seminar

Novel Control Design Techniques with Computational Efficiency and Optimality

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abstract

Most real-world engineered systems exhibit highly complex dynamical behaviors, such as uncertainties, nonlinearities, delays, and switches. This, together with the requirement of stringent controlled performance, makes the underlying control design problems rather complicated and challenging. Moreover, many control design problems are computationally intractable, which could be too complex to solve. Thus, developing an effective robust control design technique that can simultaneously render stringent controlled performance and computational efficiency becomes urgently desirable. In this talk, I will present our recent research work on novel control design techniques with computational efficiency and optimality. Two advanced control schemes, including the hybrid impulsive switching control and the exact-memory delay control, are proposed for two different types of control system designs, i.e., the switched linear control systems and the time-delay control systems, respectively. Two engineering applications on hybrid missile autopilot design and networked DC motor control systems are used to illustrate the usefulness and advantages of the proposed design techniques. One of the most important novelties of the proposed approaches lies in that the associated robust control synthesis problems can be effectively formulated as convex constrained optimization problems, and globally optimal control solutions can thus be easily obtained via convex optimizations. These proposed results have open up a new research pathway in the field of robust optimal control, they would shift the current research direction from improving numerical non-convex optimization algorithms to developing new controller structures. I will conclude with the discussions of three planned research topics directed at multidisciplinary engineering applications.

biosketch

Chengzhi Yuan received the Bachelor of Science degree in Control Science and Engineering and the Master of Science degree in Control Theory and Application both from the College of Automation Science and Engineering at South China University of Technology, Guangzhou, China in 2009 and 2012, respectively. He is currently a PhD candidate in Mechanical Engineering in the Department of Mechanical and Aerospace Engineering at North Carolina State University in Raleigh, NC. He was a teaching fellow in the Graduate School of North Carolina State University from 2015 to 2016. He has authored over 25 publications in refereed scientific and engineering journals and conference proceedings. His research interests and expertise span over broad areas of dynamic systems, control theory, system identification, and machine learning, with particular focuses on hybrid dynamical system analysis and control, robust analysis and control, linear parameter-varying control of nonlinear systems, adaptive control, and artificial neural networks applied to nonlinear system identification, dynamical pattern recognition, and pattern-based intelligent learning control. Applications of his research cover multidisciplinary engineering problems ranging from mechanical and aerospace, to electrical and biomedical engineering areas.

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