NSF DARE Conference: Transformative Opportunities for Modeling in Neurorehabilitation

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Neurofabrica: Bridging the gap between carbon and silicon

Miguel Parra, Suraj Chakravarthi Raja, Hesam Azadjou, Grace Niyo, Francisco J ValeroCuevas

Neuroplasticity is what underlies the learning process in biological systems. It is thought that this is well modeled by Hebbian learning, by which connections between pre and postsynaptic neurons strengthen if this path is used continuously. However, due to the limitations of modeling traditional general-purpose processors, there is currently no way to model plasticity on the scale of thousands of neurons without utilizing massive compute resources. We propose a novel approach, by leveraging the hardware dual of biological neurons, in the form of neuromorphic computing. We hypothesize that this technology has the capability to quickly and accurately model neuron dynamics, specifically in the field of neural plasticity. We will investigate the capabilities of modeling neurorehabilitation through investigating plasticity and adaptation, by implementing a simple system that follows Hebbian rules for strengthening synaptic connections, as well as modeling growth and development by allowing the system to recruit more neurons into the model as time goes on. This approach represents a paradigm shift by allowing the network to more naturally evolve, in accordance with physiological principles of learning and development.