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Modeling earthquake activity using a memristor-based cellular grid

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Earthquakes are absolutely among the most devastating natural phenomena because of their immediate and long-term severe consequences. Earthquake activity modeling, especially in areas known to experience frequent large earthquakes, could lead to improvements in infrastructure development that will prevent possible loss of lives and property damage. An earthquake process is inherently a nonlinear complex system and lately scientists have become interested in finding possible analogues of earthquake dynamics. The majority of the models developed so far were based on a mass-spring model of either one or two dimensions. An early approach towards the reordering and the improvement of existing models presenting the capacitor–inductor (LC) analogue, where the LC circuit resembles a mass-spring system and simulates earthquake activity, was also published recently. Electromagnetic oscillation occurs when energy is transferred between the capacitor and the inductor. This energy transformation is similar to the mechanical oscillation that takes place in the mass-spring system. A few years ago memristor-based oscillators were used as learning circuits exposed to a train of voltage pulses that mimic environment changes. The mathematical foundation of the memristor (memory resistor), as the fourth fundamental passive element, has been expounded by Leon Chua and later extended to a more broad class of memristors, known as memristive devices and systems. This class of two-terminal passive circuit elements with memory performs both information processing and storing of computational data on the same physical platform. Importantly, the states of these devices adjust to input signals and provide analog capabilities unavailable in standard circuit elements, resulting in adaptive circuitry and providing analog parallel computation. In this work, a memristor-based cellular grid is used to model earthquake activity. An LC contour along with a memristor is used to model seismic activity based on scalar values of potentials that characterize each grid site. The simulation results prove that memristor-based circuits are an interesting non conventional approach to the modeling of complex environmental processes.