COST ACTION B27

ELECTRIC NEURONAL OSCILLATIONS AND COGNITION

Country Reports

AUSTRIA

Activities in 2006
The main topics were the analysis of EEG coupling using multivariate autoregressive models and derived parameters. The properties of the various coupling parameters (Coherence, partial coherence, partial directed coherence, phase, imaginary coherence, directed transfer function) are presented and discussed. Moreover, an automated method for correcting EOG artifacts was validated. It could be shown that the presented method can reduce EOG artifacts by 80%.

List of publications:


Collaboration with other groups
University of Potsdam, Germany (*) Andreas Mueller, Switzerland (*)
University of Hamburg, Germany
Max Planck Institute Leipzig, Germany
Fraunhofer FIRST/IDA, Berlin, Germany (*)
Cost Members

Transfer of results in 2006
The BrainRate parameter (Pop-Jordanova and Pop-Jordanov, 2005) has been implemented and is provided through the open source software library BioSig (http://biosig.sf.net).

Plans for activities in 2007
& Comparison of Linear and Non-linear coupling parameters in EEG.
& Applying MVAR-based coupling parameters to ADHD database.

Report on activities of WG2

Short, vivid description of the activities in 2006
In a group of 30 infants with a conceptional age of 36 weeks, EEG and ECG recordings were made over at least 2 hours. After calculation of the instantaneous heart rate (HR) time series with beat-to-beat intervals and an automated search for slow wave bursts in the EEG, synchronization between EEG bursts and the HR was studied. It was found that the occurrence of slow wave EEG bursts is associated with HR acceleration in the order of 2-3 beats/minute. Parts of the data were presented at the BME Conference in Zurich 2006 (Müller-Putz et al. 2006).

Brain-Computer Interfaces (BCIs) are systems establishing a direct connection between the human brain and a computer, thus providing an additional communication channel. They are used in a broad field of applications nowadays.
One important issue is the control of neuroprosthetic devices for the restoration of the grasp function in spinal cord injured people. In this work, an asynchronous 4-class BCI based on steady-state visual evoked potentials was used to control a 2-axes electrical hand prosthesis. During training 4 healthy subjects reached online classification accuracy between 44 and 88 %. Controlling the prosthetic hand asynchronously, the 4 subjects reached a performance of 75.5 s to 217.5 s (minimum time was 64 s) to copy a series of movements. The false positive (FP) decisions varied from 0 to 10. It can be stated that the SSVEP-based BCI, operating in asynchronous mode is feasible for the control of neuroprosthetic devices.

List of publications (published and accepted for publication) in 2006


List of conference presentations in 2006
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Collaboration with other groups Orthopedic University Hospital Heidelberg, Germany Dev. of Neonatology, Dept. of Pediatrics, University Hospital Graz, Austria

Vivid plans for activities in 2007
  ⊗ Data from healthy as well as from ill preterm infants will be recorded and analyzed. Further the analyzing tools will be extended and a data base will be implemented.
  ⊗ SSVEP-based BCI: a search method for individual optimal stimulation frequencies will be implemented.

Institute for Knowledge Discovery, BCI Lab, Graz University of Technology and Department of Psychology, Applied Neuropsychology, University of Graz Report on activities of WG3.

Dynamics of brain oscillations during translation
Grabner, R., Brunner, C., Leeb, R., Neuper, C. Pfurtscheller, G. We have conducted a pilot study where we explore whether similar ERS/ERD patterns emerge during language translation and which frequency bands sensitively respond to the difficulty of translation and the translation success. Thirteen female students of translation and interpreting were visually presented high and low frequency English words that had to be translated into German. Time-frequency representations of ERS/ERD between 2 and 50 Hz displayed a theta ERS response from about 200 to 600 ms after word presentation and differences between experimental conditions in the alpha frequency range between about 300 and 600 ms. Statistical analyses of the ERS/ERD data in the theta (4-7 Hz) and two alpha frequency bands (7-10 Hz and 10-13 Hz) revealed (a) higher parietal theta ERS and frontal upper alpha ERD during the translation of low as compared to high frequency words, and (b) generally stronger ERD in the lower alpha band and larger left-hemispheric upper alpha ERD for successfully translated in contrast to not translated low frequency words. These findings provide first evidence of the sensitivity of the theta and alpha ERS/ERD measure to lexical-semantic processes involved in language translation.


List of conference presentations in 2006
Collaboration with other groups
The study on brain oscillations during translation was devised with the support of our partners in the EU project “Eye-To-IT” (517590). These are: New Bulgarian University, Sofia, Bulgaria; University of Tampere, Tampere, Finland; Copenhagen Business School, Copenhagen, Denmark; Universitetet i Oslo, Oslo, Norway; Tobii Technologies AB, Stockholm, Sweden.

Transfer of results in 2006

Vivid plans for activities in 2007

We are planning to extend our research activities on the topic of brain oscillations during translation. Specifically, a new study will be conducted that analyzes translation processes with context. Instead of just providing a single isolated word that is to be translated, we are going to present a cloze sentence, where the subjects have to translate the last word of the sentence. This last word is going to be varied according to its cloze probability. It is also planned to measure the EEG in a more dense setup. For the study mentioned above as well as the planned experiments, we are going to analyze the data not only with ERD/ERS, but also with phase synchronization measures such as the phase locking value (PLV) between pairs of electrodes.

2007 Report

Short, vivid description of the activities in 2007
The main topics were the analysis of EEG and HR coupling in preterm infants. This behaviour is important for the study of maturational aspects of the brain and the monitoring of neurophysiologic development in preterm infants with only one single EEG and one ECG recording and might help to differentiate between normal and abnormal brain function in preterm infants. From long-term EEG and ECG registrations, sections with low heart-rate variability (HRV) and discontinuous EEG were selected and further analysed. After an automated detection of bursts EEG trials with a single EEG burst in the middle were selected and the corresponding instantaneous HR trials averaged.

