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VLSI implementation perspectives of a two-dimensional cellular automata model for earthquake simulation

I.G. Georgoudas (1), **G.Ch. Sirakoulis** (1), E.M. Scordilis (2) and I. Andreadis (1)

(1) Laboratory of Electronics, Department of Electrical and Computer Engineering, Democritus University of Thrace, GR-671 00 Xanthi, Greece, (2) Laboratory of Geophysics, Aristotle University of Thessaloniki, GR-54124, Thessaloniki, Greece (igeorg@ee.duth.gr / Fax: +30 25410 79916 / Phone: +30 25410 84197)

Cellular Automata (CA), characterised by their massive parallelism, constitute a powerful tool for modelling and simulating complex natural phenomena. A two-dimensional (2-d) 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. The calibration incorporates major seismic characteristics of the area under test. The simulation results are found in good quantitative and qualitative agreement with the recorded Gutenberg–Richter (GR) scaling relations. The model is enriched with a powerful multi-parameter interface that enables the user to load real data from different regions. The present paper examines the on-chip realization of the model. The CA implemented utilizes an array of 34x34 cells. The local CA rule, the value of the potential threshold and the number of cycles the CA has to be iterated, i.e. the number of earthquake events, constitute the input data. Furthermore, the initial seed of the aforementioned implementation, which in some extend correspond to the seismic features of the area under test, is loaded in a semi-parallel way and the process is completed in 34 time-steps. The automatic response of the processor provides the corresponding GR scaling law of the under study area. Apart from the CA cell and interconnections implementation, a number of arithmetic units are required, in order to perform multiplications, shifts and subtractions. Except for multiplications, the other operations present trivial realization complexity. Consequently, the proposed CA implementation would be advantageous in terms of compactness, portability, high-speed, low-cost and it could be easily incorporated in an efficient seismographic system.