



Hamilton Institute

Passivity-Based Stability Analysis and Applications to
Biochemical Reaction Networks

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Abstract

The passivity concept - an abstraction of energy conservation and dissipation in physical systems - has been instrumental in feedback control theory and led to breakthroughs in nonlinear and adaptive control design. In this talk we discuss the use of passivity as a stability test for classes of biochemical reaction networks. The main result determines global asymptotic stability of the network from the diagonal stability of a dissipativity matrix which incorporates information about the passivity properties of the subsystems, the interconnection structure of the network, and the signs of the feedback terms. This stability test encompasses the well-known 'secant criterion' for cyclic networks and extends it to general interconnection structures represented by graphs. An extension to reaction-diffusion PDEs is also discussed. The results are illustrated on MAPK cascade models and on branched interconnection structures motivated by metabolic networks.

Biography

Murat Arcak is an associate professor of Electrical, Computer, and Systems Engineering at the Rensselaer Polytechnic Institute in Troy, New York. He received the B.S. degree from the Bogazici University, Istanbul, in 1996, and the M.S. and Ph.D. degrees from the University of California, Santa Barbara, in 1997 and 2000, under the direction of Petar Kokotovic. He joined the faculty at Rensselaer in 2001. He has also held visiting faculty positions at the University of Melbourne, Australia, and at the Massachusetts Institute of Technology. Dr. Arcak's research is in nonlinear control theory and applications, with particular interest in large-scale networks. He received a CAREER Award from the National Science Foundation in 2003, the Donald P. Eckman Award from the American Automatic Control Council in 2006, and the Control and Systems Theory Prize from the Society for Industrial and Applied Mathematics in 2007.

Venue: Seminar Room, Hamilton Institute, Science Building,
NUI Maynooth

Time: 1.00 - 2.00pm (followed by tea/coffee)

Travel directions are available at www.hamilton.ie