TIME DELAY SYSTEMS

# Webinar

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# Balancing-based model reduction for delay systems


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## Event will take place via Zoom


**ABSTRACT:** In this talk, two approaches for model reduction of delay systems based on balancing techniques are presented. In the first approach, a decomposition of the delay system dynamics is pursued in terms of a feedback interconnection between a finite-dimensional linear system and a delay operator. Subsequently, the finite-dimensional part of the dynamics can be reduced using balancing techniques. In the second approach, a balancing technique is developed on the basis of energy functionals that provide (bounds on) a measure of energy related to observability and controllability, respectively, for the infinite-dimensional delay system. These functionals are then used as a basis for model reduction for the delay system. Benefits of these approaches are, firstly, the fact that the delay nature of the system is preserved after reduction, secondly, that input–output stability properties are preserved and, thirdly, that a computable error bound reflecting the accuracy of the reduction is provided. The effectiveness of the results is evidenced by means of illustrative examples.


**BIO:** Nathan van de Wouw obtained his MSc degree and PhD degree in Mechanical Engineering from the Eindhoven University of Technology, The Netherlands in 1994 and 1999, respectively. He currently holds a full professor position at the same institution. During 2000 and 2001, he worked at Philips Applied Technologies, Eindhoven and at the Netherlands Organisation for Applied Scientific Research (TNO), Delft. He has held positions as a visiting professor at the University of California at Santa Barbara, USA in 2006/2007, at the University of Melbourne, Australia in 2009/2010, and at the University of Minnesota, USA in 2012/2013. He has held a (part-time) full professor position at the Delft University of Technology, The Netherlands from 2015-2019. He has also held an adjunct full professor position at the University of Minnesota, USA from 2014-2021. He has published the books 'Uniform Output Regulation of Nonlinear Systems: A convergent Dynamics Approach' with A. V. Pavlov and H. Nijmeijer (Birkhauser, 2005) and 'Stability and Convergence of Mechanical Systems with Unilateral Constraints' with R. I. Leine (Springer, 2008). He serves/d on the editorial board for the journals Automatica and IEEE Transactions on Automatic Control and is currently senior editor for the IEEE Transactions on Control Systems Technology. He is also a member of the Scientific Board of the Eindhoven Artificial Intelligence Systems Institute. He is a Fellow of the IEEE for his contributions to hybrid, data-based and networked control, and in 2015 he received the IEEE Control Systems Technology Award "For the development and application of variable-gain control techniques for high-performance motion systems". His current research interests are the modelling, model reduction, analysis and control of nonlinear/hybrid and delay systems, with applications to autonomous and cooperative driving, high-tech systems, resource exploration, health applications and cyber-physical systems.

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