MATS-OLOF MATTSSON ELECTED VICE PRESIDENT

The election of Mats-Olof Mattsson as Vice President/President Elect of The Bioelectromagnetics Society (BEMS) was announced at the Annual Business Meeting on Wednesday, June 23, 1999 in Long Beach, CA, USA. Other new Board members are Maria Feychtling and Martin Meltz for Biological/Medical Sciences, Bruce McLeod for Engineering/Physical Sciences and Monica Sandstrom, At Large.

Dr. Mattsson begins his duties as chairman of the Technical Program Committee for the Twenty-second Annual Meeting in June, 2000 in Munich, Germany immediately.

KATJA POKOVIC, MILICA POPOVIC AND FRANCESCA MATTIA WIN CURTIS JOHNSON STUDENT AWARDS

There were 29 students in the 1999 student award competition. This year all students were placed in poster sessions in order for judges to visit with students individually and ask questions. The poster sessions were on Monday and Tuesday afternoon and the Awards Committee quickly tabulated the results so that the announcement could be made at the Tuesday evening social event. At the dinner on the Queen Mary Jim Lin gave an introduction about Curtis Johnson, the pioneering bioelectromagnetics engineer after whom the student awards are named. The awards were presented to the students and their advisors by President Betty Sisken. The first place winner was Katja Pokovic and her advisor, Neils Kuster from the Swiss Federal Institute of Technology in Zurich, Switzerland. The second place was awarded to Milica Popovic and her advisors at Northwestern University, Illinois, USA, and third place was awarded to Francesca Mattia and her advisor, Guglielmo D'Inzeo of the University of Rome ‘La Sapienza’, Rome, Italy.

The titles of the student presentations, the authors and affiliations, and the abstracts follow:


INTRODUCTION: Current near-field scanners enable precise measurement of electric and magnetic field strength distributions, even in the closest proximity of transmitters embedded in complex environments [1]. However, information on the polarization of the field cannot be assessed with current solutions. Specialized procedures and probes would greatly enhance the quality of the information needed for analysis and optimization of the radiating structures under test.

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NANCY WERTHEIMER RECEIVES D'ARSONVAL AWARD AT 1999 ANNUAL MEETING

Dr. Nancy Wertheimer became the seventh recipient of the d'Arsonval Medal and Award on Monday, June 21, 1999 in Long Beach, CA, USA at the Twenty-First Annual Meeting of The Bioelectromagnetics Society (BEMS). Dr. Wertheimer was introduced and the award was presented by Dr. Betty Sisken, President of BEMS, at a luncheon in honor of Dr. Wertheimer. The d'Arsonval Award is presented by BEMS to recognize outstanding achievement in bioelectromagnetics.

The text of the plaque awarded to Dr. Wertheimer reads:

By this writ, we recognize a woman of singular intellect and ingenuity, our esteemed colleague,

Nancy MacKay Wertheimer

Her's has been a diligent trek along paths not taken until she took them, a pioneering venture to probe low-frequency magnetic fields as a biologically active agent. Early on, with physicist Edward Allen Leeper, she developed wiring codes by which to index human exposure to residential magnetic fields. During a series of epidemiological studies that date from the late 1970's, which at first were greeted with caustic criticism, she persevered, unruffled, with quiet grace. In time she was accorded the innovative scientist's greatest accolade: independent confirmation of her work. Noteworthy is the absence of institutional or grant support during her decades of labor. Except for the admirable assist by colleague Leeper, she did it her way - on her own.

We take pride in conferring the Society's highest honor, the d'Arsonval Medal on this gifted woman. We do so on the 21st day of June, 1999, in the city of Long Beach, California, U.S.A.

An article by Dr. Wertheimer based on her presentation to the Society as well as the introduction by Dr. Sisken will appear in an upcoming issue of the Society's journal, Bioelectromagnetics.

The BIOELECTROMAGNETICS Society Newsletter is published and distributed to all members of the Society. Information regarding the Society may be obtained by writing to BEMS, 7519 Ridge Road, Frederick, MD 21702-3519. Institutions and libraries may subscribe to the Newsletter at an annual cost of $58.50 ($67.50 for overseas subscribers). The Newsletter serves the membership and subscribers in part as a forum for the presentation of ideas and issues related to bioelectromagnetics research. All submissions to the Newsletter must be signed and reflect the individual views of the authors and not official points of view of the Society or of the institutions with which the authors are affiliated. The Society solicits contributions to the Newsletter from its members and others in the scientific and engineering communities. News items as well as short research notes and book reviews are welcome. Advertisements inserted and distributed with the Newsletter are not to be considered endorsements.

