Coupled Fractional and Nonlinear Economic Dynamic Model: Numerical and Circuit Simulation

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ABSTRACT

Coupled nonlinear differential equations of arbitrary orders (integer and fractional orders) are implemented with electronic circuits by means of analogical integrators, adders, multipliers and the fractance circuits units with capacitors/resistors lattices using the Cadence OrCAD™ package. The $\frac{1}{s^{\alpha}}$ term that represents a fractional integration in Laplace domain is approximated using a s-domain transfer function with zeros and poles adjusted in frequency domain. The resistors and capacitors values are determined and the respective electronics schematics circuits are developed and simulated. Results obtained through electronic circuits emulation are compared with numerical simulations (NS) previously achieved and reported in the literature. Furthermore, a good agreement is verified between both approaches and demonstrate the feasibility of using Fractional Electronic Circuit Simulation (FrECS) to investigate fractional dynamics in the perspective of a physical implementation using circuits.

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