[1], Julien Claudel[1], Djilali Kourtiche[1], Isabelle Magne[2], Martine Souques[2] & François Deschamps[3]

[1]*Département Nanomatériaux, électronique et Vivant, Institut Jean Lamour (UMR 7198), Université de Lorraine - CNRS, Nancy, France, 54000*

[2]*Service des Etudes Médicales, EDF, Paris, France, 75017*

[3]*Département Concertation et Environnement, RTE, Paris-La Défense, France, 92400*
Keywords: Dosimetry (computational), ELF/LF, Work in Progress
Presented by: Mengxi Zhou

The risk of the cardiac implant wearers under occupational exposures to the electromagnetic fields has been highlighted by the 2013/35/EU European Directive. We proposed in this study the numerical approach to validate a risk assessment under low-frequency electric field exposures. The human models and the phantom for in vitro experiments were studied by using numerical simulations to determine the relation between induced current density and the external electric field. The exposure system is modeled in order to reproduce induced phenomena on a cardiac implant inside a human body under electric field exposures. The results give references for the future experimental measurements.

FS-11 [14:35]
STUDENT PAPER

Numerical assessment of the exposure to Transcranial Magnetic Stimulation coil: male and female anatomical model comparison

Simona D'Agostino[1, 2], Micol Colella[1], Micaela Liberti[1], Rosaria Falsaperla[2] & Francesca Apollonio[1]

[1]*Department of Information Engineering, Electronics and Telecommunications, Rome, Italy, 00184*

[2]*Department of Occupational and Environmental Medicine, Epidemiology and Hygiene,, INAIL, Monte Porzio Catone, Italy, 00078*

Keywords: Dosimetry (computational), ELF/LF, Work in Progress
Presented by: Simona D'Agostino

The purpose of this work is to carry out a comparative evaluation of the electromagnetic assessment between male and female human anatomical models representing medical staff during transcranial magnetic stimulation (TMS) treatment, by means of numerical dosimetry. Electromagnetic exposure is evaluated using discretized realistic human body models and considering as a source a TMS circular coil. The results of the induced electric field in the human models show that in some cases the exposure limits are exceeded, but also show that the exposure assessment seems to depend on operator's gender. This study could be a useful starting point for future risk assessment studies and for providing general safety guidance.

FS-12 [14:38]
STUDENT PAPER

Super high frequency (18 GHz) electromagnetic field effects on *Bacillus subtilis* spores

Erim Kosyer[1], Palalle G. Tharushi Perera[1], Denver Linklater[1], Rodney Croft[2, 3] & Elena P. Ivanova[1, 2]

[1]*Physics, RMIT University, Melbourne, Australia, 3001*

[2]*Australian Centre for Electromagnetic Bioeffects Research, Wollongong, Australia*

[3]*University of Wollongong, Wollongong, Australia*

Keywords: Mechanistic/Theoretical, RF/Microwaves, Work in Progress
Presented by: Erim Kosyer

As wireless technologies are constantly developing and taking leaps into the future, so do the number of electromagnetic fields (EMF) we are exposed to emitted from these devices. These EMFs range in wavelengths from a single biomolecule to whole organisms. It is understood the thermal mechanisms of interaction are responsible for possible negative effects associated with EMFs. Furthermore, there is currently no evidence surrounding non-thermal mechanisms and its possible contribution to these negative effects. Due to this gap in understanding, it brings forth a possible query that may have important ramifications for current guidelines and standards. Consequently, this issue requires further exploration.

FS-13 [14:42]
STUDENT PAPER

Collocated and distributed Massive MIMO from the human EMF exposure perspective: a comparative

study

Sergei Shikhantsov[1], Arno Thielens[1], Gunter Vermeeren[1], Emmeric Tanghe[1], Piet Demeester[1], Luc Martens[1] & Wout Joseph[1]

[1]*Department of Information Technology, Ghent University/IMEC, Ghent, Belgium, 9000*

Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)

Presented by: Sergei Shikhantsov

In this numerical study we compare two deployment strategies of massive MIMO from human exposure perspective. Propagation is modelled using the Ray-Tracing method at 3.5 GHz in a stochastic environment model. An indoor industrial environment is modelled as a square room and scatterers randomly distributed in it. Two base station (BS) configurations are studied: a compact antenna array and an array evenly covering the floorplan ceiling. The exposure is assessed in terms of the psSAR the head normalized to the power density, using the FDTD method. The exposure of the distributed BS is found to be at least two times lower than that of the collocated BS. Implications for the exposure of practical massive MIMO implementations are discussed.

FS-14 [14:45]
STUDENT PAPER

A grid electrode for *in-vitro* studies under stimulation of nanosecond electric pulses

Wen Dang[1], Xin Rao[2], Xiaodong Chen[1, 2] & Yasir Alfadhl[1]

[1]*School of Electronic Engineering and Computer Science, Queen Mary University of London, London, United Kingdom, E1 4NS*

[2]*Circuits and Systems Key Laboratory of the Ministry of Education, Hangzhou Dianzi University, HangZhou, China, 310018*

Keywords: In vitro, Pulsed, Work in Progress

Presented by: Wen Dang

Intensive nanosecond pulsed electrical fields (nsPEF) have been applied to induce a range of biological effects for the therapeutic purpose. High voltage nanosecond pulses are usually applied across a narrow metal plate cuvette in in-vitro studies. However, due to a high conductivity of the cell load culture, the resistance tends to be as low as a few tens of Ohms if a large volume of the cell samples is loaded. The low cell load resistance will result in a large current flow- posing a technical challenge to the pulse generator and also distort the pulses. In this paper, the grid electrode is proposed to increase the cell load resistance and reduce the parasitic capacitance, which exhibits an improved performance based on EM simulation.

FS-15 [14:49]
STUDENT PAPER

Electromagnetic characterization of PEMFs for the neuroprotective treatment of ischemic strokes in semi-specific models: a comparison between an active and a placebo patient

Sara Fontana[1], Micol Colella[1], Simona Salati[2], Stefania Setti[2], Francesca Apollonio[1], Ruggero Cadossi[2] & Micaela Liberti[1]

[1]*Department of Information Engineering, Electronics and Telecommunications (DIET), University of Rome "La Sapienza", Rome, Italy, 00184*

[2]*IGEA Biophysics Laboratory, Carpi, Italy, 41012*

Keywords: Dosimetry (computational), ELF/LF, Work in Progress

Presented by: Sara Fontana

The application of low intensity and low frequency pulsed electro-magnetic fields (LF-PEMFs) may represent a neuroprotective approach for the treatment of cerebral damages in patients affected by acute ischemic

stroke. An ongoing randomized, placebo-controlled, double-blind study aims to validate the PEMFs as a non-invasive, effective, tolerable, and safe treatment, as an adjunctive treatment to drug therapies already in use. This work proposes a dosimetric study on semi-specific models of a placebo and an active patient, to preliminary confirm the possible correlation between the evolution of ischemic lesion and the magnetic field values, as observed in active patients.

FS-16 [14:52]
STUDENT PAPER

Influence of the 4G/5G dynamic spectrum sharing on human RF exposure to mobile radio services

Lisa-Marie Schilling[1], Christian Bornkessel[1] & Matthias Hein[1]

[1]*RF & Microwave Research Laboratory, Thuringian Center of Innovation in Mobility, TU Ilmenau, Ilmenau, Germany*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Lisa-Marie Schilling

The gradual shutdown of the 3G mobile radio network in Germany releases spectral resources in the 2100 MHz band which can be used for successor technologies such as 4G and 5G. Since mid of 2020, dynamic spectrum sharing (DSS) has been increasingly used to enable parallel operation of 4G and 5G in one and the same frequency band. There is an increasing need of information with regard to a possible change in exposure associated with DSS. Therefore, investigations were carried out to study the exposure across the 2100 MHz band in scenarios with and without DSS. Overall, the maximum exposure has not changed due to 4G/5G DSS. The instantaneous exposure has remained comparable or even slightly decreased compared to the previous status.

FS-17 [14:55]
STUDENT PAPER

Computational analysis for non-invasive acquisition of craniospinal compliance

Fariba Karimi[1, 2], Esra Neufeld[1, 2], Arya Fallahi[1, 2], Andreas Spiegelberg[3], Andrea Boraschi[3], Vartan Kurtcuoglu[3] & Niels Kuster[1, 2]

[1]*Foundation for Research on Information Technologies in Society (IT'IS), Zurich, Switzerland*

[2]*Department of Information Technology and Electrical Engineering, Swiss Federal Institute of Technology (ETH Zurich), Zurich, Switzerland*

[3]*The Interface Group, Institute of Physiology, University of Zurich, Zurich, Switzerland*

Keywords: Clinical (diagnostics), Static, Work in Progress
Presented by: Fariba Karimi

Diagnosis, treatment, and monitoring of patients suffering from craniospinal diseases requires the measurement of intracranial pressure (ICP). Several measurement methods have been developed, but currently only invasive techniques are sufficiently reliable to be clinically accepted. As brain geometry and dielectric properties are transiently modulated by blood and cerebrospinal fluid exchange between cranial and spinal compartments, impedance measurements may be used to monitor ICP non-invasively. In this paper, we present a numerically robust and computationally efficient method for simulating pulsation-related impedance changes of the head. The approach was verified in (semi-)analytic benchmarks and applied to real data from volunteers.

Session: PS
Poster Session
Monday September 27, 2021 • 15:00 - 16:30
Flex Meet

PS-1 [15:00]

Exposure assessment of extremely low frequency magnetic fields in residential buildings within a South African urban area

France Raphela[1]

[1]*Department of Clinical Sciences, Central University of Technology, Free State, Bloemfontein, South Africa, 9300*

Keywords: Dosimetry (measurements), ELF/LF, Completed (unpublished)
Presented by: France Raphela

A study was conducted to determine the indoor and outdoor exposure levels of ELF magnetic fields in a community living in an urban area of South Africa. The mean values of exposure levels from different sources of ELF magnetic fields were calculated and the mean indoor magnetic field exposure level was 0.62 μT with the highest peak exposure level of 1.5 μT.

PS-2 [15:00]

Stochastic dosimetry for the assessment of human exposure to a 3D beamforming antenna in 5G indoor scenarios

Marta Bonato[1, 2], Laura Dossi[1], Emma Chiaramello[1], Martina Benini[1, 2], Silvia Gallucci[1, 2], Serena Fiocchi[1], Gabriella Tognola[1] & Marta Parazzini[1]

[1]*Institute of Electronics, Computer and Telecommunication Engineering (IEIIT), National Research Council (CNR), Milan, Italy, 20133*

[2]*Dipartimento di Elettronica, Informazione e Bioingegneria (DEIB), Politecnico di Milano, Milan, Italy, 20133*

Keywords: Dosimetry (computational), RF/Microwaves, Completed (published)
Presented by: Marta Bonato

The present work was performed to expand the knowledge on human RF-EMF exposure, considering the increase in variability and heterogeneity in realistic scenarios, due to the deployment of 5thgeneration networks. The focus was on a specific case of indoor scenario, where the presence of a 5G Access Point with 3D beamforming capability was simulated. The exposure levels, expressed in terms of specific absorption rate, were evaluated for a child model, coupling the traditional deterministic method with an innovative stochastic approach, called Polynomial Chaos Kriging. The results showed low exposure values compared to ICNIRP guidelines and highlighted a high exposure scenario variability, depending on the beamforming patterns of the 5G AP.

PS-3 [15:00]

Dosimetry of an intra-neural electrode for vagus nerve stimulation in electroceutical-based applications

Matteo del Brocco[1], Martina Failla[2], Vittoria Flamini[3], Guglielmo d'Inzeo[4], Silvia Bossi[2] & Caterina Merla[1]

[1]*Department of Sustainability, Italian National Agency for Energy and New Technologies , Rome, Italy, 00123*

[2]*Department of Energetic Technologies and Renewable Sources, Italian National Agency for Energy and New Technologies , Rome, Italy, 00123*

[3]*Tandon School of Engineering, New York University, New York, USA*

[4]*Department of Information Engineering, Electronics and Telecommunications, Sapienza University of Rome, Rome, Italy, 00184*
Keywords: Dosimetry (computational), IF, Work in Progress
Presented by: Caterina Merla

In this work the design and the dosimetry of an intra-neural electrode for vagus nerve stimulation have been carried out. The assessment of the induced electric field and current densities are required to establish minimal stimulating currents to proceed with in vivo experiments and to evaluate the nerve stimulation selectivity. Our dosimetry is a preliminary setting to move towards in vivo experiments with a controlled and optimized levels of stimulating signals. It provides information concerning the electrodes selectivity and the more suitable electrode configuration to achieve such a goal.

PS-4 [15:00]
STUDENT PAPER

Use of a detailed anatomical model in electrochemotherapy applied to spinal metastasis

Federico Rossano[1], Micol Colella[1], Alessandra Paffi[1], Roberta Fusco[2], Francesca Apollonio[1], Matteo Cadossi[2] & Micaela Liberti[1]

[1]*Department of Information Engineering, Electronics and Telecommunications (DIET), University of Rome "La Sapienza", Rome, Italy, 00184*

[2]*IGEA Biophysics Laboratory, Carpi, Italy, 41012*
Keywords: Electroporation, Pulsed, Work in Progress
Presented by: Federico Rossano

Electrochemotherapy (ECT) combines the principle of electroporation with chemotherapy drug in order to treat localized tumors by using a single administration of the chemotherapeutic drug. This study proposes the numerical evaluation of the treatment of a spinal metastasis in the T12 vertebra in a detailed anatomical model (Duke), using four needle electrodes inserted within the tumor, through the vertebra pedicles, as performed in spinal surgery.

