Neuromorphic Cortical Architectures for Bio-inspired Learning Machines

- University of California San Diego (UCSD) Institute for Neural Computation (INC)
- PI: Gert Cauwenberghs
- Current Team Members:
  - Henry Abarbanel
  - Gary Cottrell
  - Kenneth Kreutz-Delgado
  - Scott Makeig
  - Terrence Sejnowski
  - Nuno Vasconcelos
  - Emre Neftci
  - Mike Arnold
  - Frederic Broccard
  - Christoph Maier
  - Sadique Sheik
  - Srinjoy Das
  - Siddharth Joshi
  - Alejandro Ojeda
  - Jongkil Park
  - Bruno Pedroni
Neuromorphic Cortical Architectures for Bio-inspired Learning Machines

Our research pursues human-level machine intelligence by converging:

- Neuromorphic computing resources approaching connectivity and energy efficiency levels of the human brain;
- Bio-inspired deep learning methods, and supporting neuroscience data, to adaptively reduce algorithmic complexity.

Unique qualifications and capabilities

• Dynamically reconfigurable adaptive neuromorphic supercomputers:
  • 65k two-compartment integrate-and-fire neurons
  • Individually programmable synaptic connectivity, conductance, and axonal delay in external memory
  • 22 pJ per synapse event

• Spike-based machine learning mapped onto neural substrates:
  • Probabilistic inference using neural sampling with integrate-and-fire neurons
  • Spike-based online training of Boltzmann machines with STDP


Collaborative opportunities

- Identifying cortical primitives of neural computation and learning, accounting for multi-scale biophysical detail in:
  - Dendritic computation and spatially distributed network dynamics
  - Axonal conduction delays and neural synchrony
  - STDP and temporally distributed forms of synaptic plasticity

- High-throughput connectomics and systems neuroscience providing anatomical and physiological constraints in network and learning architectures

- Thermodynamical foundations of machine learning with biophysically realistic neural sampling
Contact Information

• Prof. Gert Cauwenberghs
• UC San Diego, Institute for Neural Computation (INC)
• Email: gert@ucsd.edu
• Phone: (858) 534 6938
• URL: http://inc.ucsd.edu