List of publications (published or accepted for publication) in 2007


COST ACTION B27
Country Reports

List of conference presentations in 2007


Pfurtscheller, G.: Mentally induced neural oscillations used to control wheelchair movement in a virtual environment. - in: Cost Meeting. Florenz am: 25.03.2007


Collaboration with other groups
Prof. Witte, Institute of Medical, Statistics, Computer Sciences and Documentation, Friedrich Schiller University, Jena, Germany
( *) Cost Members

Vivid plans for activities in 2008

✉ Comparison of Linear and Non-linear coupling parameters in EEG. The suitability of a number of coupling measures for brain-computer interfaces will be assessed. Both synchronized and self-paced modes of operation will be analyzed. The coupling parameters will be derived from a multivariate autoregressive model. Besides using the parameters themselves as features, the following measures will be inspected: coherence, phase locking value, partial directed coherence, and directed transfer function.

✉ Establish a data base with normative data; the data base is of importance to study brain maturation and to differentiate between normal and abnormal brain functions in preterm infants.
    ✉ to investigate the correlations between burst-to-burst intervals (BBI, time period between the onset of 2 consecutive EEG bursts) and HR changes and
    ✉ between CA (conceptional age) and the BBI (the BBI depends on the maturational state of the brain)

✉ Furthermore it is planned to perform combined EEG and near-infrared-spectroscopy (NIRS) measurements and continuous blood pressure measurements (to investigate the modulation of the medullary cardiac neurons) on preterm infants

✉ Search for mutual interaction between brain (EEG) and cardiovascular parameters (heart rate, respiration, blood pressure waves) during execution and imagination of a motor task

✉ A screening procedure for a simple and fast detection of the ‘resonance-like’ frequencies suitable for SSVEP-based BCI will be implemented and tested. In general, the visual system can be divided into three parallel visual evoked potential (VEP) subsystems. However, each person has its individual best responding frequency ranges. To apply best fitting stimulation frequencies, a method for a fast and accurate screening had to be developed and implemented.
BULGARIA

WG-1 report 2007

Names, mail, and e-mail addresses of those involved
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Short description of the activities in 2007
We found set of neurons located in primary motor cortex (MI) of primates that respond to observed actions, retained direction-tuning as well as movement timing information during action observation. We evaluated differences in the timing of neuronal modulation that occurred during performed and observed action trials of firing rates by a cross correlation approach. Each cell's prefer direction was defined by means of the best tuning curve fit (bootstrap cosine model, generalized linear model). A probabilistic Bayesian classifier showed that the population activity during observation, although lower than during movement, was sufficient to predict the direction of observed or performed action. Thus, MI contains neurons that reflect the aspects of a learned movement when observed in others.

List of conference presentations
Conflict of interest: Prof. Donoghue is a scientific director of Cyberkinetics Neurotechnology Systems, Inc.

Collaboration with others
Prof. J. P. Donoghue, USA (*)
(*) Non-Cost Member
Vivid plans for activities in 2008

Studies of EEG activity in Parkinson’s patients.

WG2 and WG3
Progress report for the participation of Bulgarian researchers in the COST-ENOC action B27 for the period May 2005 to December 2007

Results achieved during the period May 2005 to December 2007

Participation of the scientists from the Republic of Bulgaria was concentrated mainly in the scientific topics developed in the WGs 2 and 3. They can be summarized as follows:

(a) Investigation of the neurophysiological mechanisms of ADHD by applying advanced methods for EEG/ERP analysis. This topic was developed in cooperation with the Clinics for Child and Adolescent Psychiatry, Göttingen (Germany) and covers activities in WG2 and WG3. Also, the scientific cooperation between the Bulgarian and German groups, established more than 15 years ago, was further developed and extended. Main results were obtained in EEG recordings of children with ADHD and tic disorder, with findings showing evidences for event-related oscillatory brain activity in the theta range (4-7 Hz) as a marker of nosology differentiation (publications 3,4,7,8,10,15).

(b) Investigation of the executive brain functioning during normal and pathological aging. This line of research was developed in cooperation with the Institute of Occupational Physiology, Dortmund (Germany) and covers activities in the WG3. It was based on long-lasting scientific cooperation between the Institute of Occupational Physiology and the Bulgarian Academy of Sciences. Results obtained have shown specific changes of executive and monitoring functions with aging (publications 1,2,6,9,14).

(c) Investigation of sleep in children with psychiatric disorders. This project was developed in cooperation with the Clinics for Child and Adolescent Psychiatry, Göttingen (Germany) and covers activities in WG2. Results show specific sleep activation patterns in children with ADHD and may be used as clinical indices in the psychiatric research (publications 5,11,12,13).

Dissemination of results

Action related publications and reports


**Scientific and Technical Cooperation**

The following joint research initiatives by the groups involved in the Action resulted in proposals/awards for joint projects by other sources:

- **Project title:** "Brain mechanisms of behavioral slowing with aging"
  
  Objective: To investigate brain oscillations in normal aged subjects in relation to changes in their executive and monitoring functions
  
  Granted by: Heinrich Hertz Foundation, Düsseldorf, Germany
  
  Awardees: Teams of Dr. M. Falkenstein, Dr. J. Yordanova and Dr. V. Kolev
  
  Cooperation partners: Research teams from GE and BG

The following groups received individual grants:

- **Prof. Juliana Yordanova**, Bulgarian Academy of Sciences received funding from the National Research Council at the Ministry of Education and Sciences (Bulgaria) to examine effects of aging on the executive brain functions

- **Prof. Vasil Kolev**, Bulgarian Academy of Sciences received funding from the National Research Council at the Ministry of Education and Sciences (Bulgaria) to investigate and introduce advanced methods for EEG analysis in child psychiatry research

**ESTONIA**

**WG1 Report 2006**

Biomedical Engineering Center, Technomedicum, Tallinn University of Technology, 5 Ehitajate Rd, 19086, Tallinn, Estonia

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**Activities in 2006**
The detection of hidden changes in the EEG signal has been a most actual and difficult to solve problem during recent time. Two original methods were developed: the nonlinear method of scaling analysis of the EEG signal based on the length distribution of low variability periods (LDLVP) and the method of modulation with further integration of energy of the recorded signal. The methods were proved to reveal changes in the EEG signal caused by low-level microwave radiation.

