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FPGA based hardware and device-independent implementation of chaotic generators

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Abstract

In this paper we will describe the use of Matlab/Simulink without third party toolboxes as a single integrated environment to study and generate the HDL description of chaotic systems for rapid prototyping purposes. We will provide a review of different approaches to implement chaos generators in both analogue and digital forms with a focus on digital one. We will present a rapid prototyping method of digital chaos generators on FPGAs that is of great use for a seamless study, simulation and implementation of those systems in one environment. This will ease the design phase of the chaotic systems and will provide more flexibility for their study. Multiple chaos generators, such as Lorenz, Rössler, Chua, Linz-Sprott, and Sprott types have been designed using this method to showcase its effectiveness. In addition, for a better investigation of the chaotic dynamics, this work makes use of an implementation scheme that permits the visualization of the 3D chaotic attractor on the oscilloscope. The main focus of this paper is to provide a common implementation framework of chaos generators to target various applications, mainly cryptographic one. Newcomers to the field will easily dive in and active researchers will be able to speak the same language and build upon one anothers works more efficiently by adopting the presented guidelines.

Keywords: Chaos, Euler method, Fixed-point, FPGA, HDL Coder, ODE, Runge-Kutta

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