# Transient Dynamics in Dynamical Systems Subjected to Parameter Drift

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**Abstract**

In nature, there is a vast variety of systems that cannot be modeled by the same set of equations and parameters as time passes. This may be caused either by the contact with its environment or due to internal factors. In this talk, we present the study of dynamical systems subjected to parameter drift and its implications in their evolution. For that purpose, we show the analysis of two multi-stable systems with chaotic attractors: the Lorenz system and the time-delayed Duffing oscillator. In the first case, the drift is contained in the Rayleigh number. In the case of the Duffing oscillator, it is the time delay itself which suffers the drift. For small but non-negligible parameter change rates, we show that when a parameter crosses a bifurcation point at p_bif , the non-autonomous system suffers a regime shift which appears for p_cr> p_bif. From an experimental point of view, one would observe a transient regime before the parameter crossing and a steady state afterwards. We have uncovered the scaling laws relating the transient lifetime and the parameter value for the transition with the parameter change rate. Surprisingly, we find a gamma distribution of lifetimes in the case of the time-delayed oscillator, instead of a normal distribution as previously reported for non-delayed systems. Finally, for the Lorenz system we also explore the possibility of recovering the transient state by reversing the parameter to its original value. We obtain the relationship between the parameter change rate and the number of trajectories that tip back to the initial attractor.

**Keywords:** Transient dynamics, Parameter drift, time delay, Duffing oscillator

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