PS-5 [15:00]
STUDENT PAPER

Basic study on non-thermal effects in electro-sterilization using 500kHz burst current for *Streptococcus mutans*

Futa Okido[1], Masatake Akutagawa[1], Hiromichi Yumoto[2], Takahiro Emoto[1], Hiroo Tarao[3], Toshihiko Tominaga[4], Kouji Hirao[2], Toshitaka Ikehara[5], Emiko Yasuno[6] & Yohsuke Kinouchi[1]

[1]*electrical and Electronic Engineering, Tokushima, Japan, 770-8506*

[2]*Periodontology and Endodontology, Tokushima, Japan, 770-0042*

[3]*Electrical & Computer Eng., Takamatsu, Japan, 761-8058*

[4]*Tominaga Dental Clinic, Naruto, Japan, 771-0360*

[5]*Institute for Health Sciences, Tokushima, Japan, 770-8514*

[6]*Department of Creative Technology, Anan, Japan, 774-0017*
Keywords: In vitro, IF, Work in Progress
Presented by: Futa Okido

The major current treatment of the apical periodontitis had been cleaning of the root canal with chemicals and specialized equipment. Recently electro-magnetic apical treatment called EMAT have been proposed. However, optimal conditions and sterilization mechanisms in treatment have not been clarified sufficiently. In this study, comparative experiment was carried out by both heat sterilization(hs) and electro-sterilization(es) to examine non-thermal effect by electro-sterilization. As results of experiments, it was not observed that

electro-magnetic stimulation promote sterilization effect by non-thermal effect.

PS-6 [15:00]

Effects of moderate intensity magnetic field and magnetic force on the proliferation of bone cells

Sachiko Yamaguchi-Sekino[1] & Masaki Sekino[2]

[1]*National Institute of Occupational Safety and Health, Japan, Kawasaki, Japan, 2148585*

[2]*Department of Bioengineering, Graduate School of Engineering, University of Tokyo, Tokyo, Japan, 138656*

Keywords: In vitro, Static, Work in Progress

Presented by: Sachiko Yamaguchi-Sekino

The present study focuses on the effects of moderate intensity (34–273 mT) magnetic field and magnetic force on the proliferation of bone cells. A samarium cobalt (SmCo) magnet (Hitachi Metals Ltd., Japan) was placed inside a non-magnetized CO_2 incubator. The exposure level of static magnetic field on the 96 well plate was 34–273 mT (Average: 177 ± 82 mT) and the magnetic force was 0.06–4.14 T^2/m (Average: 1.84 ± 1.28 T^2/m). Exposure to moderate SMF intensity promotes the proliferation of the MC3T3 cells although correlation between exposure parameters has not been observed.

PS-7 [15:00]

Characterization of exposure scenarios generated in novel and emerging vehicle technologies

Gabriella Tognola[1], Barbara Masini[1], Marta Bonato[1], Emma Chiaramello[1], Silvia Gallucci[1], Serena Fiocchi[1], Marta Parazzini[1] & Paolo Ravazzani[1]

[1]*IEIIT - Institute of Electronics, Information Engineering and Telecommunications, CNR - Italian National Research Council, Sites of Milan and Bologna, Italy, 20133*

Keywords: Dosimetry (computational), RF/Microwaves, Review, Commentary, Recommendation, Evaluation

Presented by: Gabriella Tognola

The paper extensively reviews all the existing and forthcoming exposure scenarios generated by radio-frequencies (RF) used by the novel technologies in smart vehicular applications, driving assistance systems, and intelligent transport system, including IoT devices for monitoring road infrastructures and the novel application of 5G in autonomous vehicles. For each scenario, we provide a quantitative description and comparison of the features relevant to the exposure of people inside and outside the car, including a description of the current standards/recommendations on radiated fields set by the manufacturers of such technologies. We also review the outcomes of current researches on the assessment of the dose of exposure in such scenarios.

PS-8 [15:00]

Empirical studies on the link between environmental extremely low frequency magnetic fields and Alzheimer's disease

Anu J. Liimatainen[1, 2], Kajal Kumari[1], Henna Sarja[1], Muhammad Waseem Khan[1], Päivi Roivainen[1, 3], Sarka Lehtonen[4, 5], Jari Koistinaho[4, 5], Anne Höytö[2] & Jonne Naarala[1]

[1]*Department of Environmental and Biological Sciences, University of Eastern Finland, Kuopio, Finland, 70211*

[2]*Radiation Practices Regulation, Radiation and Nuclear Safety Authority, Helsinki, Finland, 00880*

[3]*Environmental Radiation Surveillance, Radiation and Nuclear Safety Authority, Helsinki, Finland, 00880*

[4]*A.I.Virtanen Institute for Molecular Sciences, University of Eastern Finland, Kuopio, Finland, 70211*

[5]*Neuroscience Center, University of Helsinki, Helsinki, Finland, 00014*

Keywords: In vitro, ELF/LF, Work in Progress
Presented by: Anu J Liimatainen

In this project, we will assess possible causality of the link between Alzheimer's disease (AD) and environmental extremely low frequency magnetic fields (ELF MF). In addition, we will study whether residential ELF MF exposure increases the incidence of AD. This study consists of in vitro, in vivo and epidemiological approaches.

PS-9 [15:00]
STUDENT PAPER

Effect of gyrus folding angle on peak electric field in cerebral cortex

Lorette Quéguiner[1], Gabriel Gaugain[1], Julien Modolo[2] & Denys Nikolayev[1]

[1]*IETR (Institut d'Électronique et des Technologies du numéRique) UMR 6164, CNRS, Rennes, France, 35000*

[2]*LTSI (Laboratoire de Traitement du Signal et de l'Image) U1099, INSERM, Rennes, France, 35000*
Keywords: Dosimetry (computational), All Frequencies, Completed (unpublished)
Presented by: Lorette Quéguiner

Reported transcranial current stimulation (tCS) effects on cerebral activity leave numerous questions open regarding the involved mechanisms of action. A number of studies have identified clear physiological effects, however it remains to be understood how to take into account interindividual variability to tCS: For example, to what extent does individual brain geometry, such as cerebral tissues morphology, impact this prediction? Here, we aimed at evaluating how the geometry of cortical tissue surfaces impacts the charge distribution and therefore the electric fields induced by tCS.

PS-10 [15:00]

A measurement procedure for magnetic field exposure assessment in electric vehicles: first results in actual exposure scenarios

Rosanna Pinto[1], Germana Trentadue[2], Marco Zanni[2] & Giorgio Martini[2]

[1]*Department of Sustainability, ENEA, Rome, Italy, 00123*

[2]*European Commission, Joint Research Centre (JRC), Ispra, Italy, 21027*
Keywords: Dosimetry (measurements), ELF/LF, Completed (published)
Presented by: Rosanna Pinto

Electric vehicles (EV) represent a very particular exposure scenario where the general public and power devices share a common space. In fact, electric motors, battery power converters, cables connecting all these parts and specific equipment generate stray magnetic fields (MF) and in the cables hundreds of amperes can be reached. All the mentioned sources operate in a widespread frequency range, from 0 Hz to some kHz, making the EVs very complex exposure scenarios. In this paper a measurement procedure for MF exposure assessment in electric vehicles is explored and preliminary results of its application on two electric vehicles are shown.

PS-11 [15:00]
Young Scientist

Hepatocellular carcinoma-specific AM RF EMF inhibition of tumor proliferation is not mediated by apoptosis

Hugo Jimenez[1, 2], Callum Mcgrath[1, 2], Preeya Achari[1, 2], Alexandre Barbault[3], Carl Blackman[1, 2] & Boris Pasche[1, 2]

[1]*Department of Cancer Biology, Wake Forest Baptist Medical Center, Winston-Salem, North Carolina, USA, 27157*

[2]*Comprehensive Cancer Center, Wake Forest Baptist Medical Center, Winston-Salem, North Carolina, USA, 27157*

[3]*TheraBionic GmbH, Ettlingen, Germany*

Keywords: In vitro, RF/Microwaves, Work in Progress

Presented by: Hugo Jimenez

We have shown that 27.12 MHz amplitude modulated (AM) electromagnetic fields (EMF) inhibit proliferation of tumor growth in patients, in tumor xenografts, and in cancer cell lines. Here we tested the hypothesis that HCC-specific AM RF EMF contributes to tumor cell growth inhibition by altering the cell cycle to hinder proliferation in a apoptosis-free manner.

PS-12 [15:00]

The effect of exposure to radiofrequency electromagnetic fields on cognitive function in human experimental studies: a protocol for a systematic review

Blanka Pophof[1], Jacob Burns[2], Heidi Danker-Hopfe[3], Hans Dorn[3], Torsten Eggert[3], Bernd Henschenmacher[1], Kateryna Fuks[1], Jens Kuhne[1], Cornelia Sauter[3] & Gernot Schmid[4]

[1]*Department effects and risks of ionizing and non-ionizing radiation, Federal Office for Radiation Protection, Oberschleißheim, Germany, 85764*

[2]*Institute for Medical Information Processing, Biometry and Epidemiology (IBE), Ludwig Maximillians University, Munich, Germany, 81377*

[3]*Competence Center for Sleep Medicine, Charité - Universitätsmedizin Berlin, Berlin, Germany, 12200*

[4]*Business Unit EMC & Optic, Seibersdorf Laboratories, Seibersdorf, Austria, A-2444*

Keywords: Human, RF/Microwaves, Work in Progress

Presented by: Blanka Pophof

The main objective of this systematic review is to evaluate the associations between the exposure to RF-EMF and cognitive function in human experimental studies.

PS-13 [15:00]

Unipolar and bipolar aerosol charging as time continuous Markov processes

Andreas Deser[1] & Jens Kuhne[1]

[1]*Effects and risks of ionizing and nonionizing radiation, Federal Office for Radiation Protection, Oberschleissheim, Germany, 85764*

Keywords: Mechanistic/Theoretical, Static, Completed (unpublished)

Presented by: Andreas Deser

Motivated by the emission of charged particles in the vicinity of high voltage transmission lines (corona ions) and potential health effects, an alternative stochastic approach to model aerosol charging is presented. We review aerosol charging using the conceptually and computationally clear language of continuous time Markov processes. A novel numeric approach is presented that can be used to calculate the time evolution of various particle charging processes. Its modular character makes it easy to implement and allows for quick adaptation to specific problems. We conclude with applications of ergodicity and the generalization to time dependent ion concentrations for bipolar and unipolar charging, respectively.

PS-14 [15:00]

Effects of reactive oxygen species induced by single wavelength LED light irradiation on cultured RAW 264.7 and HeLa S3 cells

Toshitaka Ikehara[1], Mutsumi Aihara[2], Takahiro Emoto[2], Masatake Akutagawa[2], Koichiro Tsuchiya[3], Akira Takahashi[3] & Yohsuke Kinouchi[2]

[1]*Tokushima bunri University, Kashiba, Japan, 639-0223*

[2]*Institute of Science and Technology, Tokushima University Graduate School, Tokushima, Japan, 770-8506*

[3]*Institute of Biomedical Sciences, Tokushima University Graduate School, Tokushima, Japan, 770-8504*

Keywords: In vitro, Optical, Completed (unpublished)

Presented by: Toshitaka Ikehara

We tested effects of UVA light irradiation on cultured RAW and HeLa cells. The irradiation for at least 3 hr did not affect the cell viability, but reactive oxygen species (ROS) induced in the cells was increased by the irradiation. Also, a decrease in intracellular glutathione (GSH) by addition of GSH synthetic inhibitor strongly induced the increase in intracellular ROS and lactate dehydrogenase activity in the medium compared to normal cells. The addition of histidine suppressed much of these increase in intracellular ROS. These results suggest that the intracellular GSH plays to protect cells as a physiological scavenger of intracellular ROS induced by the light irradiation.

PS-15 [15:00]

Personal exposure to RF-EMF prior to the deployment of the 5th generation of mobile telephony: map of a whole city

Sergio Martin-Castillo[1], Jesus Gonzalez-Rubio[1], Pablo Luis[2] & Alberto Nájera[1]

[1]*Medical Sciences, University of Castilla-La Mancha, Albacete, Spain, 02008*

[2]*Signal Theory and Communications, University of Alcalá de Henares, Alcalá de Henares, Spain, 28801*

Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)

Presented by: Alberto Nájera

In this work we present a whole urban area personal exposure to radiofrequency electromagnetic fields map of the city of Albacete (Spain) prior to the deployment of the 5th generation of mobile telephony. For this, an MVG Spy Evo personal exposure meter was used and 4 downlink frequency bands (DL) corresponding to previous generations (B20BL, B8DL, B3DL, B1B10DL) as well as the FM band were measured in 301 different locations. An exhaustive statistical analysis was carried out by location, frequency band, neighborhood and by carrying out krigging maps. The mean, median, 95th percentile and maximum values are presented for all neighborhoods and values for the entire city. In all cases, the exposure values were well below the ICNIRP limits.

PS-16 [15:00]

Personal exposure to radiofrequency electromagnetic fields in operating rooms during surgical operations

Ramon Peyro[1], Manuel Geronimo Pardo[2], Jesus Gonzalez-Rubio[1] & Alberto Nájera[1]

[1]*Medical Sciences, University of Castilla-La Mancha, Albacete, Spain, 02009*

[2]*Surgical Anesthesiology and Resuscitation Service, University Hospital Complex of Albacete, Albacete, Spain, 02009*

Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)

Presented by: Alberto Nájera

Personal RF-EMF exposure was measured during 18 surgical operations at the Complejo Hospitalario

Universitario de Albacete (Spain) using personal exposimeters. A description of personal exposure is provided in temporary and spatial terms. Levels of personal exposure were extremely low compared to regulatory limits.

PS-17 [15:00]

Influence of 5G UEs on frequency-selective exposure measurements on 5G massive-MIMO base stations

Anna-Malin Schiffarth[1], Thomas Kopacz[1], Sascha Schiessl[1] & Dirk Heberling[1, 2]

[1]*Institute of High Frequency Technology, RWTH Aachen University, Aachen, Germany*

[2]*Fraunhofer Institute for High Frequency Physics and Radar Techniques, Wachtberg, Germany*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress

Presented by: Anna-Malin Schiffarth

This work addresses the influence of a user equipment (UE) on exposure measurements at 5G NR base stations at full load. Based on measurements at five locations at a Huawei and an Ericsson base station, it is shown that a larger distance between the UE and an isotropic measurement probe leads to an elimination of the UE influence, but can also cause a changed exposition situation at the measurement point. Comparative measurements using directive antennas indicate that no influence of the UE occurs when using those. However, multipath propagation effects are not considered in this case due to the antenna's beamwidth and, thus, the total exposure at the measurement point can not be evaluated.

