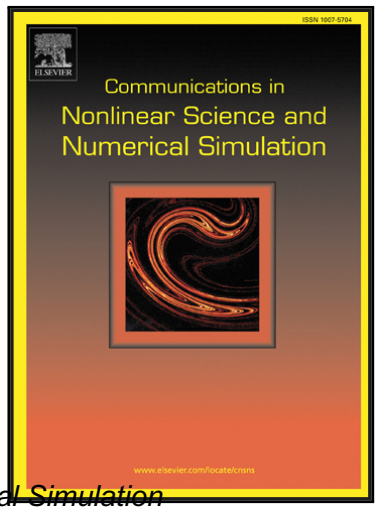

Bifurcation and chaos of a new discrete fractional-order logistic map

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Highlights

- Chaotic behaviors are widely observed in numerous fields. The theory of fractional calculus and fractional differential equations developed in recent years opened a new research field of chaos. Studies have shown that, as a generalization of the integer-order systems, the fractional-order nonlinear dynamic systems possess more complicated dynamic characteristics because of its memory effect. Therefore, the study of fractional-order chaotic systems caused widespread interest, and numerous fractional nonlinear systems with chaotic behaviors were found.
- The above studies on chaos based on the theory of fractional calculus were mainly limited to continuous system. However, the chaotic behaviors of discrete maps are universal and important in numerous fields, which are extensively studied. In recent years, several discrete maps based on fractional calculus are proposed, such as the fractional-order logistic map, fractional sine map, fractional standard map, fractional tent map, fractional 2x(mod 1), fractional Gauss map, and fractional Henon Map, and chaos reportedly exists in fractional-order discrete systems. However, all the recursive formulas of the aforementioned fractional maps are proposed based on the theory of "fractional difference".
- In this paper, we constructed a new discrete FLM by different approach instead of using fractional difference for the first time: (1) We discretized the continuous fractional logistics system based on the numerical algorithm of GrunwaldLetnikov definition in fractional calculus, and then a new FLM with memory effect was constructed by using the recursive formula of the numerical algorithm. (2) The bifurcation diagram of such map were draw by numerical simulation and a new behavior of bifurcation and chaos were found. (3) The proposed fractional-order logistic map holds rich dynamical behaviors because of its memory effect: with small order p ¡ 1, all features present in the integer-order bifurcation diagram can be observed in fractional-order bifurcation diagrams in the large parameter area; moreover, a similar "period-doubling bifurcation route to chaos also appears in the small parameter area; with large order p ¿ 1, the chaotic behavior and period-doubling bifurcation will gradually disappear. This phenomenon is different from the classic LM and the former proposed FLM based on the theory of fractional difference".
- We thank the referees and the Editor for pointing out several important modifications needed in our original manuscript. We have thoughtfully considered the comments. After careful discussions of the comments raised by the referees, we made several changes on the original paper to make it more complete and more accurate. The explanation of what we have modified in response to the reviewers comments is given point by point in the attachment (Responses to the reviewers' comments.pdf). All modifications made to the manuscript are marked in red in the revised manuscript for ease of identification.
- Therefore, we would like to re-submit our revised manuscript to Communications in Nonlinear Science and Numerical Simulation. We hope that all of these modifications fulfill the requirements to make the manuscript acceptable for publication in Communications in Nonlinear Science and Numerical Simulation.