Brain-Inspired Strategies for Optimizing the Design of Neuromorphic Sensory-Processing Systems

Giacomo Indiveri, University of Zurich

Abstract: Recently, Artificial Intelligence (AI) neural networks and learning algorithms have emerged as a successful computing paradigm for solving a wide range of complex tasks. However for many practical purposes that involve real-time interactions with the environment these algorithms, and the conventional computing systems they are implemented on, cannot match the performance of biological systems. One of the reasons is that the principles of computation used by nervous systems is radically different from those of today's computers. In this talk I will present neuromorphic electronic circuits that directly emulate the physics of computation used by biological neural processing systems, and brain-inspired signal processing strategies to build beyond von Neumann ultra-low power computing technologies for real-world sensory-processing edge-computing applications.

Giacomo Indiveri is the director of the Institute of Neuroinformatics of the University of Zurich and ETH Zurich and a dual professor of both institutions. He obtained an M.Sc. degree in electrical engineering in 1992 and a Ph.D. degree in computer science from the University of Genoa, Italy in 2004. Engineer by training, Indiveri has also expertise in neuroscience, computer science, and machine learning. He has been combining these disciplines by studying natural and artificial intelligence in neural processing systems and in neuromorphic cognitive agents. His latest research interests lie in the study of spike-based learning mechanisms and recurrent networks of biologically plausible neurons, and in their integration in real-time closed-loop sensory-motor systems designed using analog/digital circuits and emerging memory technologies. Indiveri is senior member of the IEEE society, and a recipient of the 2021 IEEE Biomedical Circuits and Systems Best Paper Award. He is also an ERC fellow, recipient of three European Research Council grants.