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2010 Special Issue of Neural Networks

Analysis and modeling of massively parallel neural signals

Uncovering how the brain processes information requires large-scale observations of neuronal activity. Recent progress in experimental techniques provide novel methods to achieve massively parallel recordings of neuronal activity. For instance, multi-channel electrodes and fluorescent molecular sensors are now commonly used to simultaneously record spiking activity of hundreds of neurons and to monitor intracellular signaling molecules, such as calcium, cAMP, and a variety of enzymes.

The unprecedented rate at which data are being collected and electronically archived today, efficient extraction of information and insight from this flood of data becomes an increasing technical and scientific challenge. This process requires in the application of high-level data mining methods including parallel and distributed strategies, finding associations and sequences, visualization by clustering, classification, and graph theory.

While mathematical models and computer simulations have played essential roles in analyzing neuronal recordings, the flood of highly detailed data generated by these advanced techniques prompt us to develop new modeling strategies for formulating and validating new hypotheses and quantitative models in a data-driven manner. Assessment of large-scale neural network simulations pose the same challenge as experimental data do.

This special issue will focus on the following topics

(a) Mathematical methods for analyzing data from massively parallel neural recordings and large-scale neural network simulations;

(b) Frameworks for constructing quantitative or conceptual models from large-scale observations of neural activity, morphology, and development;

(c) Novel neuroscientific perspectives gained by these methods.

All in all, this special issue is intended to survey the state of the art in the young and dynamic field of parallel and distributed data mining and large-scale model building and simulations.

Now effort has to be made on a multidisciplinary project in which neuroscientists, physicists, mathematicians, and computer scientists work together to arrive at a unifying picture of the complex networks of the brain.

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Submission

Please access our on-line submission system:
http://ees.elsevier.com/neunet/
Deadline for submission: October 1st, 2009
Notification of final acceptance: May 15th, 2010
Deadline for submission of final papers: June 1st, 2010
Format: as normal papers in the journal

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