Sine-Transform-Based Chaotic System With FPGA Implementation

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Abstract

As chaotic dynamics is widely used in nonlinear control, synchronization communication, and many other applications, designing chaotic maps with complex chaotic behaviors is attractive. This paper proposes a sine-transform-based chaotic system (STBCS) of generating one-dimensional (1-D) chaotic maps. It performs a sine transform to the combination of the outputs of two existing chaotic maps (seed maps). Users have the flexibility to choose any existing 1-D chaotic maps as seed maps in STBCS to generate a large number of new chaotic maps. The complex chaotic behavior of STBCS is verified using the principle of Lypunov exponent. To show the usability and effectiveness of STBCS, we provide three new chaotic maps as examples. Theoretical analysis shows that these chaoticmaps have complex dynamics properties and robust chaos. Performance evaluations demonstrate that they have much larger chaotic ranges, better complexity, and unpredictability, compared with chaotic maps generated by other methods and the corresponding seed maps. Moreover, to show the simplicity of STBCS in hardware implementation, we simulate the three new chaotic maps using the field-programmable gate array (FPGA).

Keywords

Author Keywords: Chaotic behavior; field-programmable gate array (FPGA); nonlinear control; sine-transform-based chaotic system (STBCS)
KeyWords Plus: INITIAL CONDITION; MAP; IDENTIFICATION; ENTROPY; MODELS

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