PS-18 [15:00]

The effect of radiofrequency electromagnetic fields (RF-EMF) on biomarkers of oxidative stress in vivo and in vitro: a protocol for a systematic review

Bernd Henschenmacher[1], Annette Bitsch[2], Tonia de las Heras Gala[1], Henry J. Forman[3], Athanassios Fragoulis[4], Pietro Ghezzi[5], Rupert Kellner [2], Wolfgang Koch[2], Jens Kuhne[1], Dmitrij Sachno[2], Gernot Schmid[6], Katya Tsaioun[7], Jos Verbeek[8] & Rob Wright[9]

[1]*Department "Effects and risks of ionizing and nonionizing radiation", Federal Office for Radiation Protection, Oberschleißheim, Germany, 85764*

[2]*Fraunhofer Institute for Toxicology and Experimental Medicine, Chemical Safety and Toxicology, Hannover, Germany, 30625*

[3]*Leonard Davis School of Gerontology, University of Southern California, Los Angeles, CA, USA, 90089*

[4]*Department of Anatomy and Cell Biology, Uniklinik RWTH Aachen, Aachen, Germany, 52074*

[5]*Brighton and Sussex Medical School, University of Sussex, Trafford Centre, Falmer, United Kingdom, BN1 9RY*

[6]*Seibersdorf Laboratories, Campus Seibersdorf, Falmer, Austria*

[7]*Evidence-based Toxicology Collaboration (EBTC), John Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA, 21205*

[8]*University Medical Center Amsterdam, Cochrane Work, Amsterdam, the Netherlands, 1105*

[9]*William H. Welch Medical Library, Johns Hopkins University School of Medicine, Baltimore, Maryland, USA, 21205*

Keywords: In vitro, RF/Microwaves, Review, Commentary, Recommendation, Evaluation

Presented by: Bernd Henschenmacher

Background: Oxidative stress is conjectured to be related to many diseases, and there is the hypothesis that radiofrequency fields may induce oxidative stress in various cell types and thereby compromise human and animal health. This systematic review (SR) aims to summarize and evaluate the literature in this field. Objectives: The main objective of this SR is to evaluate the associations between the exposure to

radiofrequency electromagnetic fields and oxidative stress in experimental models (in vivo and in vitro).

PS-19 [15:00]

The intense electric field acts by torque on tubulin dipoles and opens up microtubule lattice

Jiří Průša[1], Ahmed T. Ayoub[2], Djamel E. Chafai[1, 3], Daniel Havelka[1] & Michal Cifra[1]

[1]*Bioelectrodynamics, Institute of Photonics and Electronics of the Czech Academy of Sciences, Prague, Czech Republic, 18251*

[2]*Biomolecular Simulation Center, Department of Pharmaceutical Chemistry, Heliopolis University, Cairo, Egypt, 11777*

[3]*Institute of Physiology of the Czech Academy of Sciences, Prague, Czech Republic, 14220*

Keywords: Mechanistic/Theoretical, Pulsed, Completed (published)

Presented by: Michal Cifra

Microtubules (MTs) are natural protein polymer nanotube structures essential in many fundamental cell functions. Since building blocks of MTs (tubulin proteins) have exceptional electric properties, a pertinent question is how can an external electric field affect MTs structure. To address this question, we carried out an all-atom molecular dynamics simulation of a MT ring in an intense electric field. We found that a nanosecond-scale electric field acts by a torque action on tubulin dipoles which propagates to the weakest point of the MT lattice leading to its opening. We propose that intense electric field might be a tool for modification of MT lattice structure.

PS-20 [15:00]

Risk assessment of contact currents due to electric accidents during welding

Pia Schneeweiss[1], Pascal Oesterreich[2, 3], Michael Kubocz[1], Rahul Sharma[2, 3], Kai Jagielski[1] & Thomas Kraus[1]

[1]*Research Center for Bioelectromagnetic Interaction (femu), Uniklinik RWTH Aachen University, Aachen, Germany, 52074*

[2]*FEF Forschungs- und Entwicklungsgesellschaft Fuegetechnik, Aachen, Germany, 52062*

[3]*Welding and Joining Institute (ISF), RWTH Aachen University, Aachen, Germany, 52062*

Keywords: Occupational, Pulsed, Work in Progress

Presented by: Pia Schneeweiss

Electrical accidents are a daily hazard for workers in the electrical welding industry. For LF touch voltages, the resulting contact currents may trigger nerves or muscles, or even induce life-threatening ventricular fibrillation. Numerical simulations are a profound method to investigate this hazard potential without endangering humans or animals. As a continuation of our previous studies with sinusoidal signals, the here investigated voltages are pulse-shaped. These signals must be decomposed into individual sinusoidal signals with their respective frequencies and phase shifts. After simulations, the individual results for current and induced electric field are recombined to assess the total hazard of the welding power source.

PS-21 [15:00]
STUDENT PAPER

Sensitivity study of tumor and tissue properties on electroporation-based treatments in oncology

Prashanth Lakshmi Narasimhan[1, 2], Zoi Tokoutsi[1], Davide Baroli[3], Marco Baragona[1], Karen Veroy[2] & Ralph Maessen[1]

[1]*Philips Research, Eindhoven, the Netherlands, 5656 AE*

[2]*Centre for Analysis, Scientific computing, and Applications, Eindhoven University of Technology, Eindhoven,*

the Netherlands, 5612 AZ

[3]*Aachen Institute for Advanced Study in Computational Engineering Science, RWTH Aachen University, Aachen, Germany, 52062*

Keywords: Electroporation, Static, Work in Progress

Presented by: Prashanth LakshmiNarasimhan

This work talks about a global sensitivity analysis for Electroporation-based cancer treatments (EBTs). The various treatment parameters (like the relative tumor positions w.r.t electrodes and the tissue properties) in EBT are commonly associated with uncertainties and these can influence the outcome in treatment planning. One approach to screen the significance of the parameters on the treatment outcome is a one-step-at-a-time method called Morris analysis. The results estimate the relative significance of the parameters for different treatment outcomes. This study can be a foundation towards incorporating uncertainties in the treatment planning strategies.

PS-22 [15:00]

EMF exposure evaluation method for underground mobile base stations

Junji Higashiyama[1], Takahiro Iyama[1], Tomoaki Nagaoka[2] & Takashi Hikage[3]

[1]*6G Laboratories, NTT DOCOMO, INC., Yokosuka, Japan, 239-8536*

[2]*Electromagnetic Compatibility Laboratory, National Institute of Information and Communications Technology, Koganei, Japan, 184-8795*

[3]*Faculty of Information Science and Technology, Hokkaido University, Sapporo, Japan, 060-0814*

Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)

Presented by: Junji Higashiyama

This paper proposes EMF exposure evaluation method for an underground mobile base station which is installed in underground and forms a service area on the ground. First, a spatial averaging scheme assuming a relatively short person such as a child is proposed considering the feature that the EMF level from the base station becomes stronger as it is closer to the ground. Second, a spherical formula using specific correction coefficient is proposed considering the multiple reflections and transmissions due to the handhole and the underground structure around the antenna. These proposals are based on the calculated results of the EMF distributions around the base stations mainly by the FDTD numerical analysis.

PS-23 [15:00]
STUDENT PAPER

Age-dependent SAR assessment based on the accuracy of tissue mass density values

Fatima Alzaabi[1], Yasir Alfadhl[1], Xiaodong Chen[1] & Azadeh Peyman[2]

[1]*Antennas & Electromagnetics Research Group, Queen Mary University of London, London, United Kingdom*

[2]*Radiation Dosimetry Department, Public Health England, Didcot, Oxfordshire, United Kingdom*

Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress

Presented by: Fatima Alzaabi

This paper evaluates potential effects of age-dependent properties related to tissue mass density on SAR values within a child model. Exposure scenariosplane waves at two frequency points of 868 MHz and 2450 MHz were considered to evaluate SAR changes (peak SAR and WBSAR) using the volume tissue average (10 g). Preliminary results show that certain percentage variation in the mass density as a function of age has a direct effect on the calculated SAR and WBSAR figures. Further work involves realistic and accurate evaluation of age-dependant tissue mass densities, along other model dimensions and dielectric properties to increase the confidence in the computed SAR values.

PS-24 [15:00]

WITHDRAWN

PS-25 [15:00]

RISEUP: Regeneration of Injured Spinal cord by Electro pUlsed bio-hybrid imPlant

RISEUP Consortium[1, 2, 3, 4, 5, 6]

[1]*Health Division, ENEA, Rome, Italy, 00123*

[2]*Center for Biomaterials and Tissue Engineering, Polytechnic University Valencia, Rome, Spain, 46022*

[3]*RISE TECHNOLOGY , RISE TECHNOLOGY SRL, Ostia (RM), Italy, 00121*

[4]*Department of Information Engineering, Electronics and Telecommunications (DIET), University Sapienza, Rome, Italy, 00184*

[5]*Metabolic and Systemic aspects of the oncogenesis (METSY), CNRS 9018, Villejuif, France, 94800*

[6]*Neuronal and Tissue Regeneration Laboratory, Centro de Investigación Príncipe Felipe, Valencis, Spain, 46012*

Keywords: Clinical (therapy), ELF/LF, Work in Progress
Presented by: RISEUP Consortium

RISEUP is a project recently funded by a FET call in H2020. This project provides a highly innovative method for the treatment of spinal cord injuries through the combination of stem cells and stimulations with micro-pulses and direct current.

PS-26 [15:00]
STUDENT PAPER

Design of a low-cost modular 5G RF-EMF exposure sensor

Kenneth Deprez[1], Sam Aerts[1], Arno Thielens[1], Gunter Vermeeren[1], Luc Martens[1] & Wout Joseph[1]

[1]*Department of Information Technology, Ghent University/IMEC, Ghent, Belgium, 9052*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Kenneth Deprez

Spatio-temporal radiofrequency (RF) electromagnetic field (EMF) exposure assessment is currently of great interest as concerns about RF-EMF exposure of the public and governmental bodies arise. To perform long-term spatio-temporal EMF exposure assessment in current and future telecommunications networks, low-cost RF-EMF exposure sensors have been designed to measure up to four frequency bands, which are determined based on the project and/or environment specifications, that are used by current telecom technologies (2G up to 4G) and in the upcoming 5G New Radio (NR) networks. Sufficiently high sampling rates for the targeted application are feasible and thus highly detailed temporal exposure assessment over a long period is possible.

PS-27 [15:00]

MWI-GAN: Generative Adversarial Networks for microwave imaging

Haoyu Jiang[1], Congsheng Li[1] & Tongning Wu[1]

[1]*China Academy of Information and Telecommunications Technology, Beijing, China, 100191*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Haoyu Jiang

We optimized the microwave imaging technology by Generative Adversarial Networks (GAN). MWI-GAN was a faster and more efficient method than traditional iterative methods, which reduced the time consumption of

microwave imaging of biological tissues such as breasts. This method also improved the accuracy compared to traditional learning algorithms.

PS-28 [15:00]

Development of a drone-based measurement system for assessing exposure to radiofrequency electromagnetic fields

Serafeim Iakovidis[1], Alexandros Vafeiadis-Sinoglou[1], Christos Apostolidis[1], Athanasios Manassas[1] & Theodoros Samaras[1]

[1]*CIRI - Center for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki, Thermi, Greece, 57001*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Theodoros Samaras

Exposure to radiofrequency electromagnetic fields changes with height, due to the physical mechanisms of wave propagation, especially in urban environments with tall buildings. Most of the measurement campaigns performed for compliance with exposure guidelines are performed outdoors and at ground level. As a consequence, it is difficult to correlate measurement results with the actual exposure of city inhabitants, who spend most of their time indoors and, quite often, live or work on the upper floors of buildings. In this work we demonstrate the construction of a drone-based measurement system with excellent positional accuracy that can be used to characterize the electromagnetic environment at different heights above the ground.

PS-29 [15:00]

***In vitro* and *in silico* investigations on glioma cells motility using a non-contact DC field**

Laura Caramazza[1, 2], Nicolò Lauciello[1], Annalisa De Angelis[2], Daniel Remondini[3], Gastone Castellani[4], Micaela Liberti[1, 2], Francesca Apollonio[1, 2] & Isabella Zironi[3]

[1]*DIET@Sapienza University of Rome, 00184, Rome, Italy, Sapienza University of Rome, Rome, Italy, 00184*

[2]*Center for Life Nano- & Neuro-Science, Fondazione Istituto Italiano di Tecnologia (IIT), Rome, Italy, 00161*

[3]*DIFA@University of Bologna, University of Bologna, Bologna, Italy, 40126*

[4]*DIMES@University of Bologna, University of Bologna, Bologna, Italy, 40126*

Keywords: In vitro, Static, Work in Progress
Presented by: Laura Caramazza

Galvanotactic study as a way to remotely guide cell motility has recently great gain attention. In this framework, “non-contact” galvanotaxis investigations could represent a powerful tool to study migration in brain tumor cells for brain cancer therapy applications. In this work authors provide in vitro experimental studies on the effect of “non-contact” direct currents (DC) electric field application to glioblastoma cell line in terms of cells migration. Multiphysics in silico investigations are performed in order to quantify the electromagnetic quantities involved during the in vitro exposures, hence providing a numerical support to the experiment.