The preliminary experiments were carried out on the group of depression patients (women, 18 subjects) and comparison group of healthy volunteers exposed during 30 min to 450 MHz microwave radiation modulated with 1000 Hz frequency. The field power density at the scalp was 0.9 mW/cm². As a subjective criteria of depression mood, the Brief Affect Scale (BAS) and Visual Analogue Scale (VAS) before and after each exposure procedure was used. Parallel a ratio of the EEG power in symmetric EEG channels of the different brain hemispheres was evaluated. The BAS revealed mood improvement after exposure for majority of depressive subjects (11) and no changes for others (7). The VAS detected significant improvement in subjective mood score after exposure. The EEG analysis showed the biggest difference in symmetry between hemispheres in temporal area. Significant results in sham condition indicate that the parameter selected as a measure is not very steady among depressive patients. This makes difficult to detect the effect caused by the EMF exposure.

List of publications:

Conference presentations:

Grants received and grant applications:
1. Effect of electromagnetic radiation on brain oscillations, ETF grant 6632
2. Microwave effects on cognitive functions, ETF grant 6173

Transfer of results
Cooperation with the Clinics of Psychiatry of the North Estonia Regional Hospital started in the area of depression diseases. The new methods of the EEG analysis are considered to develop criteria for evaluation of the mood of depression.

Plans for activities in 2007
The studies on microwave effects on brain oscillations and cognitive functions are going on. The new Neuroscan equipment purchased in the frame of Infrastructure for the Centres of Excellence in Science Programme in Estonia allows to extend the area of signals investigated to the Evoked Potentials and Event Related Potentials.

WG-1 report 2007

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Short description of the activities in 2007
The studies were aimed to 1) evaluation of changes in the EEG in depression and 2) investigation of effect of the external periodic stressor (modulated microwave exposure) on the brain EEG rhythms.
1. In this study we evaluated different electroencephalographic (EEG) measures for detection of major depressive disorder. Asymmetry in symmetric channels between hemispheres, coherence and spectral asymmetry were considered. The experiments were carried out on two groups of volunteers: a group of patients with major depressive disorder and a control group of healthy subjects. Each group consisted of 18 female persons. The 10 min resting EEG signals were used for analysis. The EEG asymmetry, coherence and the ratio of the EEG beta and theta power were calculated. The results showed small statistically insignificant increase in asymmetry and coherence in frontal and temporal region within alpha frequency band for depressive patients The calculated spectral asymmetry values were positive for patients with depressive disorder and negative for healthy subjects. Statistical differences between the depressive and healthy group
was significant ($p<0.0001$). The spectral asymmetry seems very promising as an EEG measure for detection of depression.

2. Effect of microwaves modulated at different frequencies on human EEG rhythms was evaluated. 13 healthy volunteers were exposed to microwaves (450 MHz) pulse-modulated at frequencies of 7, 14 and 21 Hz. The field power density at the scalp was 0.16 mW/cm$^2$. Our experimental protocol consisted of two five-cycle (1 min on and 1 min off) series of exposures at fixed modulation frequencies. A relative change in the EEG power with and without exposure was used as a quantitative measure. EEG frequencies recorded in the theta (4-6.8 Hz), alpha (8-13 Hz), beta1 (15-20 Hz), and beta2 (22-38 Hz) bands were analyzed. The results showed that modulated microwaves caused an increase in the average EEG alpha (17%) and beta (7%) power but the theta rhythm remained unaffected. Increases in the EEG alpha and beta power were statistically significant at the modulation frequencies of 14 and 21 Hz. Our findings suggest that the effect of the 450 MHz microwave radiation modulated at 7, 14 and 21 Hz varies depending on the modulation frequency. The effect occurred at modulation frequencies higher or close to the EEG band frequency: microwave exposure modulated at 14 Hz enhanced the EEG power in the alpha and beta1, and modulated at 21 Hz in the alpha, beta1 and beta2 frequency bands whereas no enhancement occurred during exposure to the modulation frequency of 7 Hz. Such a finding indicates possibility of parametric excitation of the oscillations in the brain by the external periodic stimulation.

List of publications in 2007


List of conference presentations in 2007


List of grants you are receiving and of grant applications made in 2006

1. Effect of electromagnetic radiation on brain oscillations ETF grant 6632
2. Microwave effects on cognitive functions ETF grant 6173

Collaboration with other groups

Not clearly established.

Transfer of results in 2007

Cooperation with the Clinics of Psychiatry of the North Estonia Regional Hospital started in the area of depression diseases. The new methods of the EEG analysis in depression are considered to develop criteria for evaluation of the mood of depression. Joint applied research project is in preparation.

Vivid plans for activities in 2008

The studies on the EEG in depression are going on. Possible effects of external stressors (modulated at different frequencies microwaves) on the state of the brain and depressive mode are planned. The studies on microwave effects on visual cognition are going on.

ITALY

COST Action B27 ‘Electric neuronal oscillations and cognition (ENOC)’

WG1 Report of research and scientific progress
ENOC meeting, Göttingen (FRG), October 12, 2007

MEETINGS:
The Italian section of COST action ‘Electric neuronal oscillations and cognition (ENOC)’ has organized the international conference “Neuroscience today: neuronal functional diversity and collective behaviors”, held in Firenze (Italy), March 26-28, 2007, within the scientific framework of ENOC and with full COST support. The conference, with over 20 distinguished invited speakers, was attended by almost 100 scientists and was successful. Publication of the conference proceedings is being negotiated.

COMMUNICATION and SUMMER SCHOOL:
The President and the Executive Board of the Italian Physical Society are considering the proposal to endorse the following topic “Mechanisms of cognition: from physics to neuroscience” for the 2009 Enrico Fermi Summer School on Physics. The school is held in Varenna (Italy), on the Lake of Como. Teaching and scientific organization will be under the responsibility of FT Arecchi and WG Sannita; scientific support from ENOC and the COST B27 sponsorship are advisable to help place the event in proper perspective and make it successful.
RESEARCH:
Research in the ENOC field has been carried on and is still in progress in Italy.

