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Reconstructing neural networks from limited data

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Researchers offer a new technique for finding hidden neurons from incomplete observations.

In *Chaos: An Interdisciplinary Journal of Nonlinear Science*, investigators report a new method for determining the connectivity of a network of neurons from incomplete observations. This is of particular interest in neuroscience, since the network structure is typically unknown and subject to change as learning occurs and synapses form or disappear.

Measurements of neuronal potential in the laboratory can be made for single cells but are often restricted to a subset of active neurons. These monitored cells are influenced by other neurons, connected to them but not monitored. These so-called hidden nodes make their presence known through noise in the measurements. The method, reported by Franz Hamilton and colleagues, is based on an adaptive filtering algorithm. This is used to obtain estimates of system noise due to errors in the model, which is, in turn, due to the missing nodes.

By using this technique, the investigators were able to reconstruct small networks with hidden nodes connected to one or more neurons. Tests were carried out with model networks consisting of both Hindmarsh-Rose neurons and Hodgkin-Huxley neurons. In addition to accurately finding the hidden nodes, the investigators showed that their method could track drifts in the noise estimate. This reveals the influence of hidden nodes when connection strength varies with time, which might occur when synapses form or are pruned during learning.

Although the reported results suggest this technique will be a powerful tool for reconstructing networks from incomplete data, there are some limitations, such as when fully synchronized network activity occurs, as happens during a seizure. Future work will aim to reconstruct the hidden node’s driving signal and to extend the method to consideration of real experimental data.


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