PS-30 [15:00]

Genotoxicity assessment of combined exposure to WiFi and UV radiation on human keratinocytes *in vitro*

Zsófia Szilágyi[1], Györgyi Kubinyi[1], Erika Szabó[1], Bertalan Pintér[1], Brahim Selmaoui[2] & György Thuroczy[1]

[1]*National Public Health Center, Non-ionizing Radiation Unit, Budapest, Hungary, 1221*

[2]*L’Institut National de l’Environnement Industriel et des Risques, Verneuil en Halate, France*

Keywords: In vitro, RF/Microwaves, Completed (unpublished)

Presented by: Zsofia Szilagyi

In the last decades the exposure to radiofrequency (RF) radiation emitted by wireless devices has increased in the human environment, whereupon has raised concerns about health effects. The International Agency for Research on Cancer classifies RF radiation as “possible carcinogenic” (Group 2B), and the ultraviolet (UV) radiation as “carcinogenic” (Group 1) respectively. We tested whether consecutive exposures of UV radiation and 2422 MHz WiFi field have any effect on human keratinocytes. Genetic toxicity was examined during in vitro experiments. We found no conclusive and coherent evidence for an induction of DNA damages, but in some cases we reported some positive results of the adverse effect of WiFi irradiation.

PS-31 [15:00]

Acceptability of a provocation protocol in the study of electrohypersensitivity : Results of the ExpoComm project

Maryse Ledent[1, 2], Maël Dieudonné[3], Jimmy Bordarie[4], Eva De Clercq[1] & Catherine Bouland[2]

[1]*Risk and Health Impact Assessment, Sciensano, Brussels, Belgium, 1050*

[2]*Ecole de Santé Publique, Université Libre de Bruxelles, Brussels, Belgium, 1070*

[3]*Dynamiques sociales et politiques de la vie privée, Centre Max Weber, Lyon2, Lyon, France, 69363*

[4]*Qualité de vie et Santé psychologique, Université de Tours, Tours, France, 37082*

Keywords: Human, All Frequencies, Completed (unpublished)

Presented by: Maryse Ledent

For most electrohypersensitive (EHS) people, experimentation remains the preferred instrument to determine the role of electromagnetic fields and to verify the accuracy of the attributions. Despite the fear of some of them to undergo laboratory exposure, most EHS people are convinced of the usefulness of provocation tests, but request innovative protocols that consider the specificity of their condition. The aim of the ExpoComm project was to co-design with EHS people a protocol considering the characteristics of their sensitivity and to evaluate the acceptability of this protocol. In this study we present the evolution of the acceptability and provide guidelines for recruiting and including volunteers in such protocol.

PS-32 [15:00]

Electro-gene transfer as a therapeutic approach for glycogen storage disease type III (GSDIII)

Doriana Triggiani[1, 2], Emanuela Pasquali[1], Emanuela Signori[3], Simona Salati[4], Carmela Marino[1], Caterina Merla[1] & Rosella Franconi[1]

[1]*Department of Sustainability, ENEA, Rome, Italy, 00123*

[2]*Italian Glycogen Storage Disease Association (AIG) NPO, Assago, Italy, 20090*

[3]*Laboratory of Molecular Pathology and Experimental Oncology, CNR - Institute of Translational Pharmacology, Rome, Italy, 00133*

[4]*Clinical Biophysics, IGEA SpA, Carpi, Italy, 41012*

Keywords: Clinical (therapy), Pulsed, Work in Progress

Presented by: Caterina Merla

Glycogen storage disease type III (GSDIII) is a rare genetic disease due to deficiency of the glycogen debranching enzyme (GDE). GSDIII is characterized by progressive accumulation of abnormal glycogen in the liver and skeletal muscle. Adult GSDIII patients usually develop a kind of muscular dystrophy. At present, no specific therapy exists while adeno-associated virus (AAV) -based gene therapy strategies are being used in GSDIII animal models. Our approach is to explore electro-gene transfer (EGT) of a plasmid vector containing a synthetic gene encoding a functional GDE as a possible approach of local gene therapy in the affected skeletal muscles.

PS-33 [15:00]
STUDENT PAPER

Challenges in four-electrode probe measurement – Data acquisition system and probe hardware for low frequency dielectric spectroscopy

Cindy Karina[1], Nishtha Chopra[2], Myles Capstick[1], Azadeh Peyman[2], Sina Hashemizadeh[1] & Niels Kuster[1, 3]

[1]*IT'IS Foundation, Zürich, Switzerland*

[2]*Radiation Dosimetry, Public Health England, London, United Kingdom*

[3]*Departments of Information Technology and Electrical Engineering, ETH Zürich, Zürich, Switzerland*

Keywords: Electrochemistry, ELF/LF, Work in Progress

Presented by: Cindy Karina

This paper presents experimental evaluation of dielectric properties using a four-electrode probe and a commercial impedance analyser in measuring high loss samples at frequencies < 1MHz. The study also attempts to overcome the electrode polarisation effect using equivalent circuit modelling. Finally, feasibility of a probe with embedded electronic circuits is studied as an approach to eliminate the need for commercial impedance analysers and to minimize stray capacitance and electrode polarization effects at extremely low frequencies.

PS-34 [15:00]

Wearable antenna: human exposure assessment in different configurations

Silvia Gallucci[1, 2], Marta Bonato[1], Martina Benini[1, 2], Serena Fiocchi[1], Emma Chiaramello[1], Gabriella Tognola[1], Paolo Ravazzani[1] & Marta Parazzini[1]

[1]*IEIIT - Institute of Electronics, Information Engineering and Telecommunications, CNR - Italian National Research Council, Milan, Italy, 20133*

[2]*Department of Electronics, Information and Bioengineering (DEIB), Politecnico di Milano, Milan, Italy, 20133*

Keywords: Dosimetry (computational), RF/Microwaves, Other

Presented by: Silvia Gallucci

This work aims to assess the human exposure to the RF-EMFs emitted by a wearable antenna since, in recent year, we have been witnessing a growth of this technology due to its wide variety of fields of application, e.g., medical, military. An exposure assessment is needed because the antenna is placed on the human wearer. A wearable antenna (f = 1.575 GHz) was tested by placing it in four realistic configurations relative to the human model. The assessment was performed by means of computational methods to estimate the SAR_{10g}@ 1 W. The obtained values have shown that the configuration with the highest value is the case of the shoulder and, differentiating the tissues, the most affected tissue among all configurations is the skin.

PS-35 [15:00]

Numerical investigation of TMS exposure of a rat brain

Micol Colella[1], Daniele Lelli[1], Alessandra Paffi[1], Giuseppina Natale[2], Filippo Carducci[3], Francesca Apollonio[1], Veronica Ghiglieri[4] & Micaela Liberti[1]

[1]*Department of Information Engineering, Electronics and Telecommunications, University of Rome La Sapienza, Rome, Italy, 00184*

[2]*Università degli Studi di Perugia, Perugia, Italy*

[3]*Laboratorio di Neuroimmagini, University of Rome La Sapienza, Rome, Italy*

[4]*Università telematica San Raffaele, Rome, Italy*

Keywords: Dosimetry (computational), Pulsed, Completed (unpublished)
Presented by: Micol Colella

In this work preliminary results of the numerical dosimetric study performed on the experiments conducted in the experimental work by Cacace and co-workers in 2017 are presented. The aim is to show the importance of an accurate dosimetry to support translational studies on small animals and to help indentify the physiological mechanisms that underlies the therapeutic abilities of rTMS exposure.

PS-36 [15:00]

Measuring principle of code-selective measurements at 5G

Holger Schwarz[1], Stephan Sommersdorf[1] & Sabine Duerr[1]

[1]*Narda Safety Test Solutions GmbH, Pfullingen, Germany, 72793*

Keywords: Dosimetry (measurements), RF/Microwaves, Completed (published)
Presented by: Holger Schwarz

With a spectrum analyzer, selective measurements can be performed and different services can be distinguished from each other. 5G signals in general can also be measured. If a certain 5G signal source should be measured, a code-selective measurement is required. This is also the basis for an extrapolation to the maximum load. Often regulators require extrapolation to the maximum load and comparison of this result with the local standard. This ensures that the exposure will not exceed the permitted limits and make the result independent from day and time when the measurement was taken.

PS-37 [15:00]

A tri-band MIMO antenna for mobile phones and its SAR analysis

Niamat Hussain[1], Hussain Askari[1], Domin Choi[1], Hyung-Do Choi[2] & Nam Kim[1]

[1]*Information and Communication Engineering, Chungbuk National University, Cheongju, Korea, 28609*

[2]*Radio Technology Research Department, Electronics and Telecommunications Research Institute, Daejeon, Korea*

Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Niamat Hussain

The design and its SAR analysis of a tri-band MIMO antenna operating at key bands of 2.45 GHz, 3.5 GHz, and 5.5 GHz has been presented. The antenna is placed at four corners of the substrate to achieve spectral diversity. The SAR_{-10g} is computed for an input power of 0.5 W at various frequency bands. The antenna shows low $SAR\text{-}_{10g}$ values of 0.148 W/kg, 0. 97 W/kg, and 1.15 W/kg at 2.45 GHz, 3.5 GHz, and 5.5 GHz, respectively and can be a good candidate for 5G cellular phones.

PS-38 [15:00]
STUDENT PAPER

Study protocol to continuously monitor extremely low-frequency and radiofrequency electromagnetic fields exposure in Switzerland: the SwissNIS project

Nicolas Loizeau[1, 2], Marco Zahner[3, 4], Jürg Fröhlich[3, 4], Erik Bühlmann[5], Christa Stephan[5], Markus Gugler[6], Marloes Eeftens[1, 2], Stefan Dongus[1, 2], Alexander Reichenbach[7], Sebastian Egger[7], Toni Ziegler[5] & Martin Röösli[1, 2]

[1]*Department of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Basel, Switzerland, 4051*

[2]*University of Basel, Basel, Switzerland, 4051*

[3]*Fields at Work GmbH, Zürich, Switzerland, 8032*

[4]*Institute of Electromagnetic Fields (IEF), ETH Zürich, Zürich, Switzerland, 8092*

[5]*Grolimund + Partner AG Environmental Engineering, Bern, Switzerland, 3006*

[6]*NED-TECH AG, Wangen an der Aare, Switzerland, 3380*

[7]*Federal Office for the Environment (FOEN), Swiss Confederation, Bern, Switzerland, 3003*
Keywords: Epidemiology, RF/Microwaves, Concept
Presented by: Nicolas Loizeau

Exposure to electromagnetic fields (EMF) is continuously changing in our daily environment due to the constant development of technology. The Federal Office for the Environment (FOEN) has commissioned the SwissNIS consortium to assess the extremely low frequency magnetic fields (ELF-MF) and radiofrequency (RF) EMF exposure of the Swiss population in their everyday life from 2021 to 2025. The SwissNIS study protocol describes yearly mobile microenvironmental measurements, home visits and continuous fixed site measurements in Switzerland. Yearly spatial and temporal trends of ELF-MF and RF-EMF exposure will be evaluated during the course of the project.

PS-39 [15:00]

Monitoring the long-term variations of the environmental field strength using exposimeters mounted on a public transport vehicle: A pilot study 2019 - 2021

Marco Zahner[1], Timon Schmid[1], Fabian Schneider[1], Martin Schmid[1], Jürg Studerus[2] & Jürg Fröhlich[1]

[1]*Fields at Work GmbH, Zurich, Switzerland, 8032*

[2]*Corporate Responsibility, Swisscom Schweiz, Worblaufen, Switzerland, 3048*
Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Marco Zahner

A pilot study using exposimeters mounted on the roof of a public transport bus was performed to assess the evolution of the RF electromagnetic fields exposure within a period of two years (2019 and 2021) in the city of St. Gallen (Switzerland). The transferability of the bus rooftop measurements to a height closer to the ground was validated by measurements performed on a bicycle following the same route as the bus. The preliminary

data shows a general decrease of 32% in measured RMS field strength in the cellular downlink bands from 2019 to 2021. Effects such as decreased mobility during the pandemic and other variabilities might be responsible for the observed decrease.

PS-40 [15:00]

ELF-MF exposure and neuronal differentiation: a preliminary study on the effect of chronic exposure on iPSC

Barbara Benassi[1], Laura Rodriguez Doblado[1], Caterina Merla[1], Victoria Moreno-Manzano[1], Manuel Monleon-Pradas[1], Carmela Marino[1] & Claudia Consales[1]

[1]*Neuronal and Tissue Regeneration Laboratory, Centro de Investigación Príncipe Felipe, Valencia, Spain, 46012*

Keywords: In vitro, ELF/LF, Work in Progress
Presented by: Claudia Consales

Extremely low frequency magnetic field (ELF-MF) exposure has been reported to induce mesenchymal (MSC) and human embryonic stem cells neuronal differentiation by modulating the levels of intracellular calcium. Here we explored the hypothesis that chronic ELF-MF exposure could sustain the neuronal differentiation of induced pluripotent stem cells (iPSC).

PS-41 [15:00]

ELF magnetic field vector orientation-dependent variations of tissue specific induced electric field strength in rats and mice during animal experiments

Gernot Schmid[1] & Rene Hirtl[1]

[1]*EMC & Optics, Seibersdorf Laboratories, Seibersdorf, Austria, A-2444*

Keywords: Dosimetry (computational), ELF/LF, Work in Progress
Presented by: Gernot Schmid

Numerical computations with a rat model exposed to ELF magnetic fields with different orientation with respect to the body axis were carried out. The results indicate that a horizontally aligned field vector (as used in most animal studies concerning childhood leukemia) lead to much higher variation of induced electric field strengths (E_i) inside relevant tissues of freely moving animals than a vertically aligned field vector. It is therefore suggested to thoroughly consider also the possibility of using a vertically aligned magnetic field vector in the design of future animal studies in order to minimize uncertainties, and a rationale based on quantitative information for the field orientation finally used shall be given.

PS-42 [15:00]

Research program "Radiation Protection in the Process of Power Grid Expansion"

Janine-Alison Schmidt[1], Christoph Boehmert[1], Dirk Geschwentner[1], Bernd Henschenmacher[1], Jens Kuhne[1], Blanka Pophof[1] & Gunde Ziegelberger[1]

[1]*Competence Centre for Electromagnetic Fields, Federal Office for Radiation Protection, Oberschleißheim, Germany, 85764*

Keywords: Public Health Policy, ELF/LF, Work in Progress
Presented by: Janine-Alison Schmidt

In connection with energy transition the existing electricity grids in Germany are being expanded and upgraded. In order to improve risk assessment and to reduce scientific uncertainties, the Federal Office for Radiation Protection (BfS) started the accompanying research program "Radiation Protection in the Process of Power Grid Expansion" in 2017. Ten research topic areas including 40 individual research projects are

investigated during the course of the research program.

