UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

PHD PROGRAM IN INFORMATION AND COMMUNICATION TECHNOLOGY FOR HEALTH

PHD PROGRAM IN INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING

PhD course announcement

Title: **Riemannian Geometry-based Methods for Artefact Removal, Inter-Subject Generalization, and Statistical Analysis for EEG Signal**

Lecturer: **Dr. Marco Congedo**

Directeur de Recherche CNRS
Responsable Equipe ViBS
GIPSA-lab, 38000, Grenoble
Univ. Grenoble Alpes, CNRS, Grenoble-INP

Credits: **4.5**

Short bio notes

Marco Congedo obtained the Ph.D. degree in Biological Psychology with a minor in Statistics from the University of Tennessee, Knoxville, in 2003. From 2003 to 2006 he has been a post-doc fellow at the French National Institute for Research in Informatics and Control (INRIA) and at France Telecom R&D, in France. In 2007 Dr. Congedo has been appointed Research Scientist at the "Centre National de la Recherche Scientifique" (CNRS), working in the GIPSA Laboratory at the University of Grenoble Alpes, France. Since 2020 he is Research Director at CNRS. Dr. Congedo's research is focused on human electroencephalography (EEG), particularly on mathematical tools useful for the analysis and classification of EEG data such as inverse solutions, blind source separation and Riemannian geometry. He has co-authored over 150 scientific publications.

Schedule (lectures will be held at via Claudio 21, Building 3, ground floor, Napoli)

Date (time)	Hours	Room	Lecturer
25/02/2025 (9:30 am - 13:30 pm; 14:30 pm – 16:30)	6	C2A	Marco Congedo
26/02/2025 (9:30 am - 13:30 pm; 14:30 pm – 16:30)	6	C2A	Marco Congedo
27/02/2025 (9:30 am - 13:30 pm; 14:30 pm – 16:30)	6	C2A	Marco Congedo

Content

I Lesson - Introduction: Course introduction; Recap on the Riemannian geometry and its application on EEG processing.

II Lesson – Riemannian geometry-based artefact removal: In this lecture, different Riemannian geometry-based methods for automatic artifact removal from EEG signals will be discussed. Practical examples will be used to illustrate the application of these techniques, emphasizing their effectiveness and utility in enhancing the reliability of brain signal analysis.

III Lesson – Spectral co-registration of EEG data to improve the inter-subject generalization: This lecture will focus on the generalization problem, a significant challenge for modern Brain-Computer Interface applications. After a brief introduction to the properties of spectral SPD matrices, their structure, and their role in EEG signal analysis, innovative methods to address the generalization issue will be discussed, with particular emphasis on the Riemannian Registration, its computational characteristics, and its main advantages.

IV Lesson – Statistical analysis for EEG data processed using Riemannian geometry: In this lecture, different statistical approaches and tools will be presented. The emphasis will be on identifying and applying the most appropriate methods for specific experimental designs, including studies involving placebo controls, pre-post treatment analyses, and those incorporating multiple treatments or tasks. These methods will be explored to highlight how they can improve the reliability of conclusions drawn from experimental data, ensuring more accurate interpretations and robust results in various research contexts.

Notes

Participants are requested to send an e-mail to Dott. Nicola Moccaldi (nicola.moccaldi@unina.it) with the following information: Student name, name of the PhD course and cycle, **by 24 February, 2025**.

There will be a final assessment based on a questionnaire on the topics covered across the Module.