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New method can help identify brain disorders simply and effectively FREE

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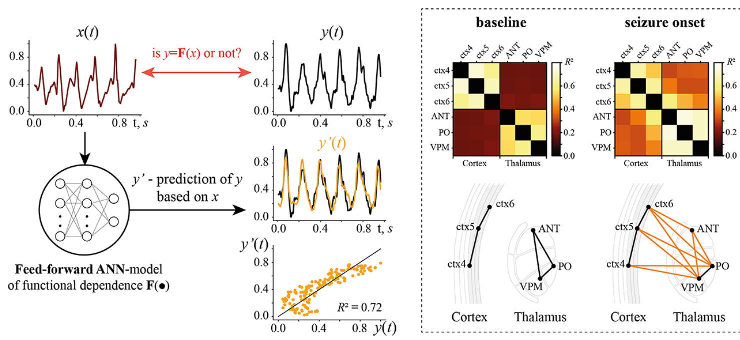
Researchers found feed-forward artificial neural networks are an effective mathematic model for identifying functional connectivity.



The brain is a complex network where constantly evolving streams of information are being exchanged among billions of neurons. Predicting the functional connectivity of different areas in the brain is important for providing diagnostics of brain disorders, such as epilepsy, Parkinson's disease and Alzheimer's disease. However, the mathematics to calculate functional dependence for the human brain is complex and costly to be computed.

Frolov et al. introduced a new and more effective computational approach for determining functional connectivity. Using a feed-forward artificial neural network, the researchers confirmed already known results showing functional interdependence between cortical layers and thalamic nuclei at the onset of epileptic discharge in rats. They incorporated the technique using artificial neural networks (ANNs), recently developed machine learning computational systems. The feed-forward approach has the simplest ANN architecture and can track functional relationships at a small computational cost.

The team started by testing the approach on coupled Rössler systems, which are nonlinear systems used for studying synchronous behavior known as generalized synchronization (GS). The feed-forward model accurately predicted the presence of functional interdependence in the system, and the researchers concluded the new method would be suitable for GS detection in chaotic systems with noisy data.

They then analyzed electrocorticography (ECoG) recordings from rats that were genetically predisposed to absence epilepsy and confirmed the functional connectivity between thalamic nuclei and cortex layers.

Due to the success of this first ever application of feed-forward ANNs to neuro-data, researchers have high expectations for the future. "It seems to us that our method has great prospects in the analysis of big neurophysiological data," said author Alexander Hramov.

Source: "Feed-forward artificial neural network provides data-driven inference of functional connectivity," by Nikita Frolov, Vladimir Maksimenko, Annika Lüttjohann, Alexey Koronovskii, and Alexander Hramov, *Chaos: An Interdisciplinary Journal of Nonlinear Science* (2019). The article can be accessed at https://doi.org/10.1063/1.5117263.