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Long-range interaction in a 2D cellular automata model of fundamental seismic attributes and parametric optimisation with the use of genetic algorithms

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A 2D Cellular Automata (CA) dynamic system constituted of cells-charges has been proposed for the simulation of the earthquake process. The CA model has been calibrated with the use of real data and the simulation results are found in good quantitative and qualitative agreement with the recorded Gutenberg–Richter (GR) scaling relations. In this paper, the study is focused on two points; (a) the application of an extended neighbourhood regarding the activation range of the rule applied to each CA cell and (b) the optimal parameterisation of the model introducing the use of genetic algorithms. The former regards the incorporation in the CA activation rule of the deformation of the seismic waves as they propagate away from the source. The terms of near-field and far-field deformation, which are inverse proportional to the square of the distance and inverse proportional to the distance from the source correspondingly, have been included in the rule extending as well the active neighbourhood of each cell. The second point upgrades the parameterisation of the model by applying a standard genetic algorithm (GA). The GA evolves an initially random population of candidate solutions of model's parameters, i.e. the potential threshold V_o and the size of the CA grid N, through genetic operators, e.g. mutation and crossover, such that in time appropriate (fitter) solutions to emerge. At every evolutionary step (generation), the candidate solutions are decoded and evaluated according to a predefined quality criterion, which is realised here by comparing in what extent the simulation results

match the GR law derived from recorded data of the area under test.