

Reconfigurable Logic - Based Acceleration of Cellular Automata Models

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Cellular Automata (CA) have been used for many decades to model physical processes and dynamical systems. From the 3×3 and 5×5 neighborhoods of the 1950s, and typically on binary images, as recently as the mid-2010s the neighborhoods went up to 15×15 on images with a few states. Field Programmable Gate Array (FPGA) technology, already applicable to CA model acceleration since the early 1990s, has reached such maturity levels that a small device can model large-neighborhood CA. In this work we present an architecture which we have fully implemented, that can execute CA models with up to 29×29 neighborhoods on 256-state cells for Full High Definition (FHD) image input/output with real-time 60 frames-per-second capability [1]. Emphasis of the present work is on the game-changing opportunities that FPGA technology creates to the CA and dynamical systems communities [2]. We present results from the Greenberg-Hastings and Hodgepodge models, as well as a large-neighborhood anisotropic model. Large neighborhoods may yield qualitatively different results vs. smaller neighborhoods, or lead to results which are merely impossible to produce with small neighborhoods [3].

References

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