PS-43 [15:00]

Effects of in vitro exposures to 900MHz electromagnetic fields on neural stem cell integrity and differentiation

Camille Mougin[1, 2], Stéphane Mortaud[2] & Anne-Sophie Villegier[1]

[1]*Unité de Toxicologie Expérimentale, Institut national de l'environnement industriel et des risques, Verneuil-en-Halatte, France, 60500*

[2]*Immunologie et Neurogénétique Expérimentales et Moléculaires, UMR7355, Orléans, France, 45071*

Keywords: In vitro, RF/Microwaves, Completed (unpublished)

Presented by: Anne-Sophie Villegier

Because of the important fragility of neural stem cells (NSCs) in response to environmental stressors, the main goal of this study was to assess NSCs integrity and differentiation in response to environmental and high levels radiofrequency electromagnetic fields (RF-EMF, GSM 900-MHz). Our results suggested that RF-EMF may increase double strand DNA break, decrease cell growth and cell viability. RF-EMF modified NSCs differentiation as shown by the increased proliferation of oligodendrocyte progenitor cells and by the reduced number of astrocytes. Therefore, RF-EMF may impact both NSCs integrity and differentiation, which are known mechanisms for cancer and neurodevelopmental impairments.

PS-44 [15:00]

EPRI occupational electric and magnetic field exposure database for the utility industry: Feasibility study

Carolina Calderon[1], Darren Addison[1], Nishtha Chopra[1], Nigel Cridland[2], Myron Maslanyj[1], Michael Silva[3] & Phung Tran[3]

[1]*Radiation Dosimetry Department , Pubic Health England, Chilton, United Kingdom, OX11 0RQ*

[2]*Operational Protection Department, Pubic Health England, Chilton, United Kingdom, OX11 0RQ*

[3]*Electric Power Research Institute, Palo Alto, California , USA, 94304-1338*

Keywords: Dosimetry (measurements), ELF/LF, Work in Progress

Presented by: Carolina Calderon

The poster presents the results of a study investigating the feasibility of creating an electric and magnetic field exposure database for the electricity industry. The database is intended for use by EMF health and safety professionals as well as industrial hygienists, to support return-to-work practices for workers with active medical devices, amongst other applications. Industry reports, datasets and scientific publications were used to populate a simple and intuitive proof-of-concept database that provides exposure data by job classification, work environment, and EMF source.

PS-45 [15:00]

Network-based measurements of actual output power levels of user equipment in commercial 5G NR networks

Paramananda Joshi[1], Fatemeh Ghasemifard[1], Davide Colombi[1] & Christer Tornevik[1]

[1]*Ericsson Research, Ericsson AB, Stockholm, Sweden*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress

Presented by: Fatemeh Ghasemifard

Summary: In this study, output power levels of user equipment (UE) are assessed by means of network data collected from three commercial 5G NR networks operating at sub-6GHz and millimeter-wave frequencies.

The results, which will be presented at the conference, show that the actual time averaged output power and consequently the radio frequency (RF) electromagnetic field (EMF) exposure levels from 5G UE are significantly lower than the maximum.

PS-46 [15:00]
STUDENT PAPER

Model based conception of microelectrodes for High Frequency Oscillations Recording and Detection

Gautier Dauly[1], Gabriel Dieuset[1], Seyedeh-Hajar Mousavi[2], Esma Ismailova[2], Pascal Benquet[1], Fabrice Wendling[1] & Mariam Al-harrach[1]

[1]*LTSI U1099, F-35000, INSERM, Rennes, France, 35042*

[2]*Bioelectronics, CMP-EMSE, MOC, Gardanne, France, 13541*

Keywords: Mechanistic/Theoretical, All Frequencies, Work in Progress
Presented by: Gautier Dauly

High Frequency Oscillations (HFO, 40-600 Hz) and particularly Fast Ripples (FR, 200-600 Hz) are short transient events that appear on intracerebral EEG. They are considered as a rieliable biomarker of the Epileptogenic Zone. Microelectrodes used for FRs recording posses a high impedance which leads to attenuation and distortion in the signals. This paper presents a model-guided approach in the conception of microelectrodes optimized for the recording of FRs. In particular, the coating the metal microelectrodes with a conducting polymer such as poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS).

PS-47 [15:00]
STUDENT PAPER

The numerical approach for the validation of a risk assessment under low-frequency electric field exposures

Mengxi Zhou[1], Julien Claudel[1], Djilali Kourtiche[1], Isabelle Magne[2], Martine Souques[2] & François Deschamps[3]

[1]*Département Nanomatériaux, électronique et Vivant, Institut Jean Lamour (UMR 7198), Université de Lorraine - CNRS, Nancy, France, 54000*

[2]*Service des Etudes Médicales, EDF, Paris, France, 75017*

[3]*Département Concertation et Environnement, RTE, Paris-La Défense, France, 92400*

Keywords: Dosimetry (computational), ELF/LF, Work in Progress
Presented by: Mengxi Zhou

The risk of the cardiac implant wearers under occupational exposures to the electromagnetic fields has been highlighted by the 2013/35/EU European Directive. We proposed in this study the numerical approach to validate a risk assessment under low-frequency electric field exposures. The human models and the phantom for in vitro experiments were studied by using numerical simulations to determine the relation between induced current density and the external electric field. The exposure system is modeled in order to reproduce induced phenomena on a cardiac implant inside a human body under electric field exposures. The results give references for the future experimental measurements.

PS-48 [15:00]

The effect of intermediate frequency magnetic field at 22 kHz on human fibroblast cells *in vitro*

Bertalan Pintér[1], Zsófia Szilágyi[1], Erika Szabó[1], Györgyi Kubinyi[1], Yves Le Dréan[2] & György Thuroczy[1]

[1]*National Public Health Center, Non-ionizing Radiation Unit, Budapest, Hungary, 1221*

[2]*Université de Rennes I, l'Environnement et le Travail, Rennes, France*

Keywords: In vitro, IF, Work in Progress
Presented by: Bertalan Pinter

The aim of this study was to examine whether the intermediate frequency (IF) has any effect on DNA in human fibroblast cells in vitro. Furthermore, the adaptive response was also investigated. The cells were exposed to 22 kHz, 100 microtesla IF radiation (as adaptive dose) and 4 hours later were challenged with 2.5 Gy X-ray ionizing radiation. Evaluation of the DNA damage was performed with Fpg-modified alkaline comet assay.

PS-49 [15:00]

Broadband and band-selective measurements of radiofrequency EM field with drone system around 5G base station

Peter Necz[1], Balázs Gyulai[2], József Krausz[2] & György Thuroczy[1]

[1]*Department of Non-Ionizing Radiation, National Public Health Center, Budapest, Hungary*

[2]*National Media and Infocommunications Authority, Budapest, Hungary*
Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: György Thuroczy

The aim of present study wasto use a drone system to perform RF exposure measurements in the vicinity of 5G base station. Another aim was to check how to use a lightweight personal exposimeter and a spectrum analyzer in the study.Conducting measurements by common, commercially available exposimeters should be useful in the future exposimetry studies, also for measuring 5G base stations. The results show that measured field strength values are strongly depending on the pattern of the base station's beam and the distance. Nevertheless several conditions must be considered in the planning phase and carrying out such studies.

PS-50 [15:00]

Radiofrequency EMF effects on neuroinflammation and microglial activation in an Alzheimer's disease mouse model

Hyejin Park[1], Ye Ji Jeong[1], Nam Kim[2], Hyung-Do Choi[3] & Hae-June Lee[1]

[1]*Korea Institute of Radiological and Medical Sciences, Seoul, Korea, 01812*

[2]*Chungbuk National University, Chungju, Korea, 28644*

[3]*Electronics and Telecommunications Research Institute, Daejeon, Korea, 34129*
Keywords: In vivo, RF/Microwaves, Work in Progress
Presented by: Hae-June Lee

According to increasing public concerns regarding the effects of RF-EMFs emitted from mobile phones on brain function, we investigated the impact of RF-EMFs on neurodegenerative disease using AD mouse models. AD is the most common form of neurodegenerative disease. To evaluate the effect of RF exposure on neuroinflammation and microglial activation, we compared RF-exposed brains to those that were subjected to an anti-inflammatory agent. In this study, we found that RF exposure with a high SAR has significant anti-inflammatory effects on AD-induced neuroinflammation.

PS-51 [15:00]

AC dielectrophoresis of bacteria in coaxial mesoscopic structure potentially applicable for rapid detection and easy characterization at low cost

Leticia Gimeno Monge[1], Dominique Rauly[2], Jean Martins[3], Hassan Nehme[2], Pascal Xavier[2] & Eric Chamberod[4]

[1]*Univ. Grenoble Alpes, CNRS, Grenoble INP, G2ELab, Grenoble, France, 38000*

[2]*Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, Grenoble INP, IMEP-LaHC, Grenoble, France, 38000*

[3]*Univ. Grenoble Alpes, CNRS, IRD, Grenoble INP, IGE (UMR 5001), Grenoble, France, 38000*

[4]*Univ. Grenoble Alpes, IUT1, GEII, Grenoble, France, 38000*
Keywords: Mechanistic/Theoretical, Static, Work in Progress
Presented by: Leticia Gimeno Monge

A microwell-based bioelectrical assay, with coaxial geometry and mesoscopic size (diameter 400 µm) is designed to achieve fast dielectrophoretic migration of bacteria to its central conductor wall from an initially homogeneous bacterial suspension. The non-linear equation of cell motion is first solved using a simplified one-dimensional model in Matlab. A 3D numerical simulation using Comsol Multiphysics^{TM} is then performed. The transit time of the bacteria to reach the central conductor is estimated to be less than 12 s, with an applied voltage of 20 V_{rms}. The process could be applied to improve the measurement of bacterial concentrations in drinking water, and/or the dielectric characterization of bacteria.

PS-52 [15:00]
STUDENT PAPER

Computational analysis for non-invasive acquisition of craniospinal compliance

Fariba Karimi[1, 2], Esra Neufeld[1, 2], Arya Fallahi[1, 2], Andreas Spiegelberg[3], Andrea Boraschi[3], Vartan Kurtcuoglu[3] & Niels Kuster[1, 2]

[1]*Foundation for Research on Information Technologies in Society (IT'IS), Zurich, Switzerland*

[2]*Department of Information Technology and Electrical Engineering, Swiss Federal Institute of Technology (ETH Zurich), Zurich, Switzerland*

[3]*The Interface Group, Institute of Physiology, University of Zurich, Zurich, Switzerland*
Keywords: Clinical (diagnostics), Static, Work in Progress
Presented by: Fariba Karimi

Diagnosis, treatment, and monitoring of patients suffering from craniospinal diseases requires the measurement of intracranial pressure (ICP). Several measurement methods have been developed, but currently only invasive techniques are sufficiently reliable to be clinically accepted. As brain geometry and dielectric properties are transiently modulated by blood and cerebrospinal fluid exchange between cranial and spinal compartments, impedance measurements may be used to monitor ICP non-invasively. In this paper, we present a numerically robust and computationally efficient method for simulating pulsation-related impedance changes of the head. The approach was verified in (semi-)analytic benchmarks and applied to real data from volunteers.

PS-53 [15:00]

Evaluation of EMF exposure during the use of surgery diathermia units by multi-worker treatment teams

Jolanta Karpowicz[1], Krzysztof Gryz[1] & Patryk Zradziński[1]

[1]*Central Institute for Labour Protection, National Research Institute (CIOP-PIB), Warszawa, Poland, 00-701*
Keywords: Occupational, IF, Work in Progress
Presented by: Jolanta Karpowicz

The electromagnetic field (EMF) emitted while using surgery diathermia units (SDU) affects health care workers involved in the treatment. The ongoing study (involving: (i) questionnaires-based investigations to find configurations of the health care personnel activities during the use of SDU; (ii) measurements to find the characteristics of wave forms and levels of EMF emitted by SDU; (iii) advanced computer simulations to find

SAR distribution in the exposed workers) showed that the realistic evaluation of EMF exposure during the use of SDU needs attention to the complex frequency pattern of health care personnel exposure during the treatment and considerations of exposure scenarios involving multi-worker treatment teams.

PS-54 [15:00]

Irregularities in metrics characterising movement-related exposure to static magnetic field near MRI scanners

Jolanta Karpowicz[1]

[1]*Central Institute for Labour Protection, National Research Institute (CIOP-PIB), Warszawa, Poland, 00-701*
Keywords: Occupational, Static, Work in Progress
Presented by: Jolanta Karpowicz

Evaluating the probability to experience movement-related vertigo in the strong static magnetic field (SMF), the relevant exposure metric is usually the maximum dB/dt value. It is highly important to understand if the maximum dB/dt value reported from the exposimetric measurements reflects the real worker's exposure profile or is related to the malfunctions of measurement device caused by SMF influence. Taking into account that "manual data curation" of the results of EMC-based malfunctions (found in the analyzed data) may be not achievable for long-duration recordings or for vector parameters of exposure, it is suggested to use 99.9th percentile of dB/dt from the exposimetric measurements to characterize movement-related exposure.

PS-55 [15:00]

Wideband spectral-analysis based SAR system for a comprehensive evaluation and reduction of the uncertainty of the EMF exposure-level assessment of 5G user equipment operating multiple-frequency transmissions

Kammel RACHEDI[1], Mounir TENIOU[1], Thomas Julien[1], Julien Fouques[2], Mansour Sylla[1], Stephane Pannetrat[1] & Lyazid Aberbour[1]

[1]*ART-Fi, Orsay, France, 91400*

[2]*NEXIO Group, Sevres, France, 92310*
Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)
Presented by: Kammel RACHEDI

This paper presents for, the first time, a comprehensive evaluation of the uncertainty of the SAR assessment on a commercial 5G mobile phone, being put in real-life multiple-frequency transmissions (i.e., EN-DC), and compared to the case while the mobile phone is enforced to transmit sequentially the corresponding frequency bands. It is found that the later test mode is with higher uncertainties as compared to the case of real-life operation of the mobile-phone while being tested for SAR compliance. It is achievable thanks to novel frequency selective SAR instrumentation, which is enabled by wideband radiofrequency (RF) spectrum analysis measurement architecture, and presents a solution for the limitations of traditional SAR systems.

