

TIME DELAY SYSTEMS

Webinar

TDS

$$\dot{x}(t) = A(t)x(t) + \int_{-\sigma}^{\tau} W(\vartheta, t)u(t + \vartheta) d\vartheta + \sum_{j=1}^g p_j(t)u(t - \tau_j(t))$$

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Numerical bifurcation analysis for delay equations



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March 7, 2025, Friday @ 4:00 pm (CET)

7:00 am (PDT), 10:00 am (EDT), 11:00 pm (CST)

Event will take place via Zoom

ABSTRACT: I plan to talk about recent developments for DDE-Biftool [D]. DDE-Biftool is a library for numerical bifurcation analysis of delay differential equations (DDE) and renewal equations (REs). Originally developed by Koen Engelborghs et al [E], it is able to find and track equilibria, periodic solutions, connecting orbits and their stability and bifurcations by solving nonlinear problems (if necessary after discretization) directly. The typical outcome of the analysis are bifurcation diagrams in one or two system parameters showing boundaries between parameter regions with qualitatively different behavior.

The talk will review new developments that have been contributed by various colleagues over the last decade:

- * normal form analysis of equilibria and their bifurcations (contributed by Bosschaert, Janssens, Wage, Kuznetsov),
- * neutral delay differential equations (contributed independently by Barton, Terrien, and Hesselt, Gurevich, Javaloyes),
- * problems with discrete symmetry (collaboration with Alawfi, Dankowicz),
- * distributed delays and renewal equations (collaboration with Ando).

[D] J. Sieber, K. Engelborghs, T. Luzyanina, G. Samaey, D. Roose, DDE-BIFTOOL Manual - Bifurcation analysis of delay differential equations, url: <https://sourceforge.net/p/ddebiftool/git/ci/master/tree/>

[E] K. Engelborghs, T. Luzyanina, and D. Roose, Numerical bifurcation analysis of delay differential equations using DDE-BIFTOOL, ACM Transactions on Mathematical Software, 80928 (2002), pp. 1–21.

BIO: Prof Jan Sieber has received his PhD in Mathematics from the Humboldt University of Berlin (Germany) in 2001, with a thesis on delay-induced instabilities in lasers. From 2002 to 2006 he worked in Bristol (UK) in the Engineering Mathematics Department on delays in mechanical engineering and control. He was in a postdoctoral position in the Department of Engineering in Aberdeen (UK) from 2006-2008, developing methods to track unstable periodic responses in mechanical experiments using feedback control. He was appointed as Senior Lecturer in Mathematics at the University of Portsmouth (UK) in 2008, working there until 2012. Since then he has been at the University of Exeter (UK). His research interests are tipping points, systems with delay, dynamics of piecewise smooth systems, numerical methods and experimental techniques for bifurcation analysis.



Questions? Contact: Gabor Orosz, orosz@umich.edu