Mingoo Seok, Stefano Fusi, *Designing a New Generation of Low-Power Neuromorphic Memory for Pervasive Sensing Devices Having Online Learning Ability*

Over the last four decades, pervasive sensing devices have played a crucial role in society. They have been workhorses for industrial control and infrastructure monitoring, and they are now finding applications in areas such as mobile health, unmanned vehicles, smart cities, and the Internet of Things. Designing the new generation of these devices will be extremely challenging, as they will be demanded to perform more complex and cognitive tasks with less energy budget. The approach to this challenge is to design and realize electronic devices that implement artificial neural networks using digital neuromorphic hardware. The advantage of neuromorphic hardware is energy efficiency, as it takes inspiration from the biological brain, which is far more efficient than traditional computers. One of the fundamental limitations of existing neuromorphic hardware is related to memory capacity, which can be catastrophically low when the network is required to learn online from its experience by changing its synaptic weights. This is particularly problematic when these synaptic weights have limited precision. In this project, Seok and Fusi propose to devise scalable synaptic memory models by taking inspiration from the biological synapses. The new synaptic models may be individually more complex than a conventional model, but provide significantly better scalability for storing a large number of memories in large-scale neuromorphic hardware. If successful, this proposed research can cause a groundbreaking paradigm shift by enabling synaptic memory to be compact, low power, and powerful enough to allow neural pervasive sensing devices to learn autonomously.