PS-56 [15:00]

A magnetic resonant coupling wireless power transfer system with grounded resonator to reduce interaction with human body

Xianyi Duan[1], Junqing Lan[2], Yinliang Diao[1, 3], Jose Gomez-Tames[1] & Akimasa Hirata[1]

[1]*Dept. of Electrical and Mechanical Engineering, Nagoya , Japan, 4668555*

[2]*College of Electronic Engineering , Chengdu, China, 610065*

[3]*College of Electronic Engineering , Guangzhou, China, 510642*
Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)

Presented by: Xianyi Duan

This study proposed a magnetic resonant coupling wireless power transfer (MRC-WPT) system with a grounded loop to mitigate its interaction with human body. For the proposed WPT with grounded resonator , the peak spatial-average SAR and whole-body average SAR were 60% reduced as compared to that without grounding. The maximum permissible input power for the proposed WPT system was estimated to be 33.5 kW at a worst-case scenario to comply with the limits for whole-body average SAR prescribed in international guidelines and standard.

PS-57 [15:00]
STUDENT PAPER

Numerical assessment of the exposure to Transcranial Magnetic Stimulation coil: male and female anatomical model comparison

Simona D'Agostino[1, 2], Micol Colella[1], Micaela Liberti[1], Rosaria Falsaperla[2] & Francesca Apollonio[1]

[1]*Department of Information Engineering, Electronics and Telecommunications, Rome, Italy, 00184*

[2]*Department of Occupational and Environmental Medicine, Epidemiology and Hygiene,, INAIL, Monte Porzio Catone, Italy, 00078*

Keywords: Dosimetry (computational), ELF/LF, Work in Progress
Presented by: Simona D'Agostino

The purpose of this work is to carry out a comparative evaluation of the electromagnetic assessment between male and female human anatomical models representing medical staff during transcranial magnetic stimulation (TMS) treatment, by means of numerical dosimetry. Electromagnetic exposure is evaluated using discretized realistic human body models and considering as a source a TMS circular coil. The results of the induced electric field in the human models show that in some cases the exposure limits are exceeded, but also show that the exposure assessment seems to depend on operator's gender. This study could be a useful starting point for future risk assessment studies and for providing general safety guidance.

PS-58 [15:00]

Do TRP channels partially contribute in generating the basal membrane conductance triggered by high intensity nanosecond electric pulses in bovine adrenal chromaffin cells?

Lisha Yang[1], Thomas Gould[2], Sophia Pierce[1], Gale Craviso[1] & Normand Leblanc[1]

[1]*Department of Pharmacology, University of Nevada, Reno School of Medicine, Reno, Nevada, USA, 89557*

[2]*Department of Physiology and Cell Biology, University of Nevada, Reno School of Medicine, Reno, Nevada, USA, 89557*

Keywords: Electroporation, Pulsed, Work in Progress
Presented by: Lisha Yang

In bovine adrenal chromaffin cells, a 5 ns electric pulse elicits an instantaneous inward current at resting membrane potential that may lead to activation of voltage gated Ca^{2+} channels. We hypothesize that this current may be partially carried by one or more TRP channels. In this study, RT-PCR experiments first confirmed the expression in bovine chromaffin cells of several members of the TRPC, TRPM, TRPV, TRPP and TRPML subfamilies, and TRPA1, including TRPC 4/5 and TRPM 7, for which specific blockers exist. Patch clamp experiments then revealed that M084, a specific blocker of TRPC4/5 channels, but not FTY720, which blocks TRPM7, inhibited the NEP-induced current, indicating that these channels may play a role in this process.

PS-59 [15:00]

Mobile phone use and time trend of brain tumor incidence rate in Korea: An ecological study

Kyung-Hwa Choi[1], Johyun Ha[2], Sanghyuk Bae[3], Ae-kyoung Lee[4], Hyung-Do Choi[4], Young Hwan Ahn[5], Mina Ha[1], Hyunjoo Joo[1], Ho-Jang Kwon[1] & Kyu-Won Jung[2]

[1]*Department of Preventive Medicine, Dankook University College of Medicine, Cheonan, Korea*

[2]*National Cancer Control Institute, Goyang, Korea*

[3]*Department of Preventive Medicine, The Catholic University of Korea, Seoul, Korea*

[4]*EM Environment Research Team, ETRI, Daejeon, Korea*

[5]*Department of Neurosurgery, Ajou University Hospital, Suwon, Korea*

Keywords: Epidemiology, RF/Microwaves, Completed (unpublished)

Presented by: Kyung-Hwa Choi

The number of mobile phone subscribers increased in Korea. In Korea, the incidence of glioma increased, while total brain tumors not. Glioblastoma was more increased than other types of glioma in Korea. No association between the number of mobile phone subscribers with the brain tumor incidence in Korea.

PS-60 [15:00]

Complete workflow for compliance evaluations of beam-forming millimeter-wave devices

Sylvain Reboux[1], Jingtian Xi[2], Sven Kuehn[2], Beyhan Kochali[3] & Niels Kuster[2, 4]

[1]*ZMT Zurich MedTech AG, Zurich, Switzerland, 8004*

[2]*Foundation for Research on Information Technologies in Society (IT'IS Found, Zurich, Switzerland*

[3]*Schmid & Partner Engineering AG (SPEAG), Zurich, Switzerland*

[4]*Swiss Federal Institute of Technology (ETHZ), Zurich, Switzerland*

Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)

Presented by: Niels Kuster

We provide a complete practical workflow to evaluate the maximum power density that can be achieved by a millimeter-wave array antenna on surfaces in the near- or far-field regardless of the size of the codebook or the shape of the evaluation surface. Field integral equations and electric field measurements are used to reconstruct the electromagnetic field on any evaluation surface from measurements at very close distances from the antenna. The maximum power density across the whole codebook is found by an optimizer.The proposed method provides a practical way to assess compliance of millimeter-wave array antennas and is a valuable step forward for the standardization of RF EMF exposure compliance procedures of 5G devices.

PS-61 [15:00]

Evaluation of the virucidal efficacy of high peak power microwave on bovine coronavirus on surfaces

Ibtissam Echchgadda[1], Jody Cantu[2], Joseph Butterworth[2], Bryan Gamboa[1], David Freeman[2], Francis Ruhr[2], Weston Williams[2], Leland Johnson[1], Jason Payne[1], Robert Thomas[3], William Roach[4] & Bennett Ibey[1]

[1]*Air Force Research Laboratory, 711th Human Performance Wing, Airman Systems Directorate, Bioeffects Division, Radio Frequency Bioeffects Branch, JBSA Fort Sam Houston, TX, USA, 78234*

[2]*Air Force Research Laboratory, General Dynamics Information Technology, JBSA Fort Sam Houston, TX, USA, 78234*

[3]*Air Force Research Laboratory, 711th Human Performance Wing, Airman Systems Directorate, Bioeffects Division, JBSA Fort Sam Houston, TX, USA, 78234*

[4]*Air Force Office of Scientific Research, Air Force Research Laboratory, Arlington, VA, USA, 22203*

Keywords: In vitro, RF/Microwaves, Completed (published)

Presented by: Ibtissam Echchgadda

This study evaluated if 1-10,000 microseconds pulsed high peak power microwave (HPPM) at 2.8, 5.6, 8.5,

and 9.3 GHz could abrogate bovine coronavirus (BCoV) survival on a plastic surface, and thus the virus infectivity. Results showed no relevant dose dependent inactivation in virus infectivity was achieved across exposures at 1-10000 pulses compared to sham exposure. Although, there were statistically significant reductions in virus titer with 2.8 and 9.3 GHz exposures, the differences in log reduction was < 1.0 $\log_{10}$ for all RF exposures compared to sham. The data suggest that pulsed HPPM exposures across the 2-10 GHz band might not be an effective virucidal approach for treating hard surfaces.

PS-62 [15:00]
STUDENT PAPER

Super high frequency (18 GHz) electromagnetic field effects on *Bacillus subtilis* spores

Erim Kosyer[1], Palalle G. Tharushi Perera[1], Denver Linklater[1], Rodney Croft[2, 3] & Elena P. Ivanova[1, 2]

[1]*Physics, RMIT University, Melbourne, Australia, 3001*

[2]*Australian Centre for Electromagnetic Bioeffects Research, Wollongong, Australia*

[3]*University of Wollongong, Wollongong, Australia*

Keywords: Mechanistic/Theoretical, RF/Microwaves, Work in Progress
Presented by: Erim Kosyer

As wireless technologies are constantly developing and taking leaps into the future, so do the number of electromagnetic fields (EMF) we are exposed to emitted from these devices. These EMFs range in wavelengths from a single biomolecule to whole organisms. It is understood the thermal mechanisms of interaction are responsible for possible negative effects associated with EMFs. Furthermore, there is currently no evidence surrounding non-thermal mechanisms and its possible contribution to these negative effects. Due to this gap in understanding, it brings forth a possible query that may have important ramifications for current guidelines and standards. Consequently, this issue requires further exploration.

PS-63 [15:00]

Maxwell-Wagner-based detection of bacteria through the formation of a dielectrophoretic biofilm-like layer in a coaxial mesoscopic structure

Dominique Rauly[1], Leticia Gimeno Monge[2], Pascal Xavier[1], Eric Chamberod[4], Marion Amalvy[1, 3] & Jean Martins[3]

[1]*Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, Grenoble INP, IMEP-LaH, Grenoble, France, 38000*

[2]*Univ. Grenoble Alpes, CNRS, Grenoble INP, G2Elab, Grenoble, France, 38000*

[3]*Univ. Grenoble Alpes, CNRS, IRD, INP-G, IGE (UMR 5001), Grenoble, France, 38000*

[4]*Univ. Grenoble Alpes, IUT1, Grenoble, France, 38000*

Keywords: In vitro, ELF/LF, Concept
Presented by: Dominique Rauly

This paper presents an original way to exploit the bacteria detection strategy based on dielectrophoresis (DEP) and impedimetry. Rather than using a conventional Array of InterDigitated Electrodes, a coaxial structure is used here, because it allows more quantitative analysis of bacterial concentration, and easy extension to macroscopic devices. When applying an AC voltage (20 Vrms; F < 100 kHz) a layer of bacteria rapidly forms on central conductor by DEP. This biofilm-like layer induces a Maxwell-Wagner effect leading to a significant increase of the impedance modulus, compared to a case of homogeneous bacterial concentration. Combined with the speed of operation, this leverage principle could open up new detection possibilities.

PS-64 [15:00]

Development of novel spatial synthetic exposure system for studies on thermal perception thresholds of biological effects exposed to millimeter-wave

Ryunosuke Ozaki[1], Takashi Hikage[1], Hiroshi Masuda[2] & Tatsuya Ishitake[2]

[1]*Faculty of Information Science and Technology, Hokkaido University, Sapporo, Japan, 0600814*

[2]*Department of Environmental Medicine, Kurume University School of Medicine Kurume, Kurume, Japan, 8300011*

Keywords: Human, RF/Microwaves, Completed (unpublished)
Presented by: Ryunosuke Ozaki

A novel millimeter-wave exposure equipment was developed for studies on thermal perception thresholds of biological effects exposed to millimeter-wave at 60 GHz band that is one of beyond 5G candidate frequency band. To achieve controllable high-duty exposure on human skin, we newly designed a spatial synthetic exposure system consists of two lens antennas that can irradiate focused beam. After 6 minutesof exposure, the temperature on an expected area of a skin phantom surface increased 4 degrees Celsius with 2W of antenna input power. In summary, developed equipment can achieve the required high exposure on the sample.

PS-65 [15:00]

EMF-Portal as database for literature searches in systematic reviews

Dagmar Dechent[1], Lambert Bodewein[1], Kristina Schmiedchen[1] & Sarah Driessen[1]

[1]*Research Center for Bioelectromagnetic Interaction (femu), Uniklinik RWTH Aachen University, Aachen, Germany, 52074*

Keywords: Public Health Policy, All Frequencies, Work in Progress
Presented by: Dagmar Dechent

The EMF-Portal (www.emf-portal.org) is the most comprehensive scientific literature database on biological and health-related effects of electromagnetic fields with an inventory of currently 33,200 publications (April 2021). It served as the major literature database to identify relevant articles for nine systematic reviews of our team that evaluate biological and health-related effects of electric, magnetic and electromagnetic fields. Here, we outline the methodology and the general findings from the prepared systematic reviews.

PS-66 [15:00]

Exposure to extremely low-frequency magnetic fields in low- and middle-income countries: An overview

Dan Baaken[1, 3], Daniel Wollschläger[1], Theodoros Samaras[2], Joachim Schüz[3] & Isabelle Deltour[3]

[1]*Institute of Medical Biostatistics, Epidemiology and Informatics (IMBEI), University Medical Center Mainz, Mainz, Germany, 55131*

[2]*Aristotle University of Thessaloniki, Thessaloniki, Greece, 54124*

[3]*Environment and Lifestyle Epidemiology, International Agency for Research on Cancer (IARC/WHO), Lyon, France, 69372*

Keywords: Epidemiology, ELF/LF, Completed (published)
Presented by: Isabelle Deltour

To compare extremely low-frequency magnetic field (ELF-MF) exposure in the general population in low- and middle-income countries (LMICs) with high-income countries (HIC), we carried out a systematic literature search. We identified 25 relevant studies, which showed large heterogeneity in design, exposure environment and exposure assessment. Proportions of homes exposed to at least 0.3μT were many times higher in LMICs compared to HIC. Based on limited data, exposure to ELF-MF in LMICs appeared higher than in HIC, but a

direct comparison is hampered by a lack of systematic monitoring studies. Representative measurement studies on residential exposure to ELF-MF are needed in LMICs together with better standardization in the reporting.