Submit items for consideration to: M. E. O'Connor, University of Tulsa, Psychology Department, 600 S College, Tulsa, OK 74104-3189. (Tel: 918-631-2838; Fax: 918-631-2833; E-mail: mary-oconnor@utulsa.edu)

M. E. O’Connor, Editor

For Newsletter items, contact the Editor.

For other Society business, contact: The Bioelectromagnetics Society, 7519 Ridge Road, Frederick, MD 21702-3519. Tel: 301-663-4252; Fax: 301-371-8955; E-mail: 75230.1222@compuserve.com

BEMS Web Site:

http://www.bioelectromagnetics.org
OBJECTIVE: The objective of this project was to develop the probe as well as the measurement procedure needed to enable not only the information on the field amplitude but also information on the polarization of the field at any measured location.

METHOD AND DESIGN: For the description of an arbitrarily oriented ellipse in three dimensional space five parameters are needed: semimajor axis (a), semiminor axis (b), two angles describing the orientation of the normal vector of the ellipse (ϕ, θ) and one angle describing the distortion of the semimajor axis (ψ). The probe consists of two sensors with different angles toward the probe axis. By rotating the probe around its axis, a minimum of three measurements (total six readings) are necessary to reconstruct the polarization ellipse. For the reconstruction of ellipse parameters, the equation has been separated into a linear part and a non-linear part. Solving the linear part yields direct assessment of the parameters (a, b), while the non-linear part is used to determine unknown angles of the ellipse (ϕ, θ, ψ). For this purpose the Givens algorithm has been embedded into a downhill simplex algorithm. The initial measurement data defined by the sensor angles (γ1, γ2) and the probe rotation angles (β1, β2, β3) are crucial for the success and accuracy of the reconstruction routine. The optimal sensor and measurement angles as well as the most effective reconstruction procedure were evaluated using a genetic algorithm [2] with the sensor and measurement angles as genotypes. For each step the simulated probe values of 100 arbitrary linear and elliptical polarized fields were used as the input to the reconstruction algorithm, and the output was statistically evaluated. The genetic algorithm selected and mutated the probe angle and reconstruction parameters until the optimum was found with respect to high reconstruction accuracy and low sensitivity to measurement errors or manufacturing deviations in the probe.

Based on the numerical analysis, a probe prototype with two 3mm long dipole sensors placed on their substrates and with optimized angles toward the probe axis (γ=30° and 120°) was built and tested. A reconstruction routine for elliptical and linear polarization has been implemented into the DASY software, as has the visualization of the measured vector field. The elegance of the procedure is that the precision can be enhanced by adaptively increasing the number of measurements per position, starting from the initial three angles (e.g., β=0°, 100° and 240°).

CONCLUSIONS: A novel type of E-field probe has been analyzed, optimized and constructed. Together with the developed numerical algorithm (combined non-linear/linear matrix solver), it is possible to reconstruct the ellipse parameters and with that to gain not only information about the field amplitude but also information about the field polarization at any measured location.


Poster No. P-124 - Katja Pokovic

FEM MODEL OF MUSCLE FIBER CONDUCTION RELEVANT TO IMPROVEMENT OF PROSTHETIC DEVICES. M. Popovic, A. Taflove and T.A. Kuiken. Electrical and Computer Engineering Department, Northwestern University, Evanston, Illinois 60208, USA. 2Northwestern University Medical School, Rehabilitation Institute of Chicago, Chicago, Illinois 60611, USA.

