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# Integrated Control-System Design via Generalized LQG (GLQG) Theory

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## Abstract

Thirty years of control systems research has produced an enormous body of theoretical results in feedback synthesis. Yet such results see relatively little practical application, and there remains an unsettling gap between classical single-loop techniques (Nyquist, Bode, root locus, pole placement) and modern multivariable approaches (LQG and $H_\infty$ theory). Large scale, complex systems, such as high performance aircraft and flexible space structures, now demand efficient, reliable design of multivariable feedback controllers which optimally tradeoff performance against modeling accuracy, bandwidth, sensor noise, actuator power, and control law complexity. This presentation will describe a methodology which encompasses numerous practical design constraints within a single unified formulation. The approach, which is based upon coupled systems of modified Riccati and Lyapunov equations, encompasses time-domain linear-quadratic-Gaussian theory and frequency-domain H theory, as well as classical objectives such as gain and phase margin via the Nyquist circle criterion. In addition, this approach encompasses the optimal projection approach to reduced-order controller design. The current status of the overall theory will be reviewed including both continuous-time and discrete-time (sampled-data) formulations. The presentation will focus on the