Numerical bifurcation analysis of delay equations: a user-friendly MatCont interface

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Abstract

The recent work [1] introduced a novel approach to the study of stability and bifurcations of delay equations. The technique consists in reformulating the delay equation as an abstract differential equation and applying to the latter a pseudospectral discretization in order to obtain a system of ordinary differential equations (ODEs). The approximating system of ODEs can then be studied with one of the many bifurcation packages available for ODEs, e.g., MatCont [2].

The approach is very effective and versatile: initially developed for delay differential equations and renewal equations with constant finite discrete and distributed delays, in subsequent works it has been extended to state-dependent and infinite delays and to physiologically structured population models formulated as partial differential equations. The main current drawback for the user is that either the approximating ODE needs to be fully specified via the graphical user interface (GUI) of MatCont, by manually inserting all the coefficients once the discretization parameters are fixed, or otherwise the discretization can be defined independently of the GUI in a suitable script, thus requiring to interact with the bifurcation package via MATLAB's command line. This renders the approach less accessible to users who are not familiar with the numerical discretization technique and with programming languages.

In this work we present an extension of MatCont and its GUI implementing the method and providing a user-friendly way of directly specifying the delay equation and the discretization parameters, allowing the user to take full advantage of MatCont's features.

References

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