Large scale high resolution network generation: Producing known validation sets for serial reconstruction methods that use histological images of neural tissue

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In previous work, we developed the NETMORPH framework. This framework is aimed at the generation of large scale neuronal networks (thousands of neurons) with detailed neuron morphology, and at simulating activity in such networks at different stages of network development. This combination of scale and resolution leads to a great deal of complexity, and is encountered experimentally when computer reconstruction is done after novel scanning technology extracts large scale histological data sets from a block of neural tissue. A high-throughput technology for scanning at that resolution and scale has been developed at the Brain Networks Laboratory, the knife-edge scanning miscroscope (KESM, McCormick, 2007).

In order to simulate activity that includes the effects of long-range axonal connectivity, which may be identified in these large data sets, it is essential to develop reliable methods of automated serial reconstruction. It is difficult to validate the performance of a reconstruction method for large scale neuronal networks, since there are no known network structures with corresponding histological slice images. We propose to use the network generation capabilities of NETMORPH to produce virtual data sets in the form of stacks of histological slice images, for which the originating network is known. The performance and reliability of automated serial reconstruction methods may be evaluated, by introducing to the virtual data set image artifacts and missing data in a manner characteristic of the output of KESM.

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