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Emergent stochastic oscillations and signal detection in tree networks of excitable elements ALI KHALEDI NASAB, Department of Physics and Astronomy, Ohio University, JUSTUS KROMER, Center for Advancing Electronics Dresden, TU Dresden, LUTZ SCHIMANSKY-GEIER, Humboldt-Universität zu Berlin, ALEXANDER NEIMAN, Dept. of Physics and Astronomy, and Neuroscience Ohio University — We study the stochastic dynamics of strongly-coupled excitable elements on a tree network. The peripheral nodes receive independent random inputs which may induce large spiking events propagating through the branches of the tree and leading to global coherent oscillations in the network. This scenario may be relevant to action potential generation in certain sensory neurons, which possess myelinated distal dendritic tree-like arbors with excitable nodes of Ranvier at peripheral and branching nodes and exhibit noisy periodic sequences of action potentials.We focus on the spiking statistics of the central node, which fires in response to a noisy input at peripheral nodes. We show that, in the strong coupling regime, relevant to myelinated dendritic trees, the spike train statistics can be predicted from an isolated excitable element with rescaled parameters according to the network topology. Furthermore, we show that by varying the network topology the spike train statistics of the central node can be tuned to have a certain firing rate and variability or to allow for an optimal discrimination of inputs applied at the peripheral nodes.

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