

# Proceedings

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### Coherence Analysis of All-Night Sleep EEG. - P. Achermann and A.A. Borbély (Institute of Pharmacology, University of Zurich, CH-8057 Zurich, Switzerland).

The interhemispheric and intrahemispheric coherence of the EEG may provide information on the functional connectivities between brain regions. The present study was designed to explore state-specific changes of EEG coherence during sleep. The nocturnal sleep EEG of 8 young healthy subjects was recorded. The power spectra (averages of five 4-s epochs) and coherence spectra (20-s epochs) between different bipolar derivations were calculated in the frequency range of 0.25-25 Hz. - Intrahemispheric anterior-posterior coherences in nonREM sleep showed distinct peaks in the frequency range of sleep spindles, in the low delta band, and in the alpha band. Coherence was low throughout the entire frequency range in stage 1 and REM sleep. - Interhemispheric coherences of corresponding sites showed an entirely different pattern. Coherence in nonREM sleep was high in the delta, theta and alpha range, and the distinct peaks of intrahemispheric coherence were also present. They were most prominent in the anterior derivations. The pattern in stage 1 and REM sleep was similar to that of nonREM sleep although the typical peaks were absent and the values in the low delta range were lower. - Our results indicate that a state-specific high coherence is limited to distinct frequencies within the low delta, alpha and sigma band.

**Effect of Inter-Target Interval on P300 Source Distribution in Young and Elderly Normal Healthy Subjects. - P. Anderer\*, H.V. Semlitsch\*, R.D. Pascual-Marqui\*\* and B. Saletu\* (\*Dept. of Psychiatry, University of Vienna, Vienna, Austria; \*\*The KEY Institute for Brain-Mind Research, University Hospital of Psychiatry,**

### Zurich, Switzerland).

According to the triarchic model, P300 amplitude depends, at given levels of global probability, stimulus meaning and information transmission, on the specific sequence of preceding stimuli. Thus, in an oddball paradigm, P300 amplitude should depend on  $1/ITI$  where ITI is the inter-target interval. - Single potentials evoked by target tone bursts ( $p=0.10$ ;  $N=31$ ), were averaged according to their occurrence in the experiment, separately for 58 normal healthy subjects aged 20-29 years, and 41 normal healthy subjects aged 60-79 years. Latencies, amplitudes and electrical activity in the brain localized by means of "low resolution electromagnetic tomography (LORETA)" were evaluated. - P300 latency was strongly related to  $1/ITI$  both in young and elderly subjects, with short latencies for long ITIs ( $r=0.91$  and  $r=0.89$  in young and elderly, respectively). On the other hand, P300 amplitude at Pz was related to  $1/ITI$  only in young subjects with high amplitudes for long ITIs ( $r=-0.75$ ), but not in elderly ( $r=-0.19$ ). - As shown previously, LORETA revealed frontal and parieto-occipital P300 generators. In young subjects the parieto-occipital source was predominant for short ITI. With increasing ITI the parieto-occipital source decreased, while the frontal increased. In elderly, however, frontal and parieto-occipital P300 sources were approximately equal in size and strength, independent of the ITI.

**Sex or Pre-Treatment Differences on EEG-Effects of Morphine in Low Concentrations? - M.J. Barbanoj\*, G. Salazar\*, R.M. Antonijuan\*, F. Jane\*, P. Anderer\*\* and B. Saletu\*\* (\*Pharmacological Research Area, Research Institute of Sant Pau Hospital, Dept. of Pharmacology and Therapeutics, U.A.B., E-08025 Barcelona, Spain; \*\*Pharmacopsychiatry Section, Sleep Laboratory, Dept. of Psychiatry, University of Vienna, Vienna, Austria).**

In contrast to the abundant findings on EEG-effects of anaesthetic doses of opiates there are scarce data reporting on low-concentrations.

cal stage of the disease. We found the same pattern of EEG-alterations in the healthy family members with the mutation compared to members without the mutation as in AD-patients compared to healthy subjects, however, less clear. This finding indicates that EEG may be used for early detection of AD.

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**Spatiotemporal ERD/ERS in Parkinson Patients. - J. Diez\*, G. Pfurtscheller\*\*, F. Reisecker\*, B. Ortmayr\*\* and K. Zalaudek\*\* (\*Krankenhaus der Barmherzigen Brüder, Dept. of Neurology, Graz-Eggenberg; \*\*Ludwig Boltzmann-Institute for Medical Informatics and Neuroinformatics, TU Graz, Austria).**

Thirteen right-handed patients with Parkinson's disease (PD); mean age 63 years) were studied and compared to a control group of 14 subjects (mean age 61). Concerning akinesia in the PD patients six cases showed no predominance, three cases a slight, one a severe predominance on the left side, and three patients suffered from right Hemi-Parkinson. The subjects were seated in a reclining chair with their eyes closed and were asked to press a button on a joy stick with their thumb briskly every 12-15 sec without counting. The EEG for each hand was recorded separately with a sampling frequency of 100 Hz containing approximately 60 trials each. The data from each subject, triggered according to movement onset and offset, were filtered and ERD / ERS calculated. It was found that for right thumb movement in the 6-8 Hz band the ERD was larger and more widespread in PD as compared to the control group. The difference was largest on electrode FCz overlying the premotor area and SMA. In the beta band (20-24 Hz) the ERD was slightly larger in the control group's pre-movement interval at electrode PCz. In the post-movement interval of left thumb movement, beta ERS was much larger on electrodes C3 and C4 in normals as compared to PD patients.