PS-67 [15:00]

The effect of 1800 MHz radiofrequency electromagnetic field and cadmium co-exposure on protein expression profile and metabolic profile in JAR and JEG-3 cells

Longtao Zhu[1], Yumin Jin[1], Chuan Sun[2] & Guangdi Chen[1]

[1]*Bioelectromagnetics Lab, Zhejiang University School of Medicine, Hangzhou, China, China, 310058*

[2]*Zhejiang Provincial Key Lab of Geriatrics & Geriatri, Department of Geriatrics, Zhejiang Hospital, Hangzhou, China, China, 310058*

Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Guangdi Chen

Proteomics was used to analyze the changes of protein expression profile in JAR and JEG-3 cells after exposure to 1800 MHz RF-EMF and Cd. The results showed that 156 and 172 proteins expressed differentially in JAR and JEG-3 cells respectively. In addition, co-exposure of 1800 MHz RF-EMF and Cd can induce ATP5IF1 protein up-regulated in JAR cells while down-regulated in JEG-3 cells; BASP1, SRXN1, MT2A and MT1X and other proteins also expressed differentially in JAR and JEG-3 cells. Finally, the differently expressed proteins in JAR cells (MT2A) and JEG-3 cells (Cyclin D3 and TM2D3) were verified by Western blot. The results of this study suggested that 1800 MHz RF-EMF and Cd could affect the proteomic profiles in JAR and JEG-3 cells.

PS-68 [15:00]
Young Scientist

10ns bipolar pulses: effects on the plasma membrane permeability of 2D and 3D cellular models

Rosa Orlacchio[1], Muriel Golzio[2], Marie-Pierre Rols[2], Philippe Leveque[1] & Delia Arnaud-Cormos[1, 3]

[1]*Univ. Limoges, CNRS, XLIM, UMR 7252, F-87000, Limoges, France*

[2]*Institut de Pharmacologie et de Biologie Structurale, Université de Toulouse, CNRS, UPS, 31077, Toulouse, France*

[3]*Institut Universitaire de France (IUF), 75005, Paris, France*

Keywords: Electroporation, Pulsed, Completed (published)
Presented by: Rosa Orlacchio

Bipolar pulses can cancel the bioeffects induced by high-intensity nsPEF. However, cancellation can be totally reversed by applying a certain delay between the two opposite phases of the bipolar pulse. In this study we explore the effects of 10 nsPEF unipolar, bipolar, or bipolar with a 100 ns interphase interval, on the plasma membrane permeabilization. YO-PRO^{TM}-1 (YP) and propidium iodide (PI) uptake were used as markers of membrane permeabilization immediately after the application of the pulses in in vitro 2D and 3D cellular models, respectively. Results evidenced that bipolar cancellation occurred in both models considered and it was completely tapered out when a delay of 100 ns was introduced between the two phases.

PS-69 [15:00]

Calculated, simulated, and measured RF EMF exposure in the proximity of cellular base station antenna sites between 800 MHz and 2600 MHz

Gunter Vermeeren[1], Leen Verloock[2], Mart Verlaek[3], Michel Goethals[3], Wout Joseph[2] & Luc Martens[1]

[1]*imec - WAVES, Department of Information Technology at Ghent University, Ghent, Belgium, B-9052*

[2]*WAVES, Department of Information Technology at Ghent University - imec, Ghent, Belgium, B-9052*

[3]*Bureau for Environment and Spatial Development – Flanders, Departement Omgeving, Brussels, Belgium, B-1000*

Keywords: Dosimetry (computational), RF/Microwaves, Completed (published)

Presented by: Gunter Vermeeren

Regulatory bodies most often evaluate compliance around base station antenna sites with local regulations and international guidelines using calculations or simulations. In this study, we compared calculated with and simulated and measured exposure around selected base station antenna sites in Flanders. We measured the RF exposure around base station antennas using a spectrum analyzer and a triaxial probe, calculated the exposure based on the far-field radiation patterns of the base station antennas, and applied the FDTD method to simulate the exposure. We observed that variations of up to 30 dB between calculated, measured, and simulated exposures at locations that were in non line-of-sight of the base station antennas.

PS-70 [15:00]

Effect of High Peak Power Microwaves (HPPMs) on bovine coronavirus (BCoV) survival in solution

Jody Cantu[1], Ibtissam Echchgadda[2], Joseph Butterworth[1], Bryan Gamboa[2], David Freeman[1], Francis Ruhr[1], Weston Williams[1], Leland Johnson[2], Jason Payne[2], Robert Thomas[3], William Roach[4] & Bennett Ibey[2]

[1]*Air Force Research Laboratory, General Dynamics Information Technology, JBSA Fort Sam Houston, Texas, USA, 78234*

[2]*Air Force Research Laboratory, 711th Human Performance Wing, Airman Systems Directorate, Bioeffects Division, Radio Frequency Bioeffects Branch, JBSA Fort Sam Houston, Texas, USA, 78234*

[3]*Air Force Research Laboratory, 711th Human Performance Wing, Airman Systems Directorate, Bioeffects Division, JBSA Fort Sam Houston, Texas, USA, 78234*

[4]*Air Force Office of Scientific Research, Air Force Research Laboratory, Arlington, Virginia, USA, 22203*

Keywords: In vitro, RF/Microwaves, Completed (published)

Presented by: Jody Cantu

Previous work showed that exposing viral solutions to radio frequency (RF) energy caused inactivation suggesting its utility for large area decontamination. Specifically, Yang et al. reported that frequencies from 6–12 GHz impacted influenza virus infection and hypothesized it was due to mechanical coupling of the RF field. Thus, we evaluated the effect of high peak power microwave (HPPM) exposure on suspensions of a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) surrogate (bovine coronavirus, BCoV). Results indicated inactivation of BCoV at specific frequencies (5.6 GHz and 9.3 GHz); however, inactivation of BCoV was most effective at prolonged exposure during which the temperature of the solution increased to above 80 ^{o}C.

PS-71 [15:00]

Effects of prenatal exposure to a radiofrequency-electromagnetic field on the developing serotonergic system; a preliminary report

Hye Sun Kim[1], Hyung Do Choi[3], Jeong-Ki Pack[4], Nam Kim[5] & Young Hwan Ahn[1, 2]

[1]*Department of Neurosurgery, Ajou University School of Medicine, Suwon, Korea, 16499*

[2]*Neuroscience Graduate Program, Department of Biomedical Sciences, Graduate School of Ajou University, Suwon, Korea, 16499*

[3]*Radio Technology Research Department, Electronics and Telecommunications Research Institute, Daejeon, Korea, 34129*

[4]*Department of Radio Sciences and Engineering, College of Engineering, Chungnam National University, Daejeon, Korea, 34134*

[5]*School of Electrical and Computer Engineering, Chungbuk National University, Chungbuk National University, Cheongju, Korea, 28356*
Keywords: In vivo, RF/Microwaves, Completed (unpublished)
Presented by: Hye Sun Kim

We evaluated the effect of prenatal exposure to RF-EMF on the developing serotonergic system in rats. We suggest that maternal and fetal serotonin levels can be affected by prenatal RF- EMF exposure during pregnancy.

PS-72 [15:00]

Assessing membrane charging by alternating electric fields in giant unilamellar vesicles

Allen Kiester[1], Stacey Martens[1], Zachary Coker[2], Joel Bixler[1], Esin B. Sözer[3] & Bennett Ibey[1]

[1]*Radio Frequency Bioeffect Branch, Air Force Research Laboratory, Fort Sam Houston, Texas, USA, 78234*

[2]*SAIC, Fort Sam Houston, Texas, USA, 78234*

[3]*Frank Reidy Center for Bioelectrics, Old Dominion University, Virgnia, USA, 23529*
Keywords: Electroporation, Pulsed, Completed (unpublished)
Presented by: Bennett Ibey

Our group recently published direct observation of membrane charging in FluoVolt™ labeled CHO-K1 cells by nanosecond electrical pulses using a streak camera. Using this technique, called Streak Camera Microscopy (SCM), we imaged the membrane charging dynamics in giant unilamellar vesicles (GUVs) during AC exposures up to 6 MHz and compared these results to existing capacitive circuit models of membranes. This work shows further application of Streak Camera Microscopy for evaluation of high speed biological events.

PS-73 [15:00]

Preliminary results of Global questionnaire survey to researchers on standardization of experimental protocol for safety assessment of EMF

Akira Ushiyama[1], Kenji Hattori[2], Masateru Ikehata[3], Keiji Wada[4] & Yukihisa Suzuki[4]

[1]*Department of Environmental Health, National Institute of Public Health, Saitama, Japan, 3510197*

[2]*Environmental Toxicology Lab., Meiji pharmaceutical University, Tokyo, Japan, 2048588*

[3]*Biotechnology laboratory, Railway Technical Research Institute, Tokyo, Japan*

[4]*Department of Electrical and Electric Engineering, Tokyo Metropolitan University, Tokyo, Japan*
Keywords: Standards, All Frequencies, Work in Progress
Presented by: Akira Ushiyama

There is no unified method for evaluating the toxicity of electromagnetic fields and assessing health risks. In order to develop a standardization of experimental protocol for safety assessment of EMFs, we conducted an internet survey of researchers to investigate their attitudes toward the standardization method.

PS-74 [15:00]

Effects of local exposure to 28 GHz-millimeter-wave on skin blood flow in human volunteer

Tatsuya Ishitake[1], Miyako Inoue[1], Etsuko Ijima[1], Takashi Hikage[2, 3], Ryunosuke Ozaki[2], Akimasa Hirata[3], Sachiko Kodera[3], Kenji Taguchi[4], Tatsuya Kashiwa[4] & Hiroshi Masuda[1]

[1]*Department of Environmental Medicine, Kurume University, Kurume, Japan, 830-0011*

[2]*Graduate school of Information Science and Technology, Hokkaido University, Hokkaido, Japan, 060-0814*

[3]*Department of Electrical and Mechanical Engineering, Nagoya Institute of Technology, Nagoya, Japan, 466-8555*

[4]*Department of Electrical and Electronic Engineering, Kitami Institute of Technology, Kitami, Japan, 090-8507*
Keywords: Human, RF/Microwaves, Completed (unpublished)
Presented by: Tatsuya Ishitake

There is little information about the biological effects of millimeter-waves (MMW) such as 5th generation wireless systems (5G) and WiGig (IEEE 802.11ad) on human body. Aim of this study was to evaluate changes in skin blood flow at the forearm under the local exposure to 28 GHz-MMW in human volunteers. The local increase in skin blood flow was found within the target skin exposed at 1 W of antenna input power. Under the same exposure conditions, the elevation of target temperature was also observed. Therefore, our findings suggest that the local exposure to 28 GHz-MMW could affect blood flow regulation as a thermal response of human skin under present exposure conditions.

PS-75 [15:00]

Measurement accuracy of inexpensive magnetic field meters and magnetic field meter applications for smart devices

Tetsuya Tsutsumi[1], Yuuki Yamato[1], Ryuusaku Furuichi[1], Toshihisa Kadoya[1], Tomomichi Omote[1] & Chiyoji Ohkubo[1]

[1]*Japan EMF Information Center, Japan Electrical Safety & Environment Technol, Tokyo, Japan, 105-0014*
Keywords: Mechanistic/Theoretical, ELF/LF, Completed (published)
Presented by: Tomomichi Omote

There are inexpensive meters and freely downloadable applications (apps) for smart devices to measure magnetic field (MF) strength on the market. In this study, we evaluated the measurement accuracy of these meters and apps that can be easily available to the general public, under a uniform magnetic field at the power frequency (50 Hz) generated by a coil. It was shown that the measured values of these meters should be used only as a guide and the apps were not suitable for MF measurement.

PS-76 [15:00]

IIOSH (Israel Institute for Occupational Safety and Hygiene) Non-Ionizing Radiation Policy

Amnon Duvdevany[1]

[1]*NIR Section, IIOSH (Israel Institute for Occupational Safety and Hygiene), Tel-Aviv, Israel, 6101001*
Keywords: Public Health Policy, All Frequencies, Completed (published)
Presented by: Amnon Duvdevany

The Israel Institute for Occupational Safety and Hygiene (IIOSH) has developed a Non-Ionizing Radiation (NIR) guide to protect workers at workplaces from NIR hazards. The guide is intended to protect both General Public and Occupational Exposure populations, while implementing different standards and guidelines according to Israeli laws and regulations of different ministries and while applying precautionary principle to decrease exposure levels. The guide assists the employer to differentiate between populations and environments, to implement initial and general steps to reduce exposures and to prepare a detailed protection program when needed. The IIOSH policy rational, details and challenges will be discussed.

PS-77 [15:00]

Evaluation of membrane potential response to oscillating electric fields using streak camera microscopy

Joel Bixler[1], Allen Kiester[1], Zachary Coker[2] & Bennett Ibey[1]

[1]*Air Force Research Laboratory, JBSA Fort Sam Houston, Texas, USA, 78234*

[2]*SAIC, San Antonio, Texas, USA, 78234*

Keywords: Electroporation, Pulsed, Completed (unpublished)
Presented by: Joel Bixler

Streak camera based microscopy (SCM) is a powerful technique for resolving sub-microsecond dynamics for cellular exposures to pulse nanosecond electrical fields (pnsEF). Previous work demonstrated the ability to image changes in membrane potential during cellular exposure to unipolar and bipolar electric pulses.This presentation will discuss continued work to apply SCM, in conjunction with FluoVolt™ dye, to study the response of multiple cell lines to alternating current (AC) electric fields. Understanding the dynamics of plasma membrane charging during AC pulses will better inform those using such pulses to modify cell behavior.

