Wit Welcoming International Talent

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under Marie-Sklodowska Curie grant agreement No 101034285

UNIVERSITY: PUBLIC UNIVERSITY OF NAVARRE (UPNA)

WIT PROGRAMME´S RESEARCH LINE NAME: DeepLearning in BCI

DOCTORAL PROGRAMMES: Doctorate in Mathematics and Statistics https://www.unavarra.es/escuela-doctorado/doctorate-programs/current-plan/science/doctorate-in-mathematics-and-statistics?languageId=1

Doctorate in Communications Technology, Bioengineering and Renewable Energies https://www.unavarra.es/escuela-doctorado/doctorate-programs/current-plan/engineering-and-architecture/doctorate-in-communications-technology-bioengineering-and-renewable-energies?languageId=1

COMPLETE DESCRIPTION OF THE LINE

Brain-computer interfaces (BCI) extract brain patterns and turn them into messages or commands for interactive applications. BCI research is an exciting field due to its multi-disciplinary nature. It covers different topics from computational neuroscience to machine learning. Currently, this field suffers from lack of efficiency and complexity of the brain signals in out of the lab environments. BCI inefficiency is related to the high complexity of brain signals. Machine learning algorithms learn relevant brain patterns of users' tasks. However, there is a general lack of mathematical frameworks to proof their viability which renders the proposed solutions inefficient. Furthermore, although deep learning extracts information from complex data, it did not proof efficient for BCIs. This is related to the lack of mathematical frameworks for brain signals. We propose the development of full mathematical models based on statistical and deep learning to study BCI out-of-the-lab performance.

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RESEARCH GROUP NAME:

Algebra. Applications

COORDINATOR:

- Last and first name; link to the "Portal of scientific production": Luis M. Ezquerro Marín

https://academicos.unavarra.es/CawDOS//jsf/seleccionActividades/seleccionActividades.jsf?id_pers=278

- Departament: Estadística, Informática y Matemáticas
- Email: ezquerro@unavarra.es
- Telephone number: 948 16 9542

MEMBERS OF THE LINE RESEARCH:

- Marisol Gómez Fernández (UPNA & NavarraBiomed, Tutora)
- Carmen Vidaurre Arbizu (UPNA & NavarraBiomed, Tutora)
- Humberto Bustince (UPNA & NavarraBiomed)
- Alicia Martínez Remírez (UPNA & NavarraBiomed)
- Tania Jorajuria Gómez (UPNA)
- Pablo Lecumberri Villamediana (NavarraBiomed & Movalsys)
- Nora Millor Muruzabal (UPNA & NavarraBiomed)

ANOTHER RESEARCH LINES OF THE GROUP:

- Group theory. Classes of groups. Group representations and Codes
- Deconvolution and signal localization
- Machine learning, and deep learning methods for the extraction of multimodal information

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- Multimodal analysis of human movement. Application to rehabilitation and functional capacity improvement.
- Techniques for optimising information extraction from clinical signs

obtained with non-invasive techniques.

- Group theory. Aggregation and engagement: application to data classification and decision-making under uncertainty.

▪ Entities involved in research lines and contact person:

✓ Academic entities:

- Universidad Pública de Navarra (Marisol Gómez & Carmen Vidaurre, marisol@unavarra.es, carmen.vidaurre@unavarra.es)
- Vadim V Nikulin. Max Planck Institute for Human Cognitive and Brain Sciences.
- Klaus-Robert Müller. Machine Learning Group. Berlin University of Technology.
- Guido Nolte. Neurophysiology and pathophysiology. Universitätsklinikum Hamburg-Eppendorf.
- Stefan Haufe. Brain and data science group. Charité - Universitätsmedizin Berlin
- María C. Herrojo-Ruiz. Psychology Dp. Goldsmiths University of London.

✓ Industrial entities:

- NavarraBiomed (I. Lasa, ilasa@unavarra.es)
- Tecnalia (A. Ramos-Murguialday, ander.ramos@gmail.com)
- Movalsys (Pablo Lecumberri, pablo@movalsys.com)
- Google Brain (Klaus-Robert Müller)

▪ Joint supervision of doctoral thesis with international universities or non academic institutions:

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-Rouven Kennville (C. Vidaurre, Prof. V. V. Nikulin, Prof. Ragert, Prof. Villringer, in progress) with MPI Leipzig.

-Magdalena Gippert (C. Vidaurre and Prof. V.V. Nikulin) with MPI Leipzig.

- Brief group overview:

The Algebra and Applications Research group is a multidisciplinary group of mathematicians and telecommunication engineers. Currently, its research lines are focused on the development of theoretical methods for the extraction of information from multimodal data. The mathematical models and algorithms developed are applied in fields such as biomedical data classification, decision making in medicine, evaluation and classification of movement in people with motor disabilities or aging population.

They also work in the field of BCI research with focus on designing statistical and deep learning methods for the extraction of brain activity related to task relevant sources.

- Link of the group to the "Portal of scientific production":
  - https://academicos.unavarra.es/CawDOS/jsf/seleccionPersonalEstamento/seleccionPersonal.jsf

- Pictures, links… to academic or industrial partners (if any)
  - UPNA: www.unavarra.es
  - NavarraBiomed: www.navarrabiomed.es
  - CHN: www.idisna.es/conocenos/instituciones/complejo-hospitalario-de-navarra
  - Movalsys: www.movalsys.com/
  - Tecnalia: https://www.tecnalia.com
  - Google Brain: https://research.google/people/107313/
  - Goldsmiths University: https://www.gold.ac.uk

REQUIREMENTS:

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Academic Qualifications:
Mathematics Degree
Computer Science Degree
Neuroscience Degree

Specific Requirements:

Signal processing skills
Mathematical knowledge of matrix theory and machine learning tools
Programming in Python or/and MatLab
Ability to work in a multidisciplinary team