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Evolving a three-dimensional cellular automata dynamic system constituted of cells-charges for modelling real earthquake activity

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Greece is referred as the most active seismically region of Europe and one of the top active lands in the world. However, the complexity of the available seismicity information calls for the development of ever more powerful and more reliable computational tools to tackle complex problems associated with proper interpretation of the obtained geophysical information. Cellular Automata (CAs) were showed to be a promising model for earthquake modelling, because certain aspects of the earthquake dynamics, function and evolution can be simulated using several mathematical tools introduced through the use of CAs. In this study, a three-dimensional (3-d) CA dynamic system constituted of cell-charges and taking into account the recorded focal depth, able to simulate real earthquake activity is presented. The whole simulation process of the earthquake activity is evolved with an LC analogue CA model in correspondence to well known earthquake models. The parameterisation of the CA model in terms of potential threshold and geophysical area characteristics is succeeded by applying a standard genetic algorithm (GA) which would extend the model ability to study various hypotheses concerning the seismicity of the region under consideration. As a result, the proposed model optimizes the simulation results, which are compared with the Gutenberg – Richter (GR) scaling relations derived by the use of real data, as well as it expands its validity in broader and different regions of increased hazard. Finally, the hardware implementation of the proposed model is also examined. The FPGA realisation of the proposed 3-d CA based earthquake simulation model will exhibit distinct features that facilitate its utilisation, meaning low-cost, high-speed, compactness and portability. The development and manufacture of the dedicated processor aims at its effective incorporation into an efficient seismographic system. As a result, the dedicated processor could realize the first stage of a perspective, real-time, efficient system for hazard evaluation and mapping of regional, dangerous phenomena.