

➤ **Sunday November 4th, 9:30 a.m. – 12:30 p.m.**

**Analyze Locally; Infer Globally:
Tools for Integration of Multiscale Imaging Data**

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Abstract:

The grand goal in neuroscience research is to understand how the interplay of molecular, and electrical signals in nervous tissue gives rise to behavior. Experimental advances of the past decades have given scientists an increasingly powerful arsenal for obtaining data across scales, from the level of molecules to nervous systems.

The next challenge is to develop better methods for managing and integrating these data to enhance understanding of neural function in health and disease. We have been developing methods for acquiring and integrating multiscale imaging data from the nervous system.

Techniques include confocal and multiphoton microscopy and correlated electron microscopic tomography. Electron tomography is a technique whereby the 3D structure contained in a section is solved by taking a series of projections through the structure. An informatics framework consisting of a multiscale brain atlas and ontologies for multiscale anatomy has been constructed so that scientists can query and navigate imaging information across scales. As part of this work, we constructed an ontology for the subcellular anatomy of the nervous system (SAO), to bridge across spatial scales from macromolecules to supracellular domains.

The SAO is built using the Web Ontology Language (OWL), a language that supports reasoning over classes and instances of classes. It describes neurons, glia and their parts and relates macromolecular entities to their cellular and subcellular locations. It also models supracellular structures such as synapses and neuropil. The SAO allows us to describe the subcellular localization of molecular entities and also allows us to relate any part of a cell to higher order brain structure. Thus, any part of a neuron may be localized in a higher order brain region, recognizing the fact that neurons are large cells whose processes span many brain regions. We have shown how annotation of brain data with the SAO combined with rules allow us to infer new information not present in the ontology. For example, from the local interaction of a synaptic terminal with a dendritic spine, we can infer connectivity between brain regions. We have built a set of tools for annotation of images that utilize the SAO and other ontologies under development for animal models of human disease to describe imaging datasets according to the ontology.

The SAO and its extensions are providing a powerful means of integrating data contained in diverse sources and forms the basis for an extended knowledge environment built around the cell.