

▪ SIX DAYS

▪ THREE CONFERENCES

▪ ONE EXHIBITION

EUROPE'S PREMIER
MICROWAVE, RF,
WIRELESS AND
RADAR EVENT



EuMC Workshop: WM-07

EMF Biomedical Applications

Monday, Sept. 30, 2019

Technologies and modelling for electromagnetically-mediated medical treatments: at the beginning of the “electroceuticals” era

Organizer(s)

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Workshop Description:

In a nutshell, the workshop will give an extensive overview covering the main technological key-points and theoretical background for cutting-edge research and applications in the addressed area. A panel discussion will conclude the event stimulating interactions among attendees, speakers and chairmen. Of course the way towards a permanent solution is long but this workshop will provide a first insight to EUMA researchers into this very promising research. EUMA community has the potentiality of giving extremely constructive contributions in technological improvements and in modelling RF/MW interactions with biological targets.

Workshop Abstract:

In 2013, a new idea came out identifying the possibility to use electric pulses (with frequency content spanning up to MW) to precisely and selectively target nerves in order to treat different pathologies. This because nerves supervise the function of a number of organs and physiological processes as inflammation or metabolism. So, in principle, “electroceutical” can strongly affect the treatment of different pathologies with a completely new therapeutic paradigm. The workshop will address the technological aspects related to this new vision of therapeutic approaches, and will provide updated knowledge on modelling interactions between the stimulating signals (in a wide band of frequencies) and the targeted organs, down to the network of neurons. A general overview of the proposed approach will be provided to present the great potentiality of this new vision for treating pathologies. In the workshop, new technological applications related to flexible electronics (at radiofrequency-RF and microwaves-MW) and implantable devices will be proposed. Clearly the bio-electronic (at RF and MW) is one of the main ingredients of this new therapeutic approaches and this topic is a fundamental point of interest in the EUMA community. The development of innovative implantable devices realized on non-conventional materials is also a key ally for the remote stimulation of various body regions. Coupling of electronics with flexible material and nanotechnologies is crucial. On the other side, there is another level of understanding that has to be improved: the interaction of the applied electromagnetic field distributions with the bio-targets and the relevant interaction mechanisms. Indeed, the modulation of nerves and neuronal cell transmembrane potentials are necessary for the definition of precise activation of action potentials which are the natural electric signals governing our organs and neuronal fibres. Advanced modelling of tissues and organs will be proposed to provide controlled and personalized treatments. In a nutshell, the workshop will give an extensive overview covering the main technological key-points and theoretical background for cutting-edge research and applications in the addressed area.

Speakers

Speaker #1: Prof. Luciano Tarricone
Affiliation: Department of Innovation, University of Salento, Lecce, Italy
Presentation Title: Electroceuticals technologies and modelling: fundamental requirements to effectively manage future therapies
Email: luciano.tarricone@unisalento.it
Abstract: In the recent past the word “electroceutical” is attracting attention and investments. Electroceutical is a multidisciplinary initiative for medical treatments using electric/magnetic /electromagnetic power to modulate a number of body function controlled by neurological circuits. In this presentation the important role played by the use of suitable modelling techniques at cell and tissue level will be demonstrated to understand and predict possible therapeutic effects mediated by the electromagnetic stimulation. Furthermore, the fundamental role of wireless power transfer as a supportive technology for implants will be discussed. It will be also presented how the combination of the theoretical and technological capabilities can open new perspective to the use of RF technologies in biomedicine.

Speaker #2: Dr. Arnaud Pothier
Affiliation: Xlim, UMR 7252 CNRS /Limoges University RF-ELITE Department, 87060 Limoges Cedex, FRANCE
Presentation Title: Progress in dielectric spectroscopy for biological cell characterization and cell sorting at MHz frequencies
Email: arnaud.pothier@xlim.fr
Abstract: This talk will introduce emerging methods to characterize biological cells based on dielectrophoresis approaches translated to UHF frequencies. It will be proved the opportunity to use high frequency signal to discriminate intracellular features related to aggressive cancer cells especially ones know to escape to standard chemio- or radio-therapy. It will be show how to take benefit of the faculty of high frequency to penetrate into biological cells and non-invasively probe their content combined with microfluidic lab-on-chip technology capabilities to enable single cell manipulation to promote alternative and label-free cell analysis techniques.

Speaker #3: Prof. Francesca Apollonio
Affiliation: Department of Information Engineering, Electronics and Telecommunications, Sapienza University of Rome, Italy.
Presentation Title: Drug delivery through liposomes carriers mediated by pulsed electric and magnetic fields: experimental and modelling studies
Email: apollonio@diet.uniroma1.it
<p>Abstract:</p> <p>In the last decades there has been an increasing interest in integrating nanotechnology with medicine, with the aim to provide diagnosis and treatment of diseases. In this context drug delivery techniques have emerged as methods to administering a pharmaceutical compound in the site of interest. Therapeutic efficacy may be enhanced by triggering drug release in the desired organ in a controlled manner using a non-invasive external stimulus.</p> <p>How to obtain a controlled release from biocompatible carriers is the topic of the present paper once liposomes vesicles have been chosen as nanocarriers due to their wide range of advantages including good biocompatibility, good biodegradability, low antigenicity and the unique ability to entrap both hydrophilic and hydrophobic compounds.</p> <p>Therefore the aim of the paper will be to provide a proof-of-concept of remotely control a release from liposomes vesicles, by means of an electromagnetic field: either a low level magnetic field or an ultra-short intense electric pulse. The feasibility of the investigation will be pursued combining three steps: the design and realization of the applicators and exposure systems; the synthesis of the liposome and the exposure of the suitable liposome solution; the modeling of the interaction mechanism between the field and the liposome membrane bilayer.</p>

Speaker #4: Prof. Eugenijus Kaniusas
Affiliation: Institute of Electrodynamics, Microwave and Circuit Engineering, Vienna University of Technology, and Department of Surgery, Medical University Vienna, Vienna, Austria
<p>Presentation Title:</p> <p>Auricular vagus nerve stimulation - an electromagnetically-mediated medical treatment: from model to experiment</p>
Email: hubert.martens@salvianeuro.com
<p>Abstract:</p> <p>Electrical stimulation of the auricular vagus nerve is a medical treatment mediated by pulsatile stimulation of sensorial nerve endings in the ear. The treatment targets chronic pain diseases, neurodegenerative and metabolic ailments as well as inflammatory and cardiovascular diseases. While experimental data uncovers its potential clinical effects, in-silico modelling acts as a tool for optimization of the stimulation set-up.</p>

Speaker #5: Dr. Simon Hemour
Affiliation: Bordeaux University, IMS Laboratory, Talence, France.
Presentation Title: Wireless Microenergy Platform: Pushing implantable remote stimulation to the μL (micro Liter) level
Email: simon.hemour@u-bordeaux.fr
<p>Abstract:</p> <p>This presentation will first sketch the big picture of implantable medical stimulators. With the wireless power transfer perspective, it will describe the challenges and the large opportunities offered by μL-sized devices. The focus will then be given to the innovative techniques in electromagnetic field engineering recently developed to avoid electric field penetrating the tissues, and enable various benefits from lower RX size to hybridation of coils and stimulation electrodes towards implantability, durability, efficiency and affordability of the systems.</p>