香港浸會大學
HONG KONG BAPTIST UNIVERSITY

DEPARTMENT OF MATHEMATICS
數學系

Distinguished Lecture Series

Energy Based Mathematical Modeling, Simulation, and Control of Multi-physics Systems

Professor Volker Mehrmann

TU Berlin

Biography:

Prof. Volker Mehrmann received his Diploma in mathematics in 1979, his Ph.D. in 1982, and his habilitation in 1987 from the University of Bielefeld, Germany. After several visiting positions, he became a full professor at TU Chemnitz from 1993 to 2000. Since then he has been a full professor for Mathematics at TU Berlin.

Prof. Mehrmann is a member of acatech (the German academy of engineering), academia europaea and the European Academy of Sciences. He served as the president of GAMM (the International association of Applied Mathematics and Mechanics). Currently he is the president of the European Mathematical Society (EMS). He is a SIAM and AMS Fellow. He is editor of several journals in numerical analysis and editor-in-chief of Linear Algebra and its Applications.

Prof. Mehrmann was awarded an ERC Advanced Grant and also was member of the ERC Mathematics Panel. He won 2018 SIAM W. T. and Idalia Reid Prize. His research interests are in the areas of numerical mathematics/scientific computing, applied and numerical linear algebra, control theory, the theory and numerical solution of differential-algebraic equations, and recently also in energy based mathematical modeling.

Date: 14 December 2022 (Wednesday)
Time: 4:00-5:00 p.m. GMT+8 (Hong Kong Time)
Venue: Online via Zoom (Meeting ID: 914 7204 1352)

Abstract

Most real world dynamical systems consist of subsystems from different physical domains, modelled by partial-differential equations, ordinary differential equations, and algebraic equations, combined with input and output connections. To deal with such complex system, in recent years the class of dissipative port-Hamiltonian (pH) descriptor systems has emerged as a very successful modeling methodology. The main reasons are that the network based interconnection of pH systems is again pH, Galerkin projection in PDE discretization and model reduction preserve the pH structure and the physical properties are encoded in the geometric properties of the flow as well as the algebraic properties of the equations. Furthermore, dissipative pH system form a very robust representation under structured perturbations and directly indicate Lyapunov functions for stability analysis.

Another advantage of energy based modeling via pH systems is that each separate model of a physical system can be a whole model catalog from which models can be chosen in an adaptive way within simulation and optimization methods.

We discuss the class of pH descriptor systems and illustrate how many classical real world mathematical models can be formulated in this class. We illustrate the results with some real world examples from gas transport and district heating systems and point out emerging mathematical challenges.

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