Continuation for situations with noisy data

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Abstract

We investigate the approach of numerical continuaton and bifurcation analysis for situations with noisy data. This is motivated by bifurcation analysis in experiments and equation-free analysis (coarse analysis) for multi-scale systems. Both have in common that the function of interest which defines the zero problem for the continuation cannot be evaluated directly, but only indirectly via observations. In experiments, the noise in these observations is due to measurement errors and in multi-scale systems due to remaining fast scales when in the observed time the system behavior did not converge close enough to the slow low-dimensional manifold representing the macroscopic behaviour. Specialized algorithms are presented to address challenges that arise due to the presence of the noise. The results include continuation of stationary (flow) states, periodic orbits as well as traveling waves. The methods are demonstrated for examples from control-based continuation in a mechanical experiment of a periodically driven impact oscillator and equation-free analysis of particle models for car traffic and pedestrian flow. This is joint work with Frank Schilder, Emil Bureau, Ilmar Santos and Jon Juel Thomsen.

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