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Current Position: **Post-Doc, LRI (Orsay, France), CEA (Saclay, France)**  
*Statistical Signal Processing and Machine Learning for Brain Signals*  
*Brain Computer Interfaces & Epilepsy*

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## I Education

**2006 - 2009** Doctorate of Philosophy, specialty: **Biotechnology, Instrumentation, Signal and Images for Biology, Medicine and Environment**, Grenoble University, FRANCE.

*Subject:* Toward dynamical models of brain activity for the design of brain-computer interfaces

*Advisors:* Prof. Christian Jutten and Dr. Marco Congedo

*Committee:* Dr. Olivier Bertrand, Prof. François Cabestaing, Dr. Maureen Clerc, Dr. Jean-Philippe Lachaux

*Abstract:* Brain-Computer Interfaces (BCIs) aim at establishing a direct communication pathway between the human brain and an electronic device. In the past twenty years, many breakthroughs have been made in the field, but current systems remain slow and difficult to use. They indeed often constrain users to send their command at precise moments (synchronous systems). Our research work is devoted to asynchronous systems based on electroencephalography (EEG): subjects are allowed to send their commands whenever they want. This entails brain activity of the subject to be analyzed in real time to detect the task-related brain activity among the whole brain activity. Our research work focuses on three main issues raised by asynchronous BCIs: to allow users to send their command whenever they want; to improve the ability of the system to correctly recognize a particular mental task; to increase the robustness of the system when coping with possible variations in the way the subject performs mental tasks. The proposed methods aim at jointly using the spatial (cerebral areas implied), frequential (frequency bands involved) and temporal (succession of activations) features of the different mental tasks in order to compensate the low signal to interference ratio. The approaches are evaluated and compared to state-of-the-art results using datasets from the successive BCI Competitions.

**2005 - 2006** Master in **Cognitive Sciences** (Neural Networks, Cognitive Psychology, Neurophysiology), from the Grenoble Institute of Technology (INPG), *summa cum laude, mention très bien*. Grenoble, FRANCE.

**2003 - 2006** Electronical Engineering School **ENSERG** (Ecole Nationale Supérieure d'Electronique et de Radioélectrique de Grenoble, Grenoble Institute of technology)<sup>1</sup>, specialization in **Multimedia** (Signal processing, Human Computer Interfaces, Virtual reality), *magna cum laude, mention bien*.

**2001 - 2003** Lycée Champollion (Grenoble, Isère, FRANCE). 2-year post-baccalauréat preparatory program called "classes préparatoires" (specialty: Mathematics and Physics).

- **2001** Lycée Jean Prévost (Villard de Lans, Isère, FRANCE). Baccalauréat S with a specialization in Mathematics and Biology, *summa cum laude, mention très bien*.

## II Experience

**09/2009 - 10/2010 Brain-Computer Interfaces & Epilepsy** Post-Doc: Epileptic Seizure prediction and Classification of Brain Signals in Brain-Computer Interfaces. LRI/INRIA-Saclay (Orsay, FRANCE). Supervisors: Michèle SEBAG and Anthony LARUE. This work is funded by the région Île-de-France (DIGITEO).

<sup>1</sup> The ENSERG is now called PHELMA.

**02/2006 - 09/2006 Haptic Interfaces** Development of an Haptic-Based Software for the Inclusion of Blind Pupils into Regular Schools. France Telecom Research and Development (Meylan, FRANCE). Supervisor: Sylvie Vidal.

**06/2005 - 09/2005 Materials** Nanotechnologies, Influence of the Metal-MWCNT (Multi-Wall Carbon Nanotube) on the Global Resistance of a Metal-MWCNT-Metal Junction. National Nano Device Laboratories (Hsinchu, TAIWAN). Supervisor: Jyh-Hua Ting.

### III Teaching and Reviewing

**Lab sessions** ~ 20 hours: Computers and Micro-Controllers  
~ 10 hours: Introduction to the ENSE<sup>3</sup> Information System

**Reviewing** Clinical Neurophysiology, IRBM BioMedical Engineering and Research, Journal of Neural Engineering, ACIVS conference, Neural Networks

**Computer libraries** Development and maintenance of the jointDiag official R<sup>2</sup> package for approximate joint diagonalization of a set of squared matrices. Development and maintenance of CMAES R package (to be released soon) for continuous optimization based on Covariance Matrix Adaptation.

### IV Skills

**Computer skills** Unix, Windows, L<sup>A</sup>T<sub>E</sub>X, ConT<sub>E</sub>Xt, Perl, Python, Matlab, R, C, java, C++

**Technical skills** Statistical signal processing, Machine learning, Statistics, Stochastic processes, Continuous Optimization (Covariance Matrix Optimization)

**Language** French (mother tongue), english (fluent), german (scholar)

### V Bibliography

During his PhD thesis [1] and his first year of post-doc. Dr Cédric Gouy-Pailler has published one book [2], two journal articles [3 and 4], and thirteen conference articles. [5–17].