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**Improved Focus Localization with Realistic Head Models Validated by Intracranial EEG. - J.S. Ebersole and S.M. Hawes (Dept. of Neurology, Yale University School of Medicine, New Haven, CT, USA).**

Source modeling of scalp-recorded spike and seizure potentials offers a non-invasive means of localizing epileptogenic foci in candidates for therapeutic resective surgery. However, the accuracy of dipoles based on spherical head models has been questioned. - We compared in three patients dipole models of temporal lobe spikes using both three sphere and realistic boundary element (BEM) head models (Curry). The latter were obtained from head MRI segmentation. Localization of foci were confirmed by simultaneous scalp and intracranial EEG. - Dipoles based on BEM more accurately reflected epileptogenic cortical sources identified during invasive monitoring. Spherical head models resulted in dipoles which were mislocated 1-3 cm in the Z (vertical) direction. When projected in the patient's MRI these sometimes appeared erroneously in the frontal lobe. Spatio-temporal dipole models (BESA) reflected cortical sources more accurately than single moving dipoles, when spike propagation was present and when repolarization of the initial source temporally overlapped depolarization of later sources producing a misleading composite voltage field. - Realistic BEM head models improve the accuracy of dipole models of spike sources from the temporal lobe and most probably from other basal sources. They should be used whenever dipoles are co-registered with brain MRI images for clinical interpretation.

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**Cortical Imaging Based on an Analytic High Resolution EEG. - G. Edlinger\*, P. Wach\*, T. Knoesche\*\*, M. van Burik\* and G. Pfurtscheller\* (\*Institute of Biomedical**

**Engineering, University of Technology, Graz, Austria; \*\*Biomagnetic Center Twente, University of Twente, The Netherlands).**

It is well known that the EEG is a blurred and spatially low-pass filtered representation of the cortical activity. Since additional recording electrodes will not necessarily lead to an improved spatial resolution, further steps have to be taken. We derived the analytic downward continuation of the scalp potential field to an arbitrary inner surface for a spherical volume conductor model with piecewise constant conductivities. The basic idea of the Analytic High Resolution EEG (AHREEG) is the fact that a function defined on a sphere can be expressed as a weighted sum of spherical harmonics. Considering the spatial transfer function between the cortex and the scalp surface, the potential distribution on the cortex is theoretically computed by the application of the inverse transfer function to the scalp potential field. Compared to source localization procedures, the AHREEG is not based on any source distribution or on the nature of the sources. Furthermore the proposed method is unique, though ill-posed. Due to this fact and the fact that real world data are always contaminated by noise, a regularization based on general cross validation is performed to stabilize the inverse solution. Simulation results as well as the application of the AHREEG to EEG recorded during median nerve stimulation will be presented and critically discussed.

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**Convergence Acceleration for the Forward Problem in an N-shell Spherical Head Model. - G. Edlinger\*, P. Wach\* and G. Pfurtscheller\*\* (\*Institute of Biomedical Engineering, University of Technology, A-8010 Graz, Austria; \*\*Ludwig Boltzmann-Institute of Medical Informatics and Neuroinformatics, A-8010 Graz, Austria).**

The analytic solution of the potential distribution in an N-shell spherical volume conductor model for the case of the general dipolar current source position  $Q=Q(r_0, \phi_0, \theta_0)$  has been derived. Simulations for a multi-compartment head model show that the computation of the potential distribution at observation points near source points, e.g., on the cortical surface, need Legendre functions of high degree and order. For a practical implementation and an improvement in the speed of convergence for the series expansion, a renormalisation technique was applied. For a 2 shell spherical volume conductor model the renormalisation is accomplished by subtracting the potential distribution, expanded into a Legendre series, of mirror sources. Finally the closed solution of the potential distribution is added again. Thus the number of expansion coefficients to describe the potential distribution with a certain predefined accuracy is reduced significantly. For a most general spherical volume conductor model the method of mirror sources can not be applied. However, a renormalisation using a dipole in a homogeneous spherical head model still reduces the number of expansion terms.

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**Magnetic Brain Activity Evoked by the Processing of Tone and Word Stimuli: An MEG Study on Patients with High Tone Hearing Loss. - E. Emmerich\*, J. Steenbeck\*, R. Meyer\*\*, F. Gießler\*\*\*, H. Nowak\*\*\* and E. Beleites\*\* (\*Institute of Neurophysiology, \*\*Clinical Dept. of Audiology, and \*\*\*Biomagnetic Center, Friedrich-Schiller-University, Jena, Germany).**

Sustained magnetic brain waves may reflect auditory processing when elicited by tone and word stimuli. In the present study, in the dipole localisation and current density reconstruction (CSD) subsequent to the late latency components of auditory evoked responses