University of Firenze, Dept. of Physics and Institute of Applied Optics (FT Arecchi and co-workers), University of Catania, Dept. of Electronics, Informatics and Systemistics (L Fortuna and co-workers):

**Chaotic dynamics and perceptual processes**

The activity of the group was focused on the theoretical-experimental study of dynamical systems undergoing homoclinic/heteroclinic chaos, in view of plausible models of neuronal dynamics in perceptual tasks. Furthermore, such a chaos is relevant not only in physics and chemistry, but also in economics (market models with heterogeneous agents). We have recently studied synchronization in arrays of mutually coupled homoclinic systems and investigated the transition from spiking to bursting by applying small perturbations. In the case of neuronal spikes, the chaotic time of information loss (reciprocal of Liapunov coefficient) is about 1 msec; however, to activate a decision in the motor-linguistic areas, 300 msec are necessary. Thus, a suitable combination of bottom-up and top-down signals to the neurons of a cortical module provides the required lowering of Kolmogorov entropy. This consists of a partial chaos control (E. Ott, C. Grebogi, J. Yorke). The results have been presented at the 9th Experimental Chaos Conference ("Attractor selection in lasers and in electronic circuits", 29 May-1 June 2006, Sao Jose dos Campos, SP, Brasil) and at the Iberoamerican Conference on Optics (RIAO) Latinamerican Meeting on Optics Lasers and Applications (OPTILAS) "Campinas, October 22-26, 2007.

University of Genova, Dept. of Motor Science and Rehabilitation (WG Sannita and co-workers) and University of Roma Tor Vergata (L Narici and co-workers):

**Gamma activity and brain synchronization**

Research on the oscillatory brain systems has focussed on the role of gamma band oscillatory activities in the function-related synchronization of stimulus-selective neurons in the human visual cortex. Specifically, MEG human data have been extrapolated to suggest a role of bottom-up synchronization in the processing of visual and linguistic information (with possible inference about the "binding problem"). The signal-noise interaction in visual information processing has been modelled according to the stochastic resonance function and found consistent with the theory. Electrophysiological methods have been applied to document in man the (partial) independence and temporal/functional hierarchy of gamma band and low-frequency VEP components of the cortical visual mass response to contrast. Evidence that the gamma activity contributes in the cortical synchronization and development of conventional VEP responses has been provided. Pathological conditions capable to interfere selectively with the conventional VEP response while leaving gamma oscillations unaffected have been identified in a large patients’ population.

PUBLICATIONS


F.T. Arecchi "Complexity, Information Loss and Model Building: from neuro- to cognitive
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Country Reports

M. Ciszak, A. Montina and F. T. Arecchi “Spike synchronization of a chaotic array as a phase transition” submitted to Phys. Rev. E.

LITHUANIA

WG-1 Report

Institute of Psychophysiology and Rehabilitation, Kaunas Medical University

Activities in 2006

The web based data bank (http://www.pri.kmu.lt/datbank/) including records of heart rate (HR) during sleep was created. The data can be used to develop, identify and validate mathematical models of regulation of psycho-physiological processes. The time series of RR intervals collected in the data bank can be processed by traditional and nonlinear methods. The peculiarity of HR control during different sleep stages under various states of central nervous system was investigated. Visualization of sleep stages was performed using hybrid multidimensional scaling (MDS) of HR data during sleep. The effectiveness of MDS in establishing the informative HR pattern characteristics representing different sleep states was demonstrated.
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List of publications:


Conference presentations:


Activities in 2007
The methodology of the spectrum-weighted frequencies of both heart rate variability (HRV) and electroencephalogram (EEG) was developed and tested on the long term records during sleep. The frequencies represent the balance point of power within a certain spectral range. The predictive value of the frequencies and their mutual interrelations were demonstrated with respect to different sleep stages based on data from a single case. In particular, revealed stage-dependant relationships between frequencies from HRV and EEG suggest a close interrelation between autonomic cardiovascular control and activity of central nervous system. The results show that the easy-to-assess frequencies may yield a simple indicator of the sleep quality within the
COST ACTION B27
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scope of comfortable patient monitoring.

List of publications:


Conference presentations:


Collaboration with other groups

Institute of Fundamentals and Theory of Electrical Engineering,
Bioelectricity & Magnetism Lab, Vienna University of Technology, Vienna, Austria

Plans for activities in 2007

To investigate the basic behaviour (autonomic control) during different sleep stages using spectrum-weighted frequency $f_w$ derived from heart rate variability and EEG in groups of healthy subjects and coronary artery disease patients.

Institute of Mathematics and Informatics, Vilnius, Lithuania

2007 Report
Theme
Development of computer aided methods for investigation of dependency between states of central neural system and heart rate parameters. Special attention is paid to the methods of visualization of multidimensional bio-medical data.

Results
New methods of visualization of multidimensional bio-medical data are developed and applied for investigation of dependency between states of central neural system and heart rate parameters. To implement the proposed visualization methods new global optimization algorithms, necessary to enhance visualization accuracy, have been developed.

Publications and dissemination of results


The main results are presented in a joint talk with partners from the Institute of Psychophysiology and Rehabilitation:

G. Varoneckas, J. Zilinskas et al., Visualization of multidimensional biomedical data using GRID technologies, Med@Tel, 2007, 18-20 April 2007, Luxenbourg, see www.medetel.lu

A home page for dissemination of project results has been created: http://www.mii.lt/enoc

POLAND
Institute of Biocybernetics and Biomedical Engineering, Polish Academy of Sciences (IBBE PAS)
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EEG Institute
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Activities in 2006
The system using respiratory feedback for diagnosis and therapy of stuttering has been constructed (B. Stankiewicz, K. Zielinski).

