Universal Dichotomy for Dynamical Systems with Variable Delay

Andreas Otto, David Müller and Günter Radons

Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany

Delay differential equations arise as mathematical models in various fields, such as laser physics, engineering, climate dynamics, life science, control theory, and synchronization of networks. In all these applications variations of the delay time are a common phenomenon. We show that the dynamics of systems with a time-dependent delay is fundamentally affected by the functional form of the retarded argument. Associating with the latter an iterated map, the access map, and a corresponding Koopman operator, we identify two universality classes. Members in the first are equivalent to systems with a constant delay. The new, second class is characterized by the mode-locking behavior of their access maps and by an asymptotically linear, instead of a logarithmic, scaling of the Lyapunov spectrum. The membership depends in a fractal manner only on the parameters of the delay. Details can be found in[1, 2]

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[1] Andreas Otto,David Müller, and Günter Radons, PRL **118**, 044104 (2017).

[2] David Müller, Andreas Otto, and Günter Radons, arXiv:1701.05136 [nlin.CD].