Touch science and engineering in biorobotics and bionics

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When: Thursday 5 November 2025, 14:30 CET

Venue: Aula Magna, via Mezzocannone 4.

Abstract: The talk discusses selected case studies of machine learning and bioinspired AI methods applied to touch sensing technologies. In the presented scientific approach, biorobotic systems are developed by capitalizing on a fertile interaction between biomedical engineering and neuroscience, so that the advancements of neuroscientific research can lead to the development of more effective neuroAI technologies, which in turn contribute to the fundamental understanding of physiological processes. A first family of case studies is with bionic hand prostheses to restore rich tactile skills, such as the encoding of force, shape, compliance and texture in upper limb amputees (Oddo et al., eLife 2016). The developed biorobotic technologies and artificial intelligence methods, based on information encoding with neuromorphic spikes emulating physiological tactile representation, is being applied in a variety of sensory augmentation scenarios (Rongala et al., IEEE TNNLS 2017). The second family of transducers discussed is with Fiber Bragg Gratings (FBG), jointly with meta- and deep- learning methods, to monitor respiratory activity and heart biomechanics in wearable and implantable sensors for telemedicine (Filosa et al., Artificial Intelligence in Medicine 2022). The application of FBGs, deep learning and NeuroAI methods is further discussed in tactile sensing tasks aiming at the manipulation of fragile and deformable objects, by combining FEM and machine learning to augment the training datasets (Massari et al., Soft Robotics 2020), and for sensorizing the full area of anthropomorphic robotic arms for humanoids (Massari et al., Nature Machine Intelligence 2022; Pereira et al., Nature Machine Intelligence 2025; Ortone et al., Nature Communications 2026).

Bio: Calogero Maria Oddo is Associate Professor of Bioengineering at Sant'Anna School of Advanced Studies (SSSA), Pisa, Italy, an excellence university ranked 5th worldwide among small universities by Times Higher Education and 7th in the ShanghaiRanking for robotic science and engineering. He coordinates the Neuro-Robotic Touch Laboratory at The BioRobotics Institute of SSSA, supervising 25 researchers. He has a Ph.D. from SSSA, M.Sc. and B.Sc. in Electronic Engineering from the University of Pisa, 1st and 2nd level

degrees in Industrial and Information Engineering as a honours college student of SSSA (3% success rate), all with honours. He holds the national scientific qualification to be appointed as Full Professor of Bioengineering. He has over 140 published studies and several patents, and a track record in integrating biorobotics and neuroscience, with core research interests in touch science and engineering. He has 6600+ citations and 36 h-index in Scopus. He has a growing portfolio of successful research grants, with more than 12 M€ direct scientific responsibilities within EU and National projects and industrial contracts. In 2023 he received the Feltrinelli Prize for young investigators in bioengineering from the Accademia Nazionale dei Lincei, among the oldest scientific societies internationally, where he had leadership responsibilities as vice-director of the interdisciplinary centre of young scholars.

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