CAMILLE BENAROCH

camillebenaroch.com

9 avenue des chasseurs
75017 Paris
Tel. + 33 6 80 67 83 81
Mail : camille.benaroch@gmail.com
Skype : camille.benaroch
Date of birth : 01/11/1993

EDUCATION

Oct 2018 - now	**PhD in computer science** Contribution to the understanding of mental task BCI performances using predictive computational models POTIOC Team, Inria LaBRI (University of Bordeaux, CNRS, Bordeaux INP), Bordeaux, FR
Jan 2020 – Sept 2020	**University degree in Big Data and statistics** Graduate School of Cognitive Engineering ENSC, Bordeaux, FR
Sept 2016 – Sept 2018	**International M.Sc in Bioengineering and Innovation in Neurosciences** Two-year BioMedical Engineering (BME) Master Program *(valedictorian)* UNIVERSITY OF PARIS DESCARTES & ESPCI PARIS TECH, Paris, FR
Sept 2015 - Jan 2016	**First year of medical school** UNIVERSITY OF PARIS DESCARTES, Paris, FR
Sept 2012 - 2015	**Master of Electronics from the Graduate School of Engineering** ENSEIRB - MATMECA, Bordeaux, FR
Sept 2010 - June 2012	**Classes Préparatoires aux Grandes Ecoles** College preparatory classes specializing in mathematics and physics LYCEE SAINT LOUIS, Paris, FR

TECHNICAL SKILLS

Computer science	Python	●●●●○
	R	●●●○○
	Matlab	●●●●○
	Java	●●●○○
	C/C++	●●○○○
Machine learning	Theory	●●●●○
	Scikit-Learn	●●●●○
	Pandas	●●●●●
	Seaborn	●●●●●
	Pinguin	●●●●○
Signal processing	Theory	●●●●○
	Biological signals	●●●●●
	MNE	●●●●●
Neurosciences	Theory	●●●○○
	Brain-computer Interfaces	●●●●●
Electronics	Circuits and integrated systems	●●●○○
	Digital and Analog electronics	●●●○○

LANGUAGE

French	Native speaker
English	Fluent – IELTS (C1)

WORK EXPERIENCE

Oct 2018-now PhD	**POTIOC Team – Inria, Bordeaux, FR** Contribution to the understanding of mental task BCI performances using predictive computational models
Feb 2018 – Aug 2018 internship	**POTIOC Team – Inria, Bordeaux, FR** Create a statistical/probabilistic model of training that could explain and predict the learning rate and the performances of a Brain-Computer-Interface (BCI) user over training time using user's personality, skills, and timing of the experiment
2018-2020 teaching assistant	**Ecole Nationale Supérieur des Arts et Metiers (ENSAM), Bordeaux, FR** Teaching assistant in the mathematics and computer science teaching unit (python, object oriented programming, Qt) - 64 hours/year
Feb 2017 – June 2017 internship	**INSTITUT DES NEUROSCIENCES DES SYSTEMES – INSERM, Marseille, FR** Analyzing the Epileptogenicity Index (EI) using The Virtual Brain (TVB), a computational platform that allows simulating biologically realistic large-scale brain network dynamics
March 2015 – Sept 2015 internship	**IOPTIMA, Tel Aviv, Israel** Product Management and Development of a minimally invasive ophthalmic surgical tool for the treatment of glaucoma
Oct 2014 – Feb 2015 Master's project	**Institute of Cardiac Rhythm and modelling, Bordeaux, FR** 3D visualization of cardiac catheters by variating electric and magnetic fields - VHDL, PIC microcontroller, analogue electronics, Matlab)
June 2014 - Oct 2014 internship	**SAFT Industry, Bordeaux, FR** Worked with the team developing the lithium-ion batteries for the Airbus A350 (improvement of the electronic board reinforcing system security)

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HOBBIES AND INTERESTS	
Travel	Europe (Spain, Italy, United Kingdom, Germany), Asia (Israel, Japan), Oceania (Australia), Africa (South Africa, Mauritius), America (USA, Mexico)
Arts	Knitting, sewing
Sports	Gliding, yoga, fitness

