Computational method for analysis of dendritic spine shapes.

Dendritic spines, protrusions of dendritic membrane, are targets of excitatory synaptic inputs. The morphology of a spine is linked to its function. For example, a mature dendritic spine resembles a mushroom, with a wide spine head connected to the dendrite by much thinner neck. Several studies link dimensions of that mushroom to the functioning of the synapse, for example it has been shown that the amplitude of uncaging potential at the soma correlates with spine head volume and negatively correlates with spine neck length.

To study the shapes of dendritic spines quantitatively we have developed a set of computational methods for analysis of microscopy images of individual spines.

The first method allows for semi-automatic classification of spine shapes in a dataset. First, spine shapes are grouped in an unsupervised way (that is, without assuming any a priori structure of the dataset) using a clustering algorithm. Then the groups can be manually segregated according to criteria set by the researcher.

The second method has been designed to automatically measure dimensions of heads and necks of spines in large datasets. The idea is to first represent the shape of a spine as a sum of building blocks: an ellipsoid for the spine head, a cylinder for the spine neck, and possibly a cone for the part of the spine closest to the dendrite. Then widths and lengths of heads and necks can be defined based on dimensions of the fitted blocks.

In the talk I will present these methods and show their application to example datasets.