Applied Mathematics Seminar

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

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A Geometric Approach to Bifurcation- and Noise-Induced Bubbling

The term bubbling refers in the context of power converters to a phenomenon manifesting itself as high-frequency oscillations disrupting the waveform of a slowly oscillating signal in a restricted phase interval. It has been reported in many publications that the onset of bubbling occurs after a smooth bifurcation, such as a pitchfork or a Neimark-Sacker one. Therefore, it has been widely assumed that bubbling is caused by these bifurcations, although the specific mechanism leading to the onset of bubbling remained unknown. In our work, we investigate different models of power converters given by nonautonomous 1D maps. Using an extension to classical cobweb diagrams we present a different explanation of the bubbling phenomenon. In particular, we explain the observed occurrence of bubbling soon after pitchfork bifurcation and show that the onset of bubbling does not coincide with the bifurcation point. Moreover, the recently observed occurrence of bubbling in the absence of any smooth bifurcations can also be explained by the same geometric approach. This phenomenon is caused by an amplification of noise due to a cumulative effect of expanding functions in a long phase interval.

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