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Characteristic analysis and DSP realization of fractional-order simplified Lorenz system based on Adomian decomposition method.

Summary: By adopting Adomian decomposition method, the fractional-order simplified Lorenz system is solved and implemented on a digital signal processor (DSP). The Lyapunov exponent (LE) spectra of the system is calculated based on QR-factorization, and it accords well with the corresponding bifurcation diagrams. We analyze the influence of the parameter and the fractional derivative order on the system characteristics by color maximum LE (LE$_{\text{max}}$) and chaos diagrams. It is found that the smaller the order is, the larger the LE$_{\text{max}}$ is. The iteration step size also affects the lowest order at which the chaos exists. Further, we implement the fractional-order simplified Lorenz system on a DSP platform. The phase portraits generated on DSP are consistent with the results that were obtained by computer simulations. It lays a good foundation for applications of the fractional-order chaotic systems.

Keywords: fractional calculus; simplified Lorenz system; Adomian decomposition method; Lyapunov exponent diagram; digital signal processor

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