We are developing a detailed finite-element model of entire signal generation in muscle and signal conduction through the human arm. The goal of this research is to help build an improved upper-limb prosthetic device. By surgically grafting the residual brachial plexus nerves in the arm of an amputee onto each head of the biceps and triceps muscles, the electromyographic (EMG) signals from these nerve-muscle grafts could be used as additional signals for control of a powered artificial arm. A potential problem with this technique involves sensing independent surface EMG signals from each of the nerve-muscle grafts (in the case of the arm amputee, EMG signals from each head of the biceps and triceps). Crosstalk between the EMG electrodes at different recording sites should be minimized for optimal control.
of the powered arm. We are using finite-element method (FEM) modeling to predict the crosstalk between each head of the biceps and triceps, optimize the electrode configuration and placement, and simulate the effects of various surgical manipulations for the improved isolation of signals. For the initial two-dimensional (2-D) investigations, a frequency-domain FEM software package (2D Maxwell) from Ansoft was used. The analysis was performed for CW sources at 70 Hz (the center frequency of the EMG) including the effects of displacement current. Although CW waveforms are not representative of the pulses that actually propagate through the muscle tissue, they can still be used in the model to provide insight into the field distribution within the cross-sectional arm shape. Fig. 1 (left) shows the simplified geometry of the arm cross-section used for analysis. To quantify the crosstalk, we simulate the activation of only one muscle, the lateral biceps. Fig. 1 (right) suggests a means to isolate the EMG signals by surgical insulation of the muscles with appropriate materials. Tissue dielectric properties at 70 Hz were taken from the literature. Several geometries of arm cross-section were analyzed. In all cases, 25 voltage point sources (0.1V amplitude) were randomly located in the lateral biceps. The reference (ground) point was taken to be at the location of the bone. Fig. 2 shows two results from these simulations. In both cases, a 10-mm-thick insulating layer was used to separate the lateral biceps from the adjacent muscles. Fig. 2 (left) shows the result if the insulating material is fat. The estimated crosstalk between the EMG recording of the lateral biceps and the remaining recording sites is reduced by 40% compared to the case of the normal arm geometry. If the insulation material is Teflon, as for the results shown in Fig. 2 (right), the crosstalk is reduced by 90%. Further crosstalk reduction is expected in the actual human arm due to the faster fall-off of the potential with distance from a source in three dimensions. Our immediate future work involves implementing a 3-D FEM model using the Ansoft EMAS software, which allows for time-domain analysis. This will enable modeling of source pulses of arbitrary shape and duration.
MATERIALS AND METHODS: Being the dipole of SA inserted in a complex environment such as lipid membrane, by developing the model of EMFs interaction proposed by Edmond [2], based on Larmor precession theory, we could calculate the power transferred to a dipolar structure by all the ELF field components. The calculated average power transferred to the dipole at frequency \( f \),
\[
\bar{P} = \frac{1}{2\pi f} |\mathbf{L}(f)|
\]
indicating \( L(f) \) as the FFT transform of \( \mathbf{L}(t) \) (\( z \) component of the angular moment of the dipole).

RESULTS: Considering the 7-Hz field used in our exposure experiments, we analyzed the increase of \( L_z(7-\text{Hz}) \) versus mass number \( M = m_p \gamma \),
\[
\text{where } e = \text{electron charge; } m_p = \text{proton mass.}
\]
Our mechanism studied the transfer of power from an EM field to a dipole. We chose to study a model based on the interaction of a magnetic field with a dipole other than an ion because the physical characteristics of liposomes. By our model it is possible to evaluate, the characteristics of the dipoles for which there is a transfer of power. The mass numbers of these dipoles have been calculated by plotting \( L_z(f) \) versus \( M \). Peaks of \( L_z(7-\text{Hz}) \) only resulted in correspondence of specific mass numbers. In the liposome membrane only the following molecules had mass number close to calculated values: the amine group (-NH,+) of SA (\( M = 17 \)), the amine plus three methylene groups (-\( CH_3 \))\( \cdot \)NH,\( \cdot \) of SA (\( M = 59 \)), and the polar head group of DPPC (\( CH_3 \))\( \cdot \)N,\( \cdot \) of SA (\( M = 59 \)). In simulation, choosing \( M = 59 \) and \( v = 0 \), \( L_z(f) \) has two peaks at 6.6 Hz and 13.3 Hz. A similar trend results in the influx rate of substrate across lipid bilayer enhanced by exposure at 7-Hz sinusoidal (50 \( \mu \text{Tpeak} \)) with parallel static (50 \( \mu \text{T} \)) magnetic field on CA-loaded liposomes.

DISCUSSION: Taking into account our experimental conditions, we have chosen the mass numbers which correspond to the lipid bilayer’s components. The behaviour of \( L_z(f) \) versus \( f \) (frequency of the applied magnetic field) has been studied for each \( M \). A direct correspondence between the behaviour of \( L_z(f) \) versus \( f \) (when \( M = 59 \)) and the increase of the diffusion rate of substrate throughout lipid membrane versus the frequency of the applied magnetic field was found. Thus it is possible to conclude that the target of ELF field is a small fraction of SA (i.e. \( -\text{(CH}_3\text{)}\text{N}^+ \)) with mass number equal to 59. The simulation results carried us to the same conclusion of the experimental ones, thus we have studied a model that completely describes the behaviour of our experimental system.