PS-78 [15:00]
STUDENT PAPER

Collocated and distributed Massive MIMO from the human EMF exposure perspective: a comparative study

Sergei Shikhantsov[1], Arno Thielens[1], Gunter Vermeeren[1], Emmeric Tanghe[1], Piet Demeester[1], Luc Martens[1] & Wout Joseph[1]

[1]*Department of Information Technology, Ghent University/IMEC, Ghent, Belgium, 9000*
Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Sergei Shikhantsov

In this numerical study we compare two deployment strategies of massive MIMO from human exposure perspective. Propagation is modelled using the Ray-Tracing method at 3.5 GHz in a stochastic environment model. An indoor industrial environment is modelled as a square room and scatterers randomly distributed in it. Two base station (BS) configurations are studied: a compact antenna array and an array evenly covering the floorplan ceiling. The exposure is assessed in terms of the psSAR the head normalized to the power density, using the FDTD method. The exposure of the distributed BS is found to be at least two times lower than that of the collocated BS. Implications for the exposure of practical massive MIMO implementations are discussed.

PS-79 [15:00]

Nano-Pulse Stimulation (NPS) demonstrates superior efficacy in the treatment of B16-F10 melanoma tumors and produces less permanent skin damage compared to cryoablation

Amanda McDaniel[1], Bruce Freimark[1], Cebrina Bustos[1], Jeffrey Litt[1] & Richard Nuccitelli[1]

[1]*Biology, Pulse Biosciences, Hayward, CA, USA, 94545*
Keywords: In vivo, Pulsed, Work in Progress
Presented by: Amanda McDaniel

Nano-Pulse Stimulation (NPS) is a non-thermal energy modality that applies ultrafast, high-amplitude energy pulses in the nanosecond range. The application of NPS to tissues initiates a cascade of events within cells that leads to regulated cell death (RCD). B16-F10 mouse melanoma tumors were treated with NPS or cryoablation and the efficacy and resulting skin damage was compared between these modalities. NPS eliminated 95% of all tumors whereas cryoablation only eliminated 50%. In addition, cryoablation produced more dermal fibrosis than NPS. Overall, NPS demonstrated superior efficacy at complete tumor elimination and produced less dermal fibrosis than cryoablation.

PS-80 [15:00]

Experimental set up for 60 GHz millimeter wave exposure to *in vitro* 3D tissue models

Masateru Ikehata[1], Yukihisa Suzuki[2], Toshio Kamijyo[2], Sachiko Yoshie[1], Takafumi Tasaki[4], Masami Kojima[3,]

[4] & Hiroshi Sasaki[3, 4]

[1]*Biotechnology Laboratory, Railway Technical Research Institute, Tokyo, Japan, 1858540*

[2]*Department of Electrical Engineering and Computer Science, Tokyo Metropolitan University, Tokyo, Japan, 1920397*

[3]*Faculty of Ophthalmology, Kanazawa Medical University, Kanazawa, Japan, 9200293*

[4]*Department of Life Sciences Medical Research Institute, Kanazawa Medical University, Kanazawa, Japan, 9200293*

Keywords: In vitro, RF/Microwaves, Work in Progress

Presented by: Masateru Ikehata

We constructed an experimental setup of 60 GHz millimeter wave exposure to evaluate biological effects in in vitro 3D human tissue model to evaluate biological effects by exposure the millimeter wave. An exposure apparatus is constructed with a lens antenna and to expose 60 GHz millimeter wave (up to 500 mW/cm^2 in maximum power density) from directly above the surface of tissue model in a temperature and humidity controlled chamber. In preliminary experiments, the power density of the exposed millimeter wave had a Gaussian distribution on the cell surface, and cell death inferring by the thermal effect was observed dependent on the input power. A detailed analysis is underway and will be presented at the conference.

PS-81 [15:00]
STUDENT PAPER

A grid electrode for *in-vitro* studies under stimulation of nanosecond electric pulses

Wen Dang[1], Xin Rao[2], Xiaodong Chen[1, 2] & Yasir Alfadhl[1]

[1]*School of Electronic Engineering and Computer Science, Queen Mary University of London, London, United Kingdom, E1 4NS*

[2]*Circuits and Systems Key Laboratory of the Ministry of Education, Hangzhou Dianzi University, HangZhou, China, 310018*

Keywords: In vitro, Pulsed, Work in Progress

Presented by: Wen Dang

Intensive nanosecond pulsed electrical fields (nsPEF) have been applied to induce a range of biological effects for the therapeutic purpose. High voltage nanosecond pulses are usually applied across a narrow metal plate cuvette in in-vitro studies. However, due to a high conductivity of the cell load culture, the resistance tends to be as low as a few tens of Ohms if a large volume of the cell samples is loaded. The low cell load resistance will result in a large current flow- posing a technical challenge to the pulse generator and also distort the pulses. In this paper, the grid electrode is proposed to increase the cell load resistance and reduce the parasitic capacitance, which exhibits an improved performance based on EM simulation.

PS-82 [15:00]

Preliminary measurements of dielectric properties of excised human tissues and the associated challenges thereof

Anton Kordic[1], Andela Matkovic[2], Antonia Jakovcevic[3] & Antonio Sarolic[2]

[1]*Department of Neurosurgery, University Hospital Centre Zagreb, Zagreb, Croatia, HR-10000*

[2]*Chair of Applied Electromagnetics, University of Split, FESB, Split, Croatia, HR-21000*

[3]*Department of Pathology and Cytology, University Hospital Centre Zagreb, Zagreb, Croatia, HR-10000*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress

Presented by: Anton Kordic

We initiated the measurement campaign of dielectric measurements of excised human tissues obtained from hospital surgeries and autopsies. However, a number of logistical problems were encountered. The campaign

is time-consuming and inefficient with low throughput, if the samples are to be measured within a short period after excision. To circumvent this, preservation of sample properties would be required over an extended period, requiring careful protocols for tissue preservation and handling. Despite the problems with the small sample volumes, dehydration, degradation over time, and probe pressure uncertainty, in this pilot study the results converged towards the reference values.

PS-83 [15:00]

Effects of high intensity local exposure to 26.5 GHz-millimeter-waves on neuronal cells in rat brain

Etsuko Ijima[1], Tatsuya Ishitake[1], Akimasa Hirata[2], Sachiko Kodera[2], Akiko Matsumoto[3], Takashi Hikage[4] & Hiroshi Masuda[1]

[1]*Department of Environmental Medicine, Kurume University, Kurume, Japan, 830-0011*

[2]*Department of Electrical and Mechanical Engineering, Nagoya Institute of Technology, Nagoya, Japan, 466-8555*

[3]*Department of Social Medicine, Saga University School of Medicine, Saga, Japan, 849-8501*

[4]*Graduate school of Information Science and Technology, Hokkaido University, Hokkaido, Japan, 060-0814*

Keywords: In vivo, RF/Microwaves, Completed (unpublished)

Presented by: Etsuko Ijima

The possibility of 5G-MMW of mobile phones to cause any adverse health effects on the brain is a current issue in public health. However, the intensity level of the 5G-MMW exposure, which could occur the inflammation of neuronal cells, was still unclear. Aim of the present study was to investigate a threshold of the local exposure intensity of 26.5 GHz-MMW for the expression of COX-2 as an indicator of inflammation, in the rat brain. We found obvious COX-2 induction in neuronal cells in the exposed rat cortex 24 hours after the exposure under high-intensity exposure conditions.

PS-84 [15:00]
STUDENT PAPER

Electromagnetic characterization of PEMFs for the neuroprotective treatment of ischemic strokes in semi-specific models: a comparison between an active and a placebo patient

Sara Fontana[1], Micol Colella[1], Simona Salati[2], Stefania Setti[2], Francesca Apollonio[1], Ruggero Cadossi[2] & Micaela Liberti[1]

[1]*Department of Information Engineering, Electronics and Telecommunications (DIET), University of Rome "La Sapienza", Rome, Italy, 00184*

[2]*IGEA Biophysics Laboratory, Carpi, Italy, 41012*

Keywords: Dosimetry (computational), ELF/LF, Work in Progress

Presented by: Sara Fontana

The application of low intensity and low frequency pulsed electro-magnetic fields (LF-PEMFs) may represent a neuroprotective approach for the treatment of cerebral damages in patients affected by acute ischemic stroke. An ongoing randomized, placebo-controlled, double-blind study aims to validate the PEMFs as a non-invasive, effective, tolerable, and safe treatment, as an adjunctive treatment to drug therapies already in use. This work proposes a dosimetric study on semi-specific models of a placebo and an active patient, to preliminary confirm the possible correlation between the evolution of ischemic lesion and the magnetic field values, as observed in active patients.

PS-85 [15:00]

Proposal of a 5G 3.5 GHz in vitro exposure system by means of a radial transmission line

Young Seung Lee[1], Sangbong Jeon[1] & Hyung-Do Choi[1]

[1]*Radio & Satellite Research Division, Electronics and Telecommunications Research Institute, Daejeon, Korea, 34129*

Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Young Seung Lee

A fifth-generation 3.5 GHz in vitro exposure system is proposed by means of a radial transmission line (RTL). A conical horn antenna is employed for feeding to allow field symmetry. Simulation results of the input RTL return loss indicate that higher-order modes are successfully suppressed inside a radial waveguide with decreasing RTL height. Optimizations are also performed for the single mode operation in order to assure in vitro experiment performances.

PS-86 [15:00]
STUDENT PAPER

Influence of the 4G/5G dynamic spectrum sharing on human RF exposure to mobile radio services

Lisa-Marie Schilling[1], Christian Bornkessel[1] & Matthias Hein[1]

[1]*RF & Microwave Research Laboratory, Thuringian Center of Innovation in Mobility, TU Ilmenau, Ilmenau, Germany*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Lisa-Marie Schilling

The gradual shutdown of the 3G mobile radio network in Germany releases spectral resources in the 2100 MHz band which can be used for successor technologies such as 4G and 5G. Since mid of 2020, dynamic spectrum sharing (DSS) has been increasingly used to enable parallel operation of 4G and 5G in one and the same frequency band. There is an increasing need of information with regard to a possible change in exposure associated with DSS. Therefore, investigations were carried out to study the exposure across the 2100 MHz band in scenarios with and without DSS. Overall, the maximum exposure has not changed due to 4G/5G DSS. The instantaneous exposure has remained comparable or even slightly decreased compared to the previous status.

PS-87 [15:00]

Development of phantom for human body detection focusing on RCS

Kazuki Sato[1] & Kazuyuki Saito[2]

[1]*Graduate School of Science and Engineering, Chiba University, Chiba, Japan*

[2]*Center for Frontier Medical Engineering, Chiba University, Chiba, Japan*

Keywords: Human, RF/Microwaves, Work in Progress
Presented by: Kazuki Sato

In this research, we are developing a phantom for human body detection system that is necessary for the development of spatial transmission type WPT. We calculated the RCS of the human body at 5.7 GHz by numerical calculation, and developed a phantom with that value as the target.

PS-88 [15:00]

New insights from a Bayesian analysis of melatonin levels and low-frequency magnetic fields

Nicolas Bouche[1] & Kevin McConway[2]

[1]*CRAL, University of Lyon1, St Genis Laval, France, F-69230*

[2]*Mathematics And Statistics, The Open University, Milton Keynes, United Kingdom, MK7 6AA*

Keywords: Epidemiology, ELF/LF, Completed (published)

Presented by: Nicolas Bouche

The epidemiological study of Wertheimer1979 raised concerns for adverse health effects due to Extremely Low Frequency magnetic fields (ELF MF) generated by power lines. Since, epidemiological studies and laboratory studies on rats have often been contradictory, specifically regarding the biomarker melatonin. Here, we use a Bayesian model and a non-parametric approach to show that past contradictory results can be reconciled under a single framework, resolving a long standing controversy.

PS-89 [15:00]

An *In Vivo* exposure system for ELF magnetic field exposure

Myles Capstick[1], Thomas Fussinger[1], Annette Bitsch[3] & Niels Kuster[1, 2]

[1]*Foundation for Research on Information Technologies in Society (IT'IS), Zurich, Switzerland, CH-8004*

[2]*Department of Information Technology and Electrical Engineering, Swiss Federal Institute of Technology (ETH Zurich), Zurich, Switzerland, CH-8092*

[3]*Toxicology and Environmental Hygiene, Fraunhofer ITEM, Hannover, Germany, 30625*

Keywords: In vivo, ELF/LF, Work in Progress

Presented by: Myles Capstick

This paper describes the exposure system designed for the Federal Office for Radiation Protection (Bundesamt für Strahlenschutz) BFS in Germany to study the possible link between extremely low frequency magnetic fields and childhood Leukemia using genetically modified ETV6-RUNX1 mice predisposed to the occurrence of leukemia. The exposure system provides a homogeneous 50 Hz magnetic field exposure at up to 1.5mT with both fundamental and harmonic content and can house up to 315 mice per exposure group.

PS-90 [15:00]

Variations of induced electric field for an exposed mouse in an 85kHz magnetic field generator

Siriwat Wasoontarajaroen[1], Munetaka Kanagawa[1], Yukihisa Suzuki[1], Kasuki Matsubara[1], Keiji Wada[1], Shin Ohtani[2], Kenji Hattori[2], Akira Ushiyama[3] & Satoshi Nakasono[4]

[1]*Graduate School of Systems Design, Tokyo Metropolitan University, Hachioji, Japan, 192-0361*

[2]*Department of Hygienic Chemistry, Meiji Pharmaceutical University, Kiyose, Japan, 204-8588*

[3]*Department of Environmental Health, National Institute of Public Health, Wako, Japan, 351-0197*

[4]*Environmental Science Research Laboratory, Central Research Institute of Electric Power Industry, Abiko, Japan, 270-1194*

Keywords: Dosimetry (computational), IF, Work in Progress

Presented by: Siriwat Wasoontarajaroen

Variations in the induced electric field intensity of an exposed mouse body due to mass, posture and position were numerically evaluated. Exposure simulations were performed on three homogeneous mouse models made from different data sources, including anatomical, 3D photogrammetry, and oval shape models. Results were given in the whole-body-average and 99^{th}-percentile values of the induced electric field intensity.

Silver Sponsors

Bronze Sponsors

CLINICAL BIOPHYSICS

Booths

Author Index