Interactions between noise and rate-induced tipping

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Abstract

A non-autonomous system is defined to pass a tipping point when gradual changes in input levels cause the output to change suddenly. We study a prototypical model for rate-induced tipping, the saddle-node normal form subject to parameter drift and noise. We determine the most likely time of escape by finding the optimal path of escape. This is a variational optimisation problem that can be transformed into a second order boundary value problem. This is solved using continuation techniques in AUTO, which generates contours for the optimal time of escape in a two parameter plane.
The overall probability of escape can be approximated using the instantaneous eigenmodes of the also non-autonomous Fokker-Planck equation. Combining the timing and probability of escape can potentially give us an additional early-warning indicator for noise and rate-induced tipping.

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