Cont’d on page6 (STUDENT AWARDS)
From page 5 (STUDENT A WARDS)

Florida June 7-11 1998


NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES (NIEHS) PRESS RELEASE REGARDING THE NIEHS EMF-RAPID PROGRAM

NIEHS PR #9-99

ENVIRONMENTAL HEALTH INSTITUTE REPORT CONCLUDES EVIDENCE IS 'WEAK' THAT ELECTRIC AND MAGNETIC FIELDS CAUSE CANCER

After six years of accelerated, Congressionally mandated research, the National Institute of Environmental Health Sciences today announced it has concluded that the evidence for a risk of cancer and other human disease from the electric and magnetic fields (EMF) around power lines is “weak.”

NIEHS’ review and analysis of the existing data came in a report to Congress, released today. The report applies to the extremely low frequency electric and magnetic fields surrounding both the big power lines that distribute power and the smaller but closer electric lines in homes and appliances.

While sections of the report say EMF exposure “cannot be recognized as entirely safe;” the report concludes: “The NIEHS believes that the probability that EMF exposure is truly a health hazard is currently small. The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal scientific support that exposure to this agent is causing any degree of harm.”

Research continues on some “lingering concerns,” the report says, and efforts to reduce exposures should continue.

NIEHS said that the “strongest evidence” for health effects comes from statistical associations observed in human populations with childhood leukemia and chronic lymphocytic leukemia in occupationally exposed adults such as electric utility workers, machinists and welders. “While the support from individual studies is weak,” according to the report, “these epidemiological studies demonstrate, for some methods of measuring exposure, a fairly consistent pattern of a small, increased risk with increasing exposure that is somewhat weaker for chronic lymphocytic leukemia than for childhood leukemia.”

However, laboratory studies and investigations of basic biological function do not support these epidemiological associations, according to the report. It says, “Virtually all of the laboratory evidence in animals and humans and most of the mechanistic studies in cells fail to support a causal [cause and effect] relationship.”

NIEHS Director Kenneth Olden, Ph.D., said, “The lack of consistent, positive findings in animal or mechanistic studies weakens the belief that this association is actually due to EMF, but it cannot completely discount the epidemiological findings. For that reason, and because virtually everyone in the United States uses electricity and therefore is routinely exposed to EMF, efforts to encourage reductions in exposure should continue. For example, industry should continue efforts to alter large transmission lines to reduce their fields and localities should enforce electrical codes to avoid wiring errors that can produce higher fields.” An interagency committee established by the President will make a subsequent report to Congress about the findings of this report and whether any remedial actions are needed to minimize exposures. Dr. Olden said NIEHS would continue to support some research on EMF, though not at the high levels Congress provided in special legislation and appropriations.

The NIEHS report follows a six-year research program and a two-year review by the institute and by outside scientists. For the effort, Congress appropriated $23 million that the electrical industry matched. The industry had no control over what research was conducted. The funds were administered by the Department of Energy and a portion was transferred to NIEHS, targeted for health effects research. NIEHS also added $14 million of its own appropriated funds to support additional research. The total expenditure was about $60 million.
The studies reviewed and conducted by NIEHS and its grantees focused on the possibility of a link to cancer—a reaction to a leukemia study in Denver, Colo., in 1979, and to subsequent attempts to duplicate or refute it in Denver and elsewhere. But the report said NIEHS also found inadequate evidence of any link to such non-cancer diseases as Alzheimer’s, depression and birth defects. Christopher Portier, Ph.D., the associate director of the Environmental Toxicology Program at NIEHS who coordinated the evaluation effort, said, “This risk assessment gains strength and reliability from the conduct of extensive new research focused to support the evaluation and through obtaining the opinion of hundreds of scientists who participated in the evaluation. The novel methods used in this risk assessment can serve as a blueprint for resolving other difficult issues.”

