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PACO#6 - Control based continuation of autonomous system — Stabilization mechanisms

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Experimental analysis of nonlinear dynamical system is always a complicated task because these system can exhibit bifurcations, multi-stability or unstable behavior. When a mathematical system is available, numerical continuation algorithm constitute a powerful tool to investigate the so-called bifurcation diagram. Sieber and Krauskopf introduced the idea of control based continuation, obviating the need of a mathematical model so that it can be used to obtain the bifurcation diagram from a physical experiment [1]. Control based continuation methods rely on a feedback controller to stabilize the possibly unstable response of the system under test. This feedback controller must be non-invasive to ensure that the solution of the controlled system is also a solution of the uncontrolled system.
Since then, control based continuation received a growing interest and has been mostly used to track branches of periodic solutions of non-autonomous (i.e. forced) systems [4, 3, 2]. Although it has already been applied on various experiments, only few papers deal with the detailed analysis of the underlying stabi- lization mechanism [5]. Applying these methods to autonomous systems presents an additional difficulty since the frequency of the limit cycle is also an unknown. Numerical continuation algorithms solve this problem by appending the system with a phase condition.
The objectives of this study are twofold. (i) design a controller able to stabilize limit cycle oscillations, (ii) investigate the underlying stabilization mechanism of the designed controller.

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