



## Inria Research & Development for the Cybathlon BCI series

Fabien Lotte, Maureen Clerc, Aurélien Appriou, Amandine Audino, Camille Benaroch, Pierre Giacalone, Camille Jeunet, Jelena Mladenović, Thibaut Monseigne, Théodore Papadopoulo, et al.

### ► To cite this version:

Fabien Lotte, Maureen Clerc, Aurélien Appriou, Amandine Audino, Camille Benaroch, et al.. Inria Research & Development for the Cybathlon BCI series. 8th Graz Brain-Computer Interface Conference 2019, Sep 2019, Graz, Austria. 2019. hal-02433970

**HAL Id: hal-02433970**

**<https://hal-univ-rennes1.archives-ouvertes.fr/hal-02433970>**

Submitted on 9 Jan 2020

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Inria Research & Development for the Cybathlon BCI series

F. Lotte, M. Clerc, A. Appriou, A. Audino, C. Benaroch, P. Giacalone, C. Jeunet, J. Mladenovic, T. Monseigne, T. Papadopoulo, L. Pillette, A. Roc, K. Sadatnejad, F. Turi

## Team NITRO: Neurotechnology Inria Team Racing Odyssey

### INTRODUCTION

- Team NITRO, from Inria (French national research institute for digital technologies), gathers 2 Inria research teams: Potioc (Bordeaux) and Athena (Sophia-Antipolis).
- Team NITRO trains two Cybathlon BCI pilots, one in Bordeaux and one in Sophia-Antipolis.
- Both research teams work together on the BCI design [1] and implementation, based on OpenViBE [2].
- We introduce each pilot, as well as their BCI system and training procedure below.

### PILOT 1 - Presentation

- Wilfried Panatier, Graphic Designer, president of Pratikable (<http://www.pratikable.com>), an association to highlight disabilities through boarding, skating and extreme sports for all. He is himself tetraplegic and a rider!



Wilfried Panatier, 32 (center) with NITRO team members

### BCI system & training protocol

- 4-class mental imagery BCI
  - Left/right hand motor Imagery, mental subtraction, rest
- 46 active EEG channels, g.tec gUSBamp
- Classification: Adaptive Riemannian classifier [3]
  - Features: Spatial covariance matrices in 8-24Hz
  - Classifier: geodesic filter MDM with adaptive Rebias
- Progressive user training [4]
  - Pairs of 2 classes => 4 classes => Game control
  - 1 session/week => 2 sessions/week => 3 sessions/week



### PILOT 2 - Presentation

- Karine Leclerc, who lives at the René Labreuille centre. She is president of the CVS (social life council) of the centre's residents.



Karine Leclerc, 32 (right) with her medical assistant Magali Mambrucchi.

### BCI system & training protocol

- 4-class mental imagery BCI
  - Right Hand motor imagery
  - Language imagination
  - Music imagination or Left Hand motor imagery
  - Rest
- 23 EEG channels, ANT Neuro Refa8
- Classifier: Linear Discriminant Analysis (LDA)
- User training
  - Pairs of 2 classes => 4 classes => Game control

### References

- [1] Clerc, Bougrain, Lotte, ISTE-Wiley, 2016      [3] Kumar, Yger, Lotte, BCI Winter conf, 2019  
[2] Renard et al, Presence, 2010                      [4] Lotte et al., Frontiers, 2013