To assist NIEHS in reaching its conclusions, several panels of scientists reviewed the data in open, public hearings. A major panel of scientists—many of them EMF researchers—was assembled in a suburb of Minneapolis, Minn., last June to advise NIEHS. The panel rejected EMF as a “known” or proven, or even “probable” carcinogen but a majority of the panel said a role in cancer could not be ruled out and so it should be regarded as “possible” carcinogen. The NIEHS report today also recommends that the fields continue to be regarded as “possible” carcinogen. The NIEHS report says the evidence does not seem to meet the standard for listing as a known or even “anticipated” human carcinogen in the National Toxicology Program’s Report on Carcinogens.

NIEHS is one of the National Institutes of Health. NIEHS’ headquarters and laboratories in Research Triangle Park, N.C., are also the headquarters of the National Toxicology Program, and they have the same director.

* * * * *

NIEHS CONTACTS: Bill Grigg (301) 402-3378 or Tom Hawkins (919) 541-1402.

The report may be found on the Internet via EMF Rapid Web Site. Printed copies of the report can be ordered by:

Telephone: (919) 541-7534
E-mail: emf-rapid@niehs.nih.gov
Fax: (919) 541-0144

Or write:

EMF-RAPID Program,
NIEHS PO Box 12233,
Mail Drop EC-16,
Research Triangle Park, NC 27709.

CALENDAR

August 13-21, 1999. XXVIIth URSI General Assembly. Toronto, Canada. Contact: URSI ’99 Secretariat, National Research Council Canada, Ottawa, Ontario, K1A OR6, Canada. (Tel: 613-993-7271, Fax: 613-993-7250, e-mail: ursi99@nrc.ca, Web: http://www.nrc.ca/confburo/ursi99/welcome.html).

September 16-17, 1999. Mobile Telephones and Health: An Update on the Latest Research. Radisson SAS Scandinavia Hotel, Gothenburg, Sweden. Contact: Mobitel, A Division of City and Financial, 8 Westminster Court, Hipley Street, Old Woking, Surrey GU22 9LG, UK. (Tel: +44-(0)1483-720-707, Fax: +44-(0)1483-740-603).

October 4-6, 1999. International Seminar on the Effects of Electromagnetic Fields on the Living Environment, Munich, Germany. Sponsored by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), World Health Organization (WHO), and the German Federal Office for Radiation Protection (BfS). Contact: Olaf Schulz, S2.5, Institute of Radiation Hygiene, Federal Office for Radiation Protection. (Tel: +49-89-31603-262, Fax: +49-89-31603-1 80, e-mail: oschulz@bfs.de).

April 2-6, 2000. Second World Congress on Microwave and Radio Frequency Processing, Renaissance Orlando Resort, Orlando, Florida, USA. For Conference Information Contact: David E. Clark, University of Florida, Dept. of Mat. Sci. & Engrg., PO Box 116400, Gainesville, FL 3261l-6400, USA (Tel: 352-392-7660, Fax: 352-846-2033, e-mail: dclar@mse.ufl.edu). For Technical Program Contact: Jon Binner, Brunel University, Dept. of Mat. Engrg., Uxbridge UBB 3PH, UK (Tel: +44-18-95-27-40-00, Fax: +44-18-95-8-1-26-36, e-mail: jon.binner@brunel.ac.uk). Managed by: The American Ceramic Society, 735 Ceramic Place, Westerville, OH 43081, USA (Fax: 614-794-5882, Web: http://www.acers.org/2WC).

April 9-14, 2000. Millennium Conference on Antennas and Propagation, Davos, Switzerland. Contact: ESTEC Conference Bureau, PO Box 299, 2200 AG Noordwijk, The Netherlands. (Tel: +31-71-5655005, Fax: +31-71-5655658, e-mail: confburo@estec.esa.nl, Web: http://www.estec.esa.nl/AP2000)

June 9-16, 2000. Twenty-second Annual Meeting of The Bioelectromagnetics Society, The University of Munich, Munich, Germany. Contact: W/L Associates, 7519 Ridge Road, Frederick, MD 2170203519, USA. (Tel: 301-663-4252, Fax: 301-371-8955, e-mail: 75230.1222@compuserve.com, Web: http://www.bioelectromagnetics.org)

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July 5-14, 2000. Progress in Electromagnetics Research Symposium, Royal Sonesta Hotel, Cambridge, MA, USA. Contact: Professor Hsiu C. Han, 391 Durham Center, Iowa State University, Ames, IA 5001-2252, USA. (Tel: 515-294-5320, e-mail: hsiu@iastate.edu, Web: http://www.piers.org)