DELINEATING AND TRACKING HPPOCAMPAL DENDRITIC SPINE PLASTICITY USING NEURAL NETWORK ANALYSIS OF TWO PHOTON MICROSCOPY

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To study the morphological correlates of synaptic plasticity, two photon laser scatting microscopy was used to image dendrites it living hippocampal slices for extended periods (Potter *et al., Soc. Neurosci. Abstr.* 23:332, 1997).

As individual 3D images in each time series contain about 10 million volume elements (voxels), and as each series often consists of many (>20) time points, manual analysis of spine position, volume, orientation, and time of appearance and/or disappearance is time consuming and often impractical, especially if many time series are to be analyzed. Manual delineation of a small subset of images, however, provides a useful set of examples from which an automated image analysis system can draw.

In the present study, a three dimensional image segmentation and feature recognition algorithm that incorporates a feed-forward multilayer neural network and iterative relaxation was used to identify spines and estimate their three dimensional position and extent. The network was trained on manually delineated images and then applied to 3D images from several time series. Network performance is measured relative to manual delineation both in terms of identification discrepancies and volume and orientation estimates.

The algorithm used in the automated image analysis provides one means of dramatically reducing the work involved it performing quantitative analysis of 3D digital microscopic images.

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