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Non-universality of a constrained period doubling route to chaos for Rössler's system

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Abstract content
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Recently Botha and Dednam [1] demonstrated that periodic orbits exist through practically any point in the phase space of the well-known 3-dimensional Rössler system [2]. In some cases two or more distinct sets of the optimized parameters (which produce a particular periodic orbit) were found. These sets corresponded to two or more periodic orbits passing through a specific point in the phase space. Moreover, such sets could be ordered, in terms of their shortest period T, into an increasing sequence T, 2T, 4T, etc. At first glance the latter sequence appears to be an instance of the well known period doubling route to chaos. However, the fact that it is constrained (each periodic orbit in the sequence is constrained to pass through a precise point common to the whole sequence), raises the important question about whether or not the sequence obeys Feigenbaum's universal scaling laws [3,4]. Usually, in the Feigenbaum scenario, the variation of only one system parameter at a time is considered. In the present case, however, we found a period doubling route which followed a very tortuous path in the 3-dimensional parameter space of the system. For such paths the self-similarity and scaling laws of the Feigenbuam scenario were indeed violated, contrary to expectation. By using Poincaré sections, for example, we showed that the expected universal sequence of periodic windows could be fundamentally altered.

 References

[1] Botha A E and Dednam W 2014 Proc. 59th Annual Conf. SAIP
[2] Rössler O E 1976 Phys. Lett. A 57 397
[3] Feigenbaum M J 1978 J. Stat. Phys. 19 25
[4] Feigenbaum M J 1979 J. Stat. Phys. 21 669

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