Predio Dr. Alberto Cassano - CCT CONICET Santa Fe
Colectora Ruta Nac. 168 km 0 – Paraje "El Pozo"
S3007ABA Santa Fe, Argentina
(+54 342) 4511370 int. 4001/4003
imal@santafe-conicet.gov.ar
www.imal.conicet.gov.ar

Instituto de Matemática
Aplicada del Litoral
"Dra. Eleonor Harboure"
CONICET - UNL

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SEMINARIO DEL IMAL 2025
"Macías-Segovia"

Optimal Transport for Reducing Cross-Subject Variability in Motor Imagery Brain-Computer Interfaces for Rehabilitation

Catalina Galván

Resumen. Electroencephalography (EEG)-based brain-computer interfaces (BCIs) often struggle with high variability across subjects, which is particularly challenging for motor imagery (MI) paradigms used in rehabilitation. Most current MI-BCI systems require subject-specific models, which demand extensive calibration data from each new user, resulting in long setup times. To address this, transfer learning has been proposed, where large public datasets are used to pretrain models. However, even with these approaches, significant recalibration data is still needed from the target subject, or the performance is insufficient for practical use in rehabilitation. In this talk, I will present cross-subject backward optimal transport (XS-BOT), a framework built on the principles of backward optimal transport for domain adaptation. This technique reduces the need for extensive calibration by aligning the distribution of target subject data with the source (training) data using optimal transport theory. Importantly, in rehabilitation settings the BCI system indicates to the user when and which MI task to perform. However, due to the difficulties in performing MI, the user generated EEG patterns might not necessarily match the cued label. Starting from a model trained on a large group of source subjects, XS-BOT exploits the availability of these cued labels to guide the adaptation via optimal transport at the feature level, avoiding the need for model retraining. We validated XS-BOT on five public MI-BCI datasets, training on data from 54 subjects and testing on 139. The results showed that XS-BOT outperformed existing methods by approximately 20 percentage points, achieving over 81In summary, XS-BOT provides an effective solution for cross-subject adaptation in MI-BCIs, enabling accurate decoding with minimal calibration effort and simplified setup, which is crucial for real-world rehabilitation applications.

Bio. Catalina Galván es estudiante del Doctorado en Ingeniería en la Universidad Nacional del Litoral (UNL) y becaria doctoral del CONICET en el Instituto de Matemática Aplicada del Litoral (IMAL, CONICET-UNL). Además, es docente en la Facultad de Ingeniería Química de la UNL. Obtuvo su título de Bioingeniera en 2019 por la Universidad Nacional de Entre Ríos (UNER). Su principal tema de investigación consiste en el desarrollo de modelos de aprendizaje automático para interfaces cerebro-computadora (BCI) basadas en imaginería motora. Actualmente trabaja en estrategias de adaptación de dominio para mitigar las variabilidades intra e inter sujetos de las señales EEG.

Viernes 23 de mayo, 15:30 horas

El Seminario se realizará en la SUM del IMAL y se transmitirá por videoconferencia.

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