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International Graduate School on Control

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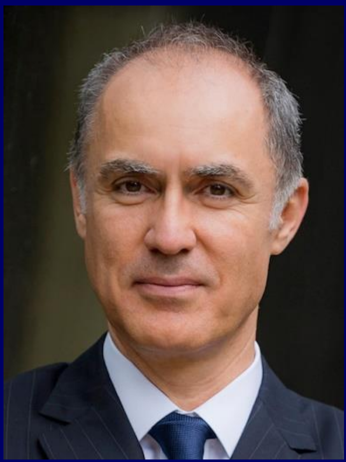
Control of PDEs and Nonlinear Delay Systems



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Abstract of the course

In the 1990s, the recursive backstepping design revolutionized robust nonlinear control, enabling stabilization of systems with uncertain nonlinearities unmatched by control and of unlimited growth. In the 2000s, taking the backstepping recursion to the continuous limit produced a similar design methodology for boundary control of PDEs and for delay systems. This course starts with an introduction to control of PDEs based on the book Boundary Control of PDEs: A Course on Backstepping Designs (SIAM, 2008), continues on with a specialization of such control designs to nonlinear delay systems based on the book Nonlinear Control Under Nonconstant Delays (SIAM, 2013), and culminates with control designs for various types of interconnected PDE-ODE systems.

No a priori knowledge on control of delay/PDE systems is required and certain, central notions are reviewed. The practical significance of the methods and concepts is illustrated through various application examples from energy, manufacturing, aerospace, traffic, robotics, and petroleum engineering.

Topics

Lyapunov stability for PDEs; boundary control of parabolic (reaction-advection-diffusion) PDEs; observers with boundary sensing; wave and beam PDEs; first-order hyperbolic (transport-dominated) PDEs; basics of motion planning for PDEs; systems with input delay and predictor feedback; delay robustness of predictor feedback; time-varying input delay; stabilization of nonlinear systems with long input delays; predictor feedback for multi-input delay systems; inverse optimality of predictor feedback; distributed input delays; state- and input-dependent delays; control of interconnected transport/wave PDEs-ODEs; introduction to adaptive control of delay and PDE systems; introduction to control of nonlinear PDEs;