

Extremum-seeking control and applications: a numerical optimization-based approach

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Abstrak

Extremum-seeking control tracks a varying maximum or minimum in a performance function such as output or cost. It attempts to determine the optimal performance of a control system as it operates, thereby reducing downtime and the need for system analysis. Extremum-seeking Control and Applications is divided into two parts. In the first, the authors review existing analog-optimization-based extremum-seeking control including gradient-, perturbation- and sliding-mode-based control designs. They then propose a novel numerical-optimization-based extremum-seeking control based on optimization algorithms and state regulation. This control design is developed for simple linear time-invariant systems and then extended for a class of feedback linearizable nonlinear systems. The two main optimization algorithms – line search and trust region methods – are analyzed for robustness. Finite-time and asymptotic state regulators are put forward for linear and nonlinear systems respectively. Further design flexibility is achieved using the robustness results of the optimization algorithms and the asymptotic state regulator by which existing nonlinear adaptive control techniques can be introduced for robust design. The approach used is easier to implement and tends to be more robust than those that use perturbation-based extremum-seeking control. The second part of the book deals with a variety of applications of extremum-seeking control: a comparative study of extremum-seeking control schemes in antilock braking system design; source seeking, formation control, collision and obstacle avoidance for groups of autonomous agents, mobile radar networks, and impedance matching.