W. Klonowski founded a new open access journal Nonlinear Biomedical Physics, BioMed Central, London, UK, and organized the Editorial Board;

We organized international conference 'Circulatory and respiratory processes -modelling, mechanical assistance and applications in anaesthesia, intensive care and..."
biofeedback' (88th Seminar of the International Centre of Biocybernetics, Polish Academy of Sciences, Chairmen: Darowski M., Klonowski W., Ferrari GF), October 26-29, Warsaw,

EEG Institute took part in several conferences and public discussions, also on TV (TVP1, TVN, TVP2, TV Styl, Polsat), concerning in particular treatment of children with ADHD, ADD, dyslexic, dysgraphic, aggressive, drug addicted, with Tourette syndrom, as well as adults with depression or sleep disorders, persons in detention houses, soldiers returning from military missions.

EEG Institute won the tender by Polish Ministry of National Education for installing EEG Biofeedback aparata in 230 schools and educational centres and to train more than 400 professionals, mainly to work with children suffering of ADHD (project financed by European Social Fund). Other courses concerned AVS (audiovisual stimulation). Lecture notes were prepared. We are going to analyzed obtained data using mini-mapping and QEEG.

List of publications:


Conference presentations:
Klonowski W.: Neurobiofeedback and Chaosensology - between conscious and unconscious, COST B27 Meeting, May 12-13, Skopje;

Klonowski W.: Thoughts and Feelings - Physics in Psychology, Neurocognitive Days in SWPS, June 06-08, Warsaw;


Klonowski W.: Importance of nonlinear models and nonlinear data processing in biomedicine, 'Circulatory and respiratory processes - modelling, mechanical assistance and applications in anaesthesia, intensive care and biofeedback', 88th ICB Seminar, October 26-29, Warsaw;

Grants received and grant applications:
• 'BIOSIGNON - Nonlinear Signal Analysis for Biomedical Applications' - application for COST open call in May 2006, Proposer - Wlodzimierz Klonowski, Polish Academy of Sciences, Warsaw, POLAND; other participants: Milan Palus, Inst.Computer Science AS CS, CZECH REPUBLIC; Hiie Hinrikus, Tallinn Technical Univ., ESTONIA*;
Jiri Wackerman, I.Grenzgebiete der Psychologie und Psychohygiene e.V., Freiburg, GERMANY;
Karl Karlsson, Reykjavik University, ICELAND;
Luigi Fortuna, University of Catania, ITALY*;
Aleksandar Kalauzi, University of Belgrade, SERBIA*;
Ernesto Pereda, Univ. of La Laguna, Tenerife, SPAIN.
(*) COST B27 Member
Financial support by COST has not been granted

- 'Neuronalne oscylacje elektryczne a procesy poznawcze - świadome wpływowanie poprzez regulację oddychania na procesy w układzie nerwowym i procesy mowy, mierzone wybranymi charakterystykami EEG i innych biosygnalów (Electric neuronal oscillations and cognitive processes - conscious influencing on processes in nervous system and on speech emission processes through breathing regulation as measured by chosen characteristics of EEG and other biosignals)' - grant of the Polish Ministry of Higher Education and Science, ca. 135.000 EUR granted for 30 months;
Coordinator - W.Klonowski;
this grant is not limited to WG1 activities, but encompasses also subjects of WG2 and WG3.

Plans for activities in 2007
We would like to improve data acquisition in the centers where EEG Institute installed EEG Biofeedback apparaata, so that these data will become available for quantitative analysis. We would also like to install in some of those centers our own apparaata for diagnosis and treatment of stuttering using respiratory biofeedback.

RUSSIA

JOINT REPORT

Lyubomir Aftanas, MD, PhD, Dr.Sci, Professor.
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Bazanova Olga, Leading Scientific Researcher
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2006.

Individual EEG alpha activity indices & creativity.
The objective was to clarify relationships between nonverbal creativity indices
from the Torrens test and individual EEG alpha activity indices: individual alpha peak frequency - IAPF, individual alpha band width - IABW, individuals amount of alpha suppression (IAAS) in eyes open vs. eyes closed condition – IAAS, alpha spindle parameters (i.e., duration & amplitude variability). The study showed that fluency in creative performance was associated with individual alpha peak frequency and alpha spindles duration, whereas originality and plasticity – with individual alpha band width and spindle amplitude variability. Both the highest and the lowest individual alpha peak frequency were associated with enhanced scores of originality. Overall, individual alpha activity indices predict fluency, plasticity, and originality of nonverbal creativity.

Development of simultaneous alpha stimulating and EMG power decreasing biofeedback (Alpha-EEG/EMG BFB) during musical practicing.

The study aimed at developing simultaneous bimodal upper alpha stimulating and EMG power decreasing biofeedback (Alpha-EEG/EMG BFB) during musical practicing (Pr). The IAPF, IABW, EMG power, and EMG high/low frequency components ratio (EMG h/l) were selected as electrophysiological indices of self control abilities. Findings from two experimental investigations evidenced that individuals showing higher IAPF and larger IABW in baseline condition improved musical performance score both after Pr and Alpha-EEG/EMG BFB. They were also more successful in increasing absolute alpha power, IABW, and EMG h/l ratio and decreasing EMG power in Alpha-EEG/EMG BFB training. Effective Pr was associated with induced alpha activity, reduced IEMG, and raised EMG H/L ratio in the post-training condition. The results were replicated in Macedonian Academy of Music 2007.

Blood pressure reactions to psychological stress are centrally controlled by brain systems that both cognitively process psychological stressors and coordinate autonomic, neuroendocrine, and cardiovascular activity with adaptive behavior. To date it has not yet been well studied whether individuals who show exaggerated stressor-induced blood pressure reactivity show more or less specific individual EEG activity/reactivity patterns of spatially distributed neural networks. If so, then this would provide evidence for a functional neural phenotype that characterizes individuals who are prone toward exaggerated cardiovascular reactivity and possibly stressor-related risk for cardiovascular disease.

Individual variability of cardiovascular reactivity and neurovisceral couplings during cardiac defense response.