- [1] Cédric Gouy-Pailler. *Vers une modélisation dynamique de l'activité cérébrale pour la conception d'interfaces cerveau-machines asynchrones*. PhD thesis, University of Grenoble, 2009.
- [2] Cédric Gouy-Pailler. *Interfaces Cerveau-Machines : Modèles dynamiques de l'activité cérébrale pour la conception de systèmes asynchrones*, volume ISBN: 978-6131503764. Editions Universitaires Européennes, 2010.
- [3] Cédric Gouy-Pailler, Marco Congedo, Clemens Brunner, Christian Jutten and Gert Pfurtscheller. Non-stationary brain source separation for multi-class motor imagery. *IEEE Trans. Biomed. Eng.*, 57(2):469–478, 2010.
- [4] Marco Congedo, Cédric Gouy-Pailler and Christian Jutten. On the blind source separation of human electroencephalogram by approximate joint diagonalization of second order statistics. *Clin. Neurophysiol.*, 119(12):2677–2686, 2008a.
- [5] Cédric Gouy-Pailler, Michèle Sebag, Antoine Souloumiac and Anthony Larue. Ensemble learning for non-invasive brain computer-interfaces using uncooperative democratic echo state communities. In *Proceedings of Neurocomp*, 2010b. Submitted.
- [6] Cédric Gouy-Pailler, Michèle Sebag, Anthony Larue and Antoine Souloumiac. Sabin: a resampling-based learning algorithm for idle state identification in asynchronous brain-computer interfaces. In *ICPR workshop on Brain Decoding*, 2010a.
- [7] C Gouy-Pailler, A Souloumiac, M Sebag and A Larue. Revisiting the classification/regression approach in brain computer interfaces: a reservoir computing approach. In *Proceedings of the TAUC conference (TAUC'10)*, 2010c.

<sup>2</sup> R is a statistical multi-purpose software. It is freely available on <http://www.r-project.org/>. The package can be downloaded on <http://cran.r-project.org/web/packages/jointDiag/index.html>.

- [8] Pierre-Olivier Amblard, Sophie Achard, Jérôme Lemoine and Cedric Gouy Pailler. Retrieving connectivity in complex networks of long range dependent stochastic processes. In *European Conference on Complex Systems European Conference on Complex Systems*, pages p76, Royaume-Uni, 2009.
- [9] Jérôme Lemoine, Cédric Gouy-Pailler, Sophie Achard and Pierre-Olivier Amblard. Recherche de la connectivité de réseaux complexes. application en fmri. In *XXII ème colloque GRETSI*, 2009.
- [10] Cédric Gouy-Pailler, Jérémie Mattout, Marco Congedo and Christian Jutten. Uncued brain-computer interfaces: a variational hidden markov model of mental state dynamics. In *Proceedings of the 17th European Symposium on Artificial Neural Networks (ESANN 09)*, 2009.
- [11] Cédric Gouy-Pailler, Reza Sameni, Marco Congedo and Christian Jutten. Iterative subspace decomposition for ocular artifact removal from eeg recordings. In *Proceedings of the 8th International Conference on Independent Component Analysis and Blind Source Separation (ICA 09)*, pages 419–426, Paraty, Brasil, 2009.
- [12] Cédric Gouy-Pailler, Marco Congedo, Christian Jutten, Clemens Brunner and Gert Pfurtscheller. Model-based source separation for multi-class motor imagery. In *Proceedings of the 16th European Signal Processing Conference (EUSIPCO-2008), EURASIP*, 2008.
- [13] Marco Congedo, Christian Jutten, Reza Sameni and Cédric Gouy-Pailler. A new general weighted least-squares algorithm for approximate joint diagonalization. In *Proceedings of the 4th International BCI Workshop*, 2008b.
- [14] Cédric Gouy-Pailler, Marco Congedo, Clemens Brunner, Christian Jutten and Gert Pfurtscheller. Multi-class independent common spatial patterns: Exploiting energy variations of brain sources. In *Proceedings of the 4th International BCI Workshop*, 2008.
- [15] Cédric Gouy-Pailler, Sophie Achard, Bertrand Rivet, Christian Jutten and Emmanuel Maby et al.. Topographical dynamics of brain connections for the design of asynchronous brain-computer interfaces. In *Proc. Int. Conf. IEEE Engineering in Medicine and Biology Society (IEEE EMBC 07)*, pages 2520–2523, Lyon, France, 2007.
- [16] Cédric Gouy-Pailler, Bertrand Rivet, Sophie Achard, Antoine Souloumiac and Christian Jutten et al.. Théorie des graphes et dynamique des connexions cérébrales pour la conception d'interfaces cerveau-machines asynchrones. In *XXI ème colloque GRETSI*, 2007.
- [17] Cédric Gouy-Pailler, Sophie Zijp-Rouzier, Sylvie Vidal and Denis Chêne. A haptic based interface to ease visually impaired pupils' inclusion in geometry lessons. In Springer, editor, *Universal Access in Human-Computer Interaction. Applications and Services*, number 4556/2007 in Lecture Notes in Computer Science, pages 598-606, 2007.