

- generator based on pseudorandomly enhanced logistic map. *Nonlinear Dynamics* **87**: 407–425.
- Pamuk, N., 2013 Determination of chaotic time series in dynamic systems. *Journal of Balikesir University Institute of Science and Technology* **15**: 77–91.
- Pehlivan, İ., E. Kurt, Q. Lai, A. Basaran, and M. C. Kutlu, 2019 A multiscroll chaotic attractor and its electronic circuit implementation. *Chaos Theory and Applications* **1**: 29–37.
- Pehlivan, I. and W. Zhouchao, 2012 Analysis, nonlinear control, and chaos generator circuit of another strange chaotic system. *Turkish Journal of Electrical Engineering and Computer Science* **20**: 1229–1239.
- Prakash, P., K. Rajagopal, I. Koyuncu, J. P. Singh, M. Alcin, *et al.*, 2020 A novel simple 4-d hyperchaotic system with a saddle-point index-2 equilibrium point and multistability: Design and fpga-based applications. *Circuits, Systems, and Signal Processing* pp. 1–22.
- Rajagopal, K., A. Akgul, S. Jafari, A. Karthikeyan, and I. Koyuncu, 2017 Chaotic chameleon: Dynamic analyses, circuit implementation, fpga design and fractional-order form with basic analyses. *Chaos, Solitons & Fractals* **103**: 476–487.
- Rajagopal, K., S. Jafari, A. Karthikeyan, A. Srinivasan, and B. Ayele, 2018 Hyperchaotic memcapacitor oscillator with infinite equilibria and coexisting attractors. *Circuits, Systems, and Signal Processing* **37**: 3702–3724.
- Rajagopal, K., M. Tuna, A. Karthikeyan, İ. Koyuncu, P. Duraisamy, *et al.*, 2019 Dynamical analysis, sliding mode synchronization of a fractional-order memristor hopfield neural network with parameter uncertainties and its non-fractional-order fpga implementation. *The European Physical Journal Special Topics* **228**: 2065–2080.
- Rashtchi, V. and M. Nourazar, 2015 Fpga implementation of a real-time weak signal detector using a duffing oscillator. *Circuits, Systems, and Signal Processing* **34**: 3101–3119.
- Tlelo-Cuautle, E., A. Pano-Azucena, J. Rangel-Magdaleno, V. Carbajal-Gomez, and G. Rodriguez-Gomez, 2016 Generating a 50-scroll chaotic attractor at 66 mhz by using fpgas. *Nonlinear dynamics* **85**: 2143–2157.
- Tuna, M., M. Alcin, İ. Koyuncu, C. B. Fidan, and İ. Pehlivan, 2019a High speed fpga-based chaotic oscillator design. *Microprocessors and Microsystems* **66**: 72–80.
- Tuna, M. and C. B. Fidan, 2016 Electronic circuit design, implementation and fpga-based realization of a new 3d chaotic system with single equilibrium point. *Optik* **127**: 11786–11799.
- Tuna, M. and C. B. Fidan, 2018 A study on the importance of chaotic oscillators based on fpga for true random number generating (trng) and chaotic systems. *Journal of the Faculty of Engineering and Architecture of Gazi University* **33**: 469–486.
- Tuna, M., A. Karthikeyan, K. Rajagopal, M. Alcin, and İ. Koyuncu, 2019b Hyperjerk multiscroll oscillators with megastability: Analysis, fpga implementation and a novel ann-ring-based true random number generator. *AEU-International Journal of Electronics and Communications* **112**: 152941.
- Tuncer, T., 2016 The implementation of chaos-based puf designs in field programmable gate array. *Nonlinear dynamics* **86**: 975–986.
- Tuncer, T. and E. Avaroğlu, 2017 Random number generation with lfsr based stream cipher algorithms. In *2017 40th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO)*, pp. 171–175, IEEE.
- Vaidyanathan, S., I. Pehlivan, L. G. Dolvis, K. Jacques, M. Alcin, *et al.*, 2020 A novel ann-based four-dimensional two-disk hyperchaotic dynamical system, bifurcation analysis, circuit realization and fpga-based trng implementation. *International Journal of Computer Applications in Technology* **62**: 20–35.
- Xu, G., Y. Shekofteh, A. Akgül, C. Li, and S. Panahi, 2018 A new chaotic system with a self-excited attractor: entropy measurement, signal encryption, and parameter estimation. *Entropy* **20**: 86.
- Zhang, Y., Z. Liu, and X. Zheng, 2008 A chaos-based image encryption asic using reconfigurable logic. In *APCCAS 2008-2008 IEEE Asia Pacific Conference on Circuits and Systems*, pp. 1782–1785, IEEE.
- Zuppa, L. A., 2010 Chaotic logistic map implementation in the pic12f629 microcontroller unit. *IFAC Proceedings Volumes* **43**: 167–170.

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