Failure of fast recovering to normal state after aversive event is the key feature of individual intolerance to emotional stress. Within the framework of this idea dynamics of the arterial blood pressure reactivity has been studied using defensive reaction of the cardiac defense response, elicited by strong aversive acoustic stimuli. Dynamical patterns of cardiovascular responses observed at this reaction makes it possible to perform the affective chronometry of defensive arousal. Healthy male volunteers with normal arterial blood pressure and patients with firstly diagnosed and untreated essential hypertension) were studied. The beat-by-beat dynamics of blood pressure values were registered by means of finger-cuff Finapres technology. It was shown that among healthy individuals with normal resting blood pressure values there are highly reactive individuals manifesting delayed systolic and diastolic blood pressure (SBP & DBP).
increases at later phases (i.e., 40-80 s post-stimulus) of the cardiac defense response. The same response pattern was obtained in hypertension patients. It was suggested that similarity of delayed pressor effects between highly reactive healthy individuals and hypertension patients index proneness of the highly reactive individuals to a risk of essential hypertension. The investigation also sought to determine emerging significant correlations between systolic and diastolic blood pressure increases at later phases of the cardiac defense response and EEG activity. It was established that enhanced blood pressure reactivity in highly reactive and patients can be predicted by lower theta and low alpha EEG band power changes.

Covariation of cortical electrical activity and cardiovascular responding during experience of anger and joy.

The main objective of this study was to investigate neurovisceral integration in response to aversive stimulus with distinct cognitive component. Emotion of anger, activated by means of recall generation method, was used as an aversive elicitor. Emotion of joy was additionally induced in the implemented experimental paradigm. The results showed that experiencing of both emotions produced increases of the SBP & DBP. Using median split of the emotional blood pressure reactivity measures, groups of highly and low reactive individuals were formed. One of the important results of the present study is that both groups revealed different patterns of neurovisceral couplings. Highly reactive individuals were characterized by more pronounced alpha-2 and alpha-3 power increase emotional during emotional arousal, whereas low reactive subjects demonstrated enhanced alpha-1 power both at rest and during emotional experience.

SERBIA

List of publications

PUBLICATIONS RELATED TO COSTB27 (Aleksandar Kalauzi, PhD) 2005 - 2007


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comparison and in the assessment of pharmaceutical product stability profiles. 1st Pharmaceutical Sciences Fair & Exhibition (1st PharmSciFair), Nice (France), 12.-17. 6., CD-ROM Abstracts, PO-323.


PUBLICATONS (Saponjic Jasna, M.D., Ph.D.) 2005-2007


disturbance induced by glutamate injection into the intertrigeminal region is abolished by an NMDA receptor antagonist in rats. *Sleep, Vol. 28, Abstract Suppl., A30.*


PUBLICATONS (Dragoslav Sokić, M.D., Ph.D.) 2005-2007


SWITZERLAND

Activities in 2007
Our COST-related activities in 2007 focused on advancing the two projects funded by the Swiss SBF agency.

For the identification of distinct EEG-defined subgroups of adults with ADHD project (A. Müller, G. Candrian et al.), recording were started in January 2007. The EEG is recorded in a resting condition, as well as while performing continuous performance tasks. Clinical subjects will be grouped by means of cluster analysis. Besides the neurophysiological assessment, subjects pass a series of neuropsychological tasks. In June 2007, an European network was set up. The following countries participate in the study: Norway, Poland, Germany, Austria, Italy, Macedonia, Turkey, Switzerland, USA). Preparatory work (definition of interview, questionnaires, neuropsychological testing tools, EEG testing tools) is completed.

For the advanced neurofeedback project (L. Jäncke, D. Brandeis, R. Drechsler, M. iecht), a pilot study on advanced regionally focused LORETA neurofeedback with 10 normal adult controls was started in January 2007. Theta-beta ratios in two frontal lobe regions were trained briefly (5 session) in a double blind cross-over design including pre- and post assessments with neuropsychological and EEG/ERP brain mapping batteries. Preliminary results suggest interesting correlations between the neuropsychological tests and training success, but little transfer between training and resting EEG.

List of publications:

Collaboration with other groups:
University of Göttingen, Germany (*)
University of Erlangen Munich, Germany (*)
University of Tübingen, Germany (*)
ZI Mannheim , Germany (*)
(*) COST members

Transfer of results in 2007
Publication of SCP neurofeedback study including press releases

Plans for activities in 2008
Continued EEG profiling with database consolidation, and controlled clinical trial with advanced Neurofeedback. Publication of papers in both projects, and consolidation of
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scientific European networks.

TURKEY

Biomedical Engineering Institute, Bogazici University, Istanbul, Turkey

Ahmet Ademoglu (ademoglu@boun.edu.tr), Adil Deniz Duru, Hamdi Eryilmaz
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Tamer Demiralp (demiralp@istanbul.edu.tr)

Activities in 2006

Modeling the multichannel ERP as consisting of several temporal as well as spatial frequency components (oscillations) corresponding to several cognitive processes and identifying these temporally and/or spatially overlapping components in time and space and localizing their sources in the 3-D brain structure.

By simulations, the deeper sources as well as the superficial ones, although they are temporally correlated, are successfully localized since they exhibit different spatial frequency distributions on subtopographies. Deeper sources tend to have a lower spatial frequency distribution on the subtopography whereas the superficial ones tend to have that of a higher one.

Conference presentations:


Transfer of results:

The spatio-temporal oscillations in the multichannel ERP data are investigated with the method and the functional link between the spatially localized source(s) for each temporal oscillation and the cognitive process is studied. Correlations with the fMRI results are also investigated.

When the technique will be packaged into a user-friendly MATLAB environment with the library developed in C, it can be reached through the website by the potential users for the dissemination of further results and augmentation of the knowledge in the research area.

