

## Editorial

### Jean-Marc Vesin

*Signal Processing Institute, Swiss Federal Institute of Technology, 1015 Lausanne, Switzerland*  
*Email: jean-marc.vesin@epfl.ch*

### Touradj Ebrahimi

*Signal Processing Institute, Swiss Federal Institute of Technology, 1015 Lausanne, Switzerland*  
*Email: touradj.ebrahimi@epfl.ch*

Brain-computer interfaces (BCI), an emerging domain in the field of man-machine interaction, have attracted increasing attention in the last few years. Among the reasons for such an interest, one may cite the expansion of neurosciences, the development of powerful information processing and machine learning techniques, as well as the mere fascination for control of the physical world with human thoughts.

BCI pose significant challenges, at both the biomedical and the data processing levels. Brain processes are not fully understood yet. Also, the information on the dynamics of these processes, up to now gathered mainly with electroencephalographic (EEG) or functional magnetic resonance imaging (fMRI) systems, is incomplete and, more than often, noisy. As such, it is important for BCI applications to determine how, physically, the maximum amount of information can be extracted, and to design efficient tools both to process the data and to classify the results.

This special issue presents nine papers exhibiting a rather balanced state of research and development in BCI. Three papers deal with information extraction, three with signal processing aspects, and three present applications. Moreover, while most current efforts concentrate on continuous EEG-based techniques, fMRI, implanted microwire electrode, and evoked potential-based techniques are also presented.

In the first batch of three papers on “information extraction,” A. Meyer-Bäse et al. study independent component analysis (ICA) and unsupervised clustering techniques and combine them to produce task-related activation maps for fMRI datasets. M. Schröder et al. explore the problem of EEG channel selection for BCI tasks, and S.-P. Kim et al. propose a nonnegative matrix factorization to identify local spatio-temporal patterns of neural activity in microwire electrode signals from monkey motor cortical regions.

The second batch of papers devoted to “signal processing” aspects of EEG signals bring new insights to this field by making use of advanced signal processing techniques and

by evaluating their performance. The paper by P. J. Durka presents a methodology for the time-frequency analysis of event-related changes in EEG signals. D. A. Peterson et al. investigate the potential of blind source separation (BSS) and support vector machine (SVM)-based classification to discriminate two cognitive tasks. Finally, D. Coyle et al. deal with the extraction of time-frequency features to discriminate two imagined movements.

The last batch concentrates on three exciting applications of BCI. The paper by G. Pfurtscheller et al. describes a BCI approach for the control of a grasping device using functional electrical stimulation by a tetraplegic patient. E. Lalor et al. present a BCI-based 3D video game using steady-state visual evoked potentials, and C.-T. Lin et al. propose an EEG-based car-driver drowsiness estimation device.

We would like to thank the authors of this special issue for their valuable submissions and the reviewers for their high-quality evaluation. We hope the contributions made here will serve to further encourage and stimulate progress in this new and exciting field. Last but not least, we would like to thank the editorial team of EURASIP JASP for their continuous support and patience.

*Jean-Marc Vesin*  
*Touradj Ebrahimi*

---

**Jean-Marc Vesin** graduated from the École Nationale Supérieure d'Ingénieurs Électriciens de Grenoble (ENSIEG, Grenoble, France) in 1980. He received his M.S. degree from Laval University, Québec, Canada, in 1984, where he spent four years on research projects. After two years in the industry, he joined the Swiss Federal Institute of Technology, Lausanne, Switzerland, where he obtained his Ph.D. degree in 1992. He is now a Senior Researcher in the Signal Processing Institute of EPFL.



His research work is focused on the analysis of biomedical signals and the computer modeling of biological systems, with an emphasis on cardiovascular and neuronal applications. He is the author of more than 150 journal and conference papers.

**Touradj Ebrahimi** is currently a Professor at EPFL, involved in research and teaching of multimedia signal processing. He has been the recipient of various distinctions such as the IEEE and Swiss National ASE Award, the SNF-PROFILE grant for advanced researchers, three ISO certificates for key contributions to MPEG-4 and JPEG 2000, and the Best Paper Award of the IEEE Transactions on Consumer Electron-



ics. His research interests include still, moving, and 3D image processing and coding, visual information security (rights protection, watermarking, authentication, data integrity, steganography), new media, and human-computer interfaces (smart vision, brain-computer interface). He is the author or the coauthor of more than 150 research publications, and holds 10 patents.