Title: Feedback-induced attractors in controlled aeroelastic wing and their detection via interval analysis

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Abstract: We consider mathematical model of an aircraft wing that is aeroelastically deformed by the airflow. A computer-based feedback control loop is introduced to suppress wing oscillations (called flutter) or to intentionally deform the wing to maximize air vehicle performance. The feedback law uses one or multiple flight control surfaces attached to the wing.

In open-loop model (without feedback) we have one global attractor, which can be the stable origin or a limit cycle in case of flutter. In controlled model under chosen feedback the qualitative picture is quite more complex. The stable origin can possess bounded basin of attraction and co-exist with stable limit cycle. Moreover, due to the bad choice of feedback law it can produce more than one stable attractor near the origin with a very small change of parameters in our system or control law (thus making the closed-loop system multistable). The usual choice of feedback is based on linear model, and while it can be robust in linear sense, it can easily be fragile from the viewpoint of nonlinear dynamics.

In our dynamical system acting under feedback loop, it is advantageous to choose feedback parameters so as to eliminate multistability and make the origin its only global attractor. We employ methods of interval analysis to detect multistability near the origin and discuss how to choose feedback law which is not fragile in our sense.