INTRODUCTION

A ‘memristor’ (portmanteau from “memory resistor”) is a passive two-terminal circuit element the electric resistance of which depends on the history of the charge that has passed through it [1].


Despite the conceptual importance of memristors, there are still few electronic devices that implement their basic functions. Recently, a polymer-based material has been developed which is able to accomplish basic memristor’s functions [2].

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Recently, it has been shown that networks of memristors with few elements and a deterministic connectivity can implement some features observed in the neuronal circuits of a simple biological system, like the Lymnea stagnalis pond snail [3].

Optical microscopy images of fibrilar networks (image sizes are 0.6 x 0.5 mm).

Our central goal is to simulate and study the adaptive properties of the self-assembled memristor networks. Such networks contain a much greater number of nodes with an unknown connectivity pattern.

RESULTS

Mean correlation value (20 different networks) as a function of time. The monotonic and decreasing correlation values as a function of time indicate that the network epochs tend to diverge the longer we stimulate. This behavior is stable regardless of the type of input used and of the networks architectures simulated. Networks with a distance-dependent connectivity decompose faster when the input is positive in one node and negative in the other, than when both inputs are positive (D). This is not the case for the randomly connected networks (C).

This suggests a relation between the input pattern and the type of connectivity that impacts the adaptive properties of the network.

The plot shows the resistance change of each connection of a given network. Connections are sorted from top to bottom according to the total change in resistance. The majority of connections (top of the pane) became resistive. A smaller fraction (middle of the pane) almost didn’t change and few of them became conductive (bottom part).