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Editorial

Directions, applications and methods in robust control

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Recent years have witnessed a tremendous growth of robust control methods and applications, and many of the underpinning techniques have reached a level of sophistication and maturity. The purpose of this Special Issue is to take a snapshot of the research and state-of-the-art in this field, showing applications, directions for future evolution, and advanced methodologies that are currently being developed. The intention is to, hence, collect in a single volume some of the latest research developments and applications of advanced robust control techniques.

It is increasingly becoming apparent that robust control theory is having impact in application areas that are further afield than the traditional physical systems many times touching upon inter-disciplinary boundaries. Meanwhile, such new application domains continue to flag new problems that continue to propel the research efforts forward. This special issue contains papers that range from applications of robust control methods to financial systems, to large interconnected systems and associated model reduction problems, to robust adaptive control and to flight control systems and contains also new theoretical developments.

Sandberg and Murray [1] discuss that there are powerful methods available for reducing the order of linear systems, such as Hankel norm approximation and balanced truncation. However, often these methods do not preserve inherent structures, such as interconnection structures. In their paper, they develop a model reduction method that preserves such structures.

Petersen [2] presents a new approach to the robust H-infinity control of an uncertain system via an output feedback controller which is both stable and has a H-infinity norm strictly less than a specified value. The use of stable controllers is preferable to the use of unstable feedback controllers in practical control problems because unstable controllers (or indeed also stable controllers with very large H-infinity norm) can lead to problems with actuator and sensor failure, sensitivity to plant uncertainties and nonlinearities and implementation problems.

Anderson *et al.* [3] provide quantitative results on how weight adjustments directly affect an H-infinity controller and, more importantly, the corresponding closed-loop transfer function matrices. They explore such issues as whether one can find the new controller after a weight change as a perturbation of the first controller, computed presumably more simply than a brand new H-infinity

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synthesis from scratch. The motivation for this study is to enable robust adaptive control algorithms that invoke weight adjustments to tune performance at each adaptive time step.

Papageorgiou and Polansky [4] propose a procedure for designing a linear time-invariant dynamic inversion autopilot with guaranteed robustness. It uses the nu-gap metric to select the dynamics that will be inverted (A and B matrices), and McFarlane–Glover loop shaping to select the controlled variable (C matrix) and the desired dynamics. They also extensively apply their methods by designing a pitch axis autopilot that achieves robust performance with a number of Boeing 747 aircraft models.

Gideon *et al.* [5] discuss application of robust control methods in financial and economic literature, and explain how robust control theory can be used by economic decision makers to investigate the fragility of decision rules across a range of economic models. They indeed apply robustness principles to a situation where the decision maker is a bank owner and the decision rule determines the optimal provisioning strategy for loan losses.

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