Power Law Behavior Around Bifurcation Points of 1-D Maps: A Supertracks Approach

FIDELIS, Antônio João[1], POLLI, Jaderson G.[1,2]; DA LUZ, Marcos G. E. [2].

[1] Instituto Federal Catarinense *campus* Rio do Sul.
[2] Departamento de Física, Universidade Federal do Paraná.

The convergence towards asymptotic states at bifurcation points BPs $r = r_b$ of 1-D mappings (of a free parameter r) presents scaling laws whose characteristic exponents in principle depend on the maps specific non-linearities [1]. Aiming to better understand such comportment, we investigated the logistic-like and sine-like family of maps by studying transcritical, pitchfork, period-doubling and tangent BPs. For so, we employed the supertrack framework, where continuous functions of r are generated, having as the initial condition the 1-D map critical point [2]. From such approach we obtained, by numerical and analytical procedures, four exponents to describe the asymptotic behavior when $r = r_b$ as well as another exponent typifying the case of $r > r_b$. Moreover, we confirmed the universality classes of transcritical and pitchfork BPs proposed in the literature and unveiled novel universality results for period-doubling and tangent BPs. Our findings highlighted the usefulness of the supertracks method, for instance, allowing to uncover universality in dynamical systems and to draw a parallels with critical phenomena [3].

References

[1] E. D. Leonel, "Defining universality classes for three different local bifurcations," Communications in Nonlinear Science and Numerical Simulation 39, 520–528 (2016).

[2] Oblow, E.M. Supertracks, supertrack functions and chaos in the quadratic map, Physics Letters A, Volume 128, Issue 8, 1988, Pages 406-412, ISSN 0375-9601,https://doi.org/10.1016/0375-9601(88)90119-3.

[3] Submitted to Chaos: An Interdisciplinary Journal of Nonlinear Science, focus issue: From Sand to Shrimps: In Honor of Professor Jason A. C. Gallas.

Type

ORAL