DOCTORAL THESIS IN COMPUTER SCIENCE	
Subject	**Contribution to the understanding of mental task BCI performances using predictive computational models**
Supervisors	**Fabien Lotte** - Research director at Inria Bordeaux Sud-Ouest , France Mail: **fabien.lotte@inria.fr** – **Professional website** **Camille Jeunet** - Research Scientist at Aquitaine Institute for Cognitive and Integrative Neurosciences (INCIA), France Mail: **camille.jeunet@u-bordeaux.fr** – **Professional website**
Summary	Brain computer interfaces (BCIs) are communication and control tools that enable their users to interact with computer by using brain activity alone (which is measured, most of the time, using electroencephalography - EEG). A prominent type of BCI is mental task (MT) based BCIs, that translate modifications in brain activity induced by MTs performed by the user (e.g., imagination of movements, mental calculation or mental rotation of an object among others) into control commands for a computer. Using an MT-BCI requires dedicated training. Indeed, the user has to generate stable and distinct brain signals for each task otherwise they will not be able to control the system. Indeed, the system will not be able to recognize which task the user is performing. Producing such brain signals is a skill to be acquired and mastered and the more the user practices the better he/she will get at it. The objective of my PhD project is to contribute to the understanding of BCI user training by first doing an experimental study of learning by participating in the CYBATHLON competition. We proposed and evaluated the design of a multi-class MT-based BCI for longitudinal training of a tetraplegic user with a newly designed machine learning pipeline based on adaptive Riemannian classifiers. Using a newly proposed BCI user learning metric, we could show that our user learned to improve his BCI control by producing EEG signals matching increasingly more the BCI classifier training data distribution, rather than by improving his EEG class discrimination. In addition, this study revealed the difficulty of setting up a reliable protocol dedicated to a long term BCI training. The second part of this work is dedicated to the understanding of MT-BCI performances using predictive computational models. We proposed various computational models of BCI user training that could predict the performances of various BCI users over training time, based on BCI systems component. As a BCI is a communication system between a user and a machine such components were related to the user-profile related characteristics but also factors extracted from machine-learning algorithms used to build the system classifier. Our results suggested that is was possible to predict BCI performances using neurophysiological characteristics of a user but also neurophysiological characteristics combined with stable characteristics (i.e., traits) or the user. In addition, our studies revealed that studying features extracted from data-driven methods could be interesting to better understand why some subjects have difficulties controlling a BCI. Indeed, reliable models of BCI performances were revealed using such features.

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PAPERS AND CONFERENCES

Journal papers	**Benaroch, C.**, Sadatnejad, K., Roc, A., Appriou, A., Monseigne, T., Pramij, S., Mladenovic, J., Pillette, L., Jeunet, C., & Lotte, F. (2021). Long-Term BCI Training of a Tetraplegic User: Adaptive Riemannian Classifiers and User Training. Frontiers in Human Neuroscience, 15, 118. Roc, A., Pillette, L., Mladenovic, J., **Benaroch, C.**, N'Kaoua, B., Jeunet, C., & Lotte, F. (2020). A review of user training methods in brain computer interfaces based on mental tasks. Journal of Neural Engineering. **Benaroch, C.,** Jeunet, C., & Lotte, F.. Can a computational model predict Mental-Task BCI performance across experiments based on users' characteristics? (submitted in PlosOne) **Benaroch, C.,** Yamamoto M.S., Roc Aline, Jeunet, C., & Lotte, F.. When should MI-BCI feature optimization include prior knowledge, and which one? (Accepted with revision in Brain-Computer Interfaces)
International conferences with reviewing committee	**Benaroch, C.**, Jeunet, C., & Lotte, F. MI-BCI Performances correlate with subject-specific frequency band characteristics. BCI 2021 - 8th International Meeting of the Brain-Computer Interface Society, Jun 2021, Virtual, France Tzdaka, E., **Benaroch, C.**, Jeunet, C., & Lotte, F. (2020, October). Assessing The Relevance Of Neurophysiological Patterns To Predict Motor Imagery-based BCI Users' Performance. In 2020 IEEE International Conference on Systems, Man, and Cybernetics (SMC) (pp. 2490-2495). IEEE. **Benaroch, C.**, Jeunet, C., & Lotte, F. (2019, September). Are users' traits informative enough to predict/explain their mental-imagery based BCI performances?. In 8th Graz BCI Conference 2019.
National conferences with reviewing committee	Yamamoto M.S , **Benaroch, C.**, Roc A., Monseigne, T. & Lotte, F. (2021). Should frequency band selection algorithms include neurophysiological constraints? . In CORTICO COllectif pour la Recherche Transdisciplinaire sur les Interfaces Cerveau-Ordinateur. Tzdaka, E., **Benaroch, C.,** Jeunet, C., & Lotte, F. (2020, October). Using neurophysiological predictors to predict MI-BCI users' performances. In CORTICO COllectif pour la Recherche Transdisciplinaire sur les Interfaces Cerveau-Ordinateur. **Benaroch, C.**, Jeunet, C., & Lotte, F. (2019, March). Computational modelling to predict/explain MI-BCI users' performances and their progression. In Journées Cortico-COllectif pour la Recherche Transdisciplinaire sur les Interfaces Cerveau-Ordinateur. **Benaroch, C.**, Jeunet, C., & Lotte, F. (2018, April). Using computational modelling to better understand and predict Mental-Imagery based BCI (MI-BCI) users' performance. In Journées CORTICO 2018-COllectif pour la Recherche Transdisciplinaire sur les Interfaces Cerveau-Ordinateur.