Activities in 2007

The studies of WGs in Turkey were mainly on three subjects:

1. Generation of cognitive potentials and multimodality.
2. The effects of some genetic and hormonal dysfunctions on cognitive functions, and
3. About clinical use of EEG biofeedback

Abstracts of some published works are as follows:


IN SEARCH FOR A POSSIBLE ROLE OF THE ALPHA-BAND IN MULTISTABLE VISUAL PERCEPTION
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Reversible figures, such as the Necker cube, make up a well-known class of visual phenomena in which an invariant stimulus pattern gives rise to at least two different perceptual interpretations. A better understanding of the neurophysiological processes underlying perceptual reversals might help to disentangle bottom-up from top-down influences on multistable perception. Former studies of our research group demonstrated a role of frontal gamma activity for attentional top-down processes while the alpha band was related to bottom-up processes which trigger the spontaneous fluctuations in visual awareness. In a recent study, we divided the extended alpha band into three sub-bands (lower-1 alpha, lower-2 alpha, upper alpha). We employed a long-term recording condition, during which 10 healthy participants observed the Necker cube for approximately 60 min and responded by pressing a button to any perceived reversal. The results showed a reversal-related alpha desynchronization differing across the time course of the experiment. It is concluded that the lower-1 alpha desynchronization reflects an automatic arousal reaction which triggers attentional processing in a bottom-up manner, whereas the lower-2 alpha desynchronization is related to attentional processes that are achieved by top-down control with limited resources. Taken together, our work suggests that oscillatory activity in the alpha-band and sub-bands of alpha might indicate different aspects during multistable perception that can be related to preconscious bottom-up processes as well as to top-down processes near visual awareness.


Event Related Potentials in Girls with Congenital Adrenal Hyperplasia
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COST ACTION B27  
Country Reports

Congenital Adrenal Hyperplasia (CAH) is the development of male secondary sexual characteristics caused by excessive androgens that its effect on the brain are unknown exactly. The aim of the present study was to define specifically the effect of the intrauterine androgen in girls with CAH during the cognitive processing of the brain. Ten children with classical CAH (females, aged 13.3±3.1 yrs) and ten healthy volunteers participated in this study (ten males and females). Electroencephalographic (EEG) activity was recorded from 32 sites by Neuroscan 4.1. The recording session consisted of two experimental paradigms; I. Auditory Oddball (P300) Paradigm (AERPs). II. Combined Auditory Oddball (P300) Paradigm and Visual Evoked Potentials (AERPs + VEPs). All statistical analyses were performed using SPSS-PC 11.0 (Ethical Committee Number: 200548/47/2005).

In AERPs paradigm, P300 responses were smaller amplitude (F(5,45)=19.64; p<0.001) and longer latencies (F(5,45)=18.16; p<0.002) in female CAH than in female controls. There were significant difference for the P300 amplitude between in female CAH and in male controls (F(5,45)=2.69; p<0.03), but not for the P300 latency in AERPs paradigm. The results were more obvious in AERPs + VEPs paradigm than in AERPs paradigm, especially in the frontal locations (F(5,45)=60.88; p<0.0001).

Since, the results are more obvious between in female CAH and female controls than between in female CAH and male controls, the responses of female CAH are seemed like the responses of male controls, moreover in smaller amplitude. Therefore, it may be suggest to identify cognitive functions for the patients with CAH. The present study is the pioneer research on the effects of the CAH on the brain electrical activity.

This work was supported by the Research Fund of the University of İstanbul, project number: 344/03062005


Necker cube reversals related theta oscillations during long term EEG recording  
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Since the results of the previous studies of our research group on multistable perception demonstrated a decrease of alpha activity, in the present study our aim was to reanalyze the same data to defining the roles of theta band for perceptual reversals with the Necker cube. We also intended to study possible influences of theta band in vigilance during the perceptual reversals, so, we introduced a long-term recording condition.

Ten healthy volunteers (5 males) participated in this study (mean age: 26 ± 2.3 yrs). The EEG was registered at Fz, Cz, Pz, and Oz sites. The recording session lasted for 66.6 minutes. In order to analyze theta power (4-8 Hz) change, we computed root mean square (RMS) values from the averaged sweeps. The analysis was conducted across different time sections (I, II, III) to analyze possible effects related to the long-term condition, taken from the beginning (I), middle (II) and end (III) of the experiment. The statistical analyses were carried out on by ANOVA for repeated measures (SPSS 11.5). In averaged responses, increased theta band activity was most stable in anterior locations (Fz and Cz) and was lowest in occipital location (F(3,27)= 6.4; p< 0.002).
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There was a significant time section x channel effect (F(6,54)= 3.78; p< 0.003) especially for the middle time section (II) and for the Fz, Cz and Pz channels.
The perceptual reversal induced theta synchronization of the present study probably reflects cognitive processes related to the recognition of the reversals.


The Properties of Brain Cognitive Processing in Girls with Congenital Adrenal Hyperplasia
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Congenital Adrenal Hyperplasia (CAH) is the development of male secondary sexual characteristics caused by excessive androgens that its effect on the brain are unknown exactly. Prenatal masculinization of the brain has been suggested in girls with classical CAH based on psychological testing. Also, the event-related brain potentials (ERPs) studies suggest that cognitive functions of males are different from females in healthy subjects with longer latency and smaller amplitude(1,2,3).
The aim of the present study was to define specifically the effect of the intrauterin androgen in girls with CAH during the cognitive processing of the brain.
Ten children with classical CAH (females, aged 13.3±3.1 yrs) and ten healthy volunteers participated in this study (ten males and females). Electroencephalographic (EEG) activity was recorded from 32 sites by Neuroscan 4.1. Since, the P300 component of the ERPs can use to identify cognitive functions of the brain by using “auditory oddball” paradigm (AERPs), the recording session was consisted of two experimental paradigms; I.Auditory Oddball(P300) Paradigm(AERPs). II.Combined Auditory Oddball(P300) Paradigm and Visual Evoked Potentials (AERPs+VEPs)(2,4). All statistical analyses were performed using SPSS-PC 11.0(Ethical Committee Number:200548/47/2005).

Results: In AERPs paradigm, P300 responses were smaller amplitude(F(5,45)=19.64;p<0.001) and longer latencies(F(5,45)=18.16;p<0.002) in female CAH than in female controls. There were significant difference for the P300 amplitude between in female CAH and in male controls(F(5,45)=2.69;p<0.03), but not for the P300 latency in AERPs paradigm. The results were more obvious in AERPs+VEPs paradigm than in AERPs paradigm, especially in the frontal locations(F(5,45)=60.88;p<0.0001).

