UNIVERSITÀ DI PADOVA
Centro di Ateneo
Padova Neuroscience Center

18 JUNE 2026 3:00 pm

SALA SEMINARI VIMM

(Via Giuseppe Orus 2, Padova)

PNC SEMINARS

A talk by Luca Pasa
(University of Padova)

SPATIO-TEMPORAL DEEP LEARNING FOR NEUROIMAGING DATA

Understanding the organization of the human brain and its network of connections is a central goal of neuroscience. Functional magnetic resonance imaging (fMRI) provides a powerful tool for studying brain activity through blood oxygenation level-dependent (BOLD) signals, enabling the estimation of functional connectivity and the construction of functional connectomes. However, the high dimensionality and complexity of fMRI connectivity data pose major challenges for traditional statistical methods. Machine learning offers promising tools for identifying subtle patterns in these data, with applications ranging from clinical classification to cognitive prediction and the study of brain development. In particular, dynamic functional connectivity highlights the importance of temporal changes in brain organization, suggesting that both spatial and temporal dimensions should be considered in fMRI analysis.

In this seminar, I will discuss the use of deep learning models for neuroimaging data, focusing on how different architectures exploit the spatio-temporal structure of fMRI signals. We start from simple temporal models, such as LSTMs, and then consider GNN-based approaches designed to model the connectome's relational structure. While GNNs can capture spatial patterns between brain regions, many existing approaches rely on static connectivity representations that may overlook the evolving nature of brain dynamics. Building on this

motivation, we explore temporal graph-based models adapted to dynamic brain connectivity data. Our evaluation of predictive models from the literature shows that simple temporal architectures can outperform more recent spatial or spatio-temporal approaches. These results emphasize the central role of temporal dynamics in fMRI analysis and suggest that explicitly adding graph-based spatial information may increase model complexity without necessarily improving performance. At the same time, they underscore the need for more effective strategies to jointly integrate spatial and temporal information across different architectural paradigms.

Biography

Luca Pasa earned his Master's degree in Computer Science from the University of Padova, where he completed his Ph.D. in Mathematical Sciences (curriculum Computer Science) in 2017. He then served as a postdoctoral researcher at the Center of Translational Neurophysiology Speech and Communication (CTNSC) at the Istituto Italiano di Tecnologia (IIT), working under the supervision of Dr. Leonardo Badino. From July 2019 to December 2021, he was a postdoctoral researcher at the University of Padua. Since 2022, he has held the position of Assistant Professor in the Department of Mathematics at the same institution.

His main research interests lie in the field of Machine Learning, including Deep Learning, Computational Neuroscience, and Automatic Speech Recognition. Currently, his research activity is focused on the application of Deep Learning methods on structured domains (sequences, trees, and graphs).

Luca Pasa has co-authored numerous research papers published in international peer-reviewed journals and conference proceedings. Currently, he is an Associate Editor for the IEEE Transactions on Neural Networks and Learning Systems (TNNLS). He is also a member of the IEEE Computational Intelligence Society, the IEEE Task Force on Deep Learning, and the Italian Association for Artificial Intelligence (AIxIA).