

Optimal Reference Shaping for Dynamical Systems: Theory and Applications

By Tarunraj Singh

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Integrating feedforward control with feedback control can significantly improve the performance of control systems compared to using feedback control alone. Focusing on feedforward control techniques, **Optimal Reference Shaping for Dynamical Systems: Theory and Applications** lucidly covers the various algorithms for attenuating residual oscillations that are excited by reference inputs to dynamical systems. The reference shaping techniques presented in the book require the system to be stable or marginally stable, including systems where feedback control has been used to stabilize the system.

Illustrates Techniques through Benchmark Problems

After developing models for applications in which the dynamics are dominated by lightly damped poles, the book describes the time-delay filter (input shaper) design technique and reviews the calculus of variations. It then focuses on four control problems: time-optimal, fuel/time-optimal, fuel limited time-optimal, and jerk limited time-optimal control. The author explains how the minimax optimization problem can help in the design of robust time-delay filters and explores the input-constrained design of open-loop control profiles that account for friction in the design of point-to-point control profiles. The final chapter presents numerical techniques for solving the problem of designing shaped inputs.

Supplying MATLAB® code and a suite of real-world problems, this book provides a rigorous yet accessible presentation of the theory and numerical techniques used to shape control system inputs for achieving precise control when modeling uncertainties exist. It includes up-to-date techniques for the design of command-shaped profiles for precise, robust, and rapid point-to-point control of underdamped systems.

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Editorial Review

About the Author

Tarunraj Singh is a professor in the Department of Mechanical and Aerospace Engineering at the University at Buffalo. For more than twenty years, Dr. Singh has worked on the control of flexible structures at various institutions, including Texas A&M University, the University of Waterloo, IBM Almaden Research Center, the Technical University of Darmstadt, and the NASA Goddard Space Flight Center.

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