Discussion: Since, the results are more obvious between in female CAH and female controls than between in female CAH and male controls, the responses of female CAH are seemed like the responses of male controls, moreover in smaller amplitude. Therefore, it may be suggest to identify cognitive functions for the patients with CAH. The present study is the pioneer research on the effects of the CAH on the brain electrical activity.

This work was supported by the Research Fund of the University of İstanbul, project number:344/03062005

References:


The Effects of the X-chromosome lossing on the Brain Cognitive Function with in Turner Syndrome


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Turner Syndrome (TS) is a genetic disorder causing from the loss of the entire or a part of the X- chromosome that it consists of many genetic knowledge. The lose of X-chromosome in girls with TS differs from healthy girls with the genetic properties of the intrauterine and postnatal development and also with reduced estrogen girls. Since, our previous results in female CAH showed that the responses of the girls with CAH are different from the female and male controls (1), it may be important to determine of brain electrical activity in girls with TS that describes deficiency of sexual identity.

The aim of the present study was to define specifically the effect of the lack of X-chromosome on cognitive development of the brain.

Eleven children with TS (females, aged 14.3 ± 1.8 yrs) and 22 healthy volunteers participated in this study (11 males and 11 females). Electroencephalographic (EEG) activity was recorded from 32 sites by Neuroscan 4.1. Since, P300 component of the ERPs can be used to identify cognitive functions of the brain by using "auditory oddball" paradigm (AERPs), the recording session was consisted of two experimental paradigms; I. Auditory Oddball (P300) Paradigm (AERPs). II. Combined Auditory Oddball (P300) Paradigm and Visual Evoked Potentials (AERPs+VEPs) (2,3). All statistical analyses were performed using SPSS-PC 11.5 (Ethical Committee Number: 200548/47/2005).

In AERPs paradigm, P300 responses were smaller in amplitude in TS than in female and also male controls. P300 responses latencies were longer in TS than in female controls but also shorter than in male controls. In AERPs paradigm, those differences were not significant. The same differences were more obvious both for P300 amplitude and latency in AERPs+VEPs paradigm than in AERPs paradigm and also were statistically significant (see Table).

<table>
<thead>
<tr>
<th>TS-Female Control</th>
<th>AERPs+VEPs</th>
<th>AERPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>P300 Frontal electrode (Fz)</td>
<td>Amplitude (µV)</td>
<td>Latency (msec)</td>
</tr>
<tr>
<td>6.7-13.3**</td>
<td>379-353**</td>
<td>5.5-7.8</td>
</tr>
</tbody>
</table>
Differences in cognitive P300 responses in TS compared both to female and male controls may reflect the effects of the X-chromosome lossing.

The present study is the pioneer research on the relationship between TS and the brain electrical activity using both AERPs and AERPs+VEPs paradigms.

References:


EFFECTS ON EVENT-RELATED POTENTIALS TO VISUAL, AUDITORY, AND BIMODAL (COMBINED AUDITORY-VISUAL) STIMULI

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The purpose of the current study was to investigate the influence of individual sensory components to unimodal (visual; VEPs and auditory; AEPs) and bimodal (BEPs; VEPs+AEPs) stimulation. A comparison with unimodal and bimodal paradigms revealed
that the amplitudes of N1 and P2 were larger during BEPs than AEPs in the anterior sites and the amplitudes of P1 was larger during BEPs than VEPs especially in the parieto-occipital locations. Furthermore, responses to bimodal stimulation have longer latencies than responses to unimodal stimulation. The N1 and P2 components were larger in amplitude and longer in latency during the bimodal paradigm and predominantly occurred at the anterior sites. Therefore, the current bimodal paradigm can be used to investigate the involvement and location of specific neural generators which contribute to higher processing of sensory information. Moreover, the paradigm may be a useful tool to investigate the level of sensory dysfunctions in clinical samples.

**Keywords** event-related potentials (ERPs), visual, auditory, and bimodal evoked potentials


**EVENT-RELATED POTENTIALS DURING AUDITORY ODDBALL, AND COMBINED AUDITORY ODDBALL-VISUAL PARADIGMS**

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**ABSTRACT**

The purpose of the current study was to investigate the properties of a new modification of the classical auditory oddball paradigm (auditory oddball paradigm combined with passive visual stimulation, AERPs+VEPs) and compare the scalp topography obtained with the new paradigm and the classical auditory oddball paradigm (AERPs) in healthy humans. The responses to bimodal stimulation, and to the classical oddball paradigm were similar to those reported in other studies in terms of location, amplitudes, and latencies of P1, N1, P2, N2, and P300. The new modification of the oddball paradigm produced P300 at fronto-central locations in contrast to centro-parietal locations during the classical oddball paradigm. The amplitudes and latencies of P300 were also significantly larger during the new than the classical paradigm. Furthermore, the amplitudes of N1 and P2, but not N2 were significantly higher and differed in location during the new paradigm in response to both target and standard stimuli. The latencies
of all three waves were significantly longer and the latency of P2 differed in location between the new and the classical paradigms in response to only the standard stimuli. The results of this study suggest that the new modification of the classical oddball paradigm produces different neural responses to the classical oddball paradigm. Therefore, this modification can be used to investigate dysfunctions in sensory and cognitive processing in clinical samples.

**Keywords** event-related potential; visual evoked potential, auditory evoked potential, bimodal evoked potentials, auditory oddball paradigm, P300

8. **Neurofeedback in fibromyalgia syndrome**

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EEG Biofeedback (Neurofeedback-NFB) is a learning strategy that enables people to alter their brainwaves. In the present case study, we applied a NFB protocol on three patients with Fibromyalgia Syndrome (FMS). The existing symptoms and clinical conditions of the patients attributed to FMS, Visual Analog Scale for pain and fatigue, Hamilton Depression and Anxiety Inventory Scales, Beck Depression and Anxiety Inventory Scales, and SF-36 were recorded before and after NFB training. Most of the symptoms were decreased after ten sessions. There was also improvement in all of the scales after the treatment. The results of the present study may suggest NFB training as a novel treatment method in FMS.

**Key words:** Neurofeedback, Fibromyalgia Syndrome, Pain