CS PhD Seminar Series

Oct 7th | 14:30-15:30 | Room 214

Satellite Positioning for Motion Capture: Inspiration and Limitation

Currently research teams all over the world are struggling with the problem of taking human motion capture outside of the lab. Laboratory setups with reflective markers have become the classic approach and gold standard, but extensive evidence suggests that human movements in laboratory settings can differ significantly from those in real-world environments. This observation is critical in the fields of rehabilitation, health, and sports science. Therefore, extensive work is being done on motion capture in real-world environments using approaches based primarily on inertial sensors or markerless computer vision systems based on machine learning. We are exploring a different approach based on advanced satellite positioning technologies. Such techniques allow centimeter-level positioning and have absolute temporal and spatial referencing. However, the underlying technology is complex and has a number of serious limitations that must be overcome before it can be used in real-world applications.

Speaker: **George Kurshakov**

Georgii Kurshakov is a third-year PhD student in Computer Science at University of Genoa. He holds a Bachelor's degree in Mechatronics and Robotics from St. Petersburg Polytechnic University, Russia, and a double Master's degree in Robotics from University of Genoa and Keio University, Japan. He currently works in collaboration with a company Gter under supervision of Vittorio Sanguineti and Giorgio Delzanno. His research focus is application of satellite positioning and inertial measurement units to human movement analysis. He also works as a teaching assistant in robotics courses.

Spectral Representation Learning

Modern machine learning, driven by advances in representation learning, has achieved remarkable empirical success on complex, high-dimensional data such as images, trajectories, and genetic sequences. In this talk, we show how truncated singular value decompositions of conditional expectation operators yield powerful representations for tasks including independence testing, conditional probability estimation, and conditional mean embedding. The key takeaway is that learning such representations is deeply connected to self-supervised methods, particularly contrastive learning, offering a two-way street between spectral approaches to challenging inference tasks and state-of-the-art unsupervised representation learning. We conclude with applications in robotics, world modeling for reinforcement learning, and causal discovery.

Speaker: **Alek Fröhlich**

Alek Fröhlich received his B.Sc. in Computer Science (2022) and M.Sc. in Applied Mathematics (2024) from the Federal University of Santa Catarina, Brazil. Before starting his Ph.D., he was a visiting student at the Institute for Pure and Applied Mathematics (2023) and a research fellow at the University of São Paulo Medical School (2023–2024), where he worked at the interface of computational pathology and multiomics. He is now a Ph.D. student in Computer Science at the University of Genoa and an ELLIS Ph.D. student at the Italian Institute of Technology and École Polytechnique, France. His research focuses on representation learning and spectral methods for nonparametric statistical inference, with a particular interest in causality and uncertainty quantification.