Abstract

Robust Control System Design: $H\infty$ Loop Shaping For Double Inverted Pendulum

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The inverted pendulum system has been considered an intriguing problem for control theory and its application. The stabilization of such a system is a primary challenge for researchers in this field because the degree of difficulty of each problem depends on the type of the chosen system and feasibility of the controller designed for that specific system.

In this thesis, a robust control system design procedure is adopted that is particularly suited for designing the robust controller for the inverted pendulum. The design procedure is based on H∞ loop shaping and recent H∞ theoretical developments. It is proved that the procedure can systematically deal with multi-input multi-output plants with nonlinear and parameter-dependent dynamics, and uncertainty in the mathematical model of our target plant used for the controller design.

At first, the general nonlinear dynamic model of inverted pendulum is developed. Then, the designer can also build many of the closed loop specifications into the cost function used for the controller synthesis. H∞ loop shaping is discussed in some detail. The pre- and /or post-compensators are found through the extensive computer simulation and experimental investigation. At last, the real-time robust controller for stabilizing the inverted pendulum is achieved and passes the all the performance test successfully. It is emphasized that our robust controller shows it is better robust than other controllers designed by LQR, optimal or state feedback methods, etc. Few researchers applied the method into inverted pendulum successfully.

Keywords: H∞ loop shaping, inverted pendulum, robust control.