Linear Matrix Inequality Based PID Robust Control for Non-Linear System

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ABSTRACT

This paper investigates the application of Linear Matrix Inequalities (LMI) approach in designing a robust PID controller for a non-linear sustem. In this work, will A planar two-link flexible manipulator is considered and a payload is attached at the end-point of the second-link as represented non-linear system. Uncertainty is introduced in this work by varying loading conditions. This work also proposes practical steps in designing the robust controller. To cast this control design problem into the LMI framework, the transfer functions of the system with various payloads are obtained by carrying out nonlinear system identification. Subsequently, the dynamic model is represented into convex formulation which leads to the formulation of system requirement into LMIs representation that can accommodate the convex model. A set of robust PID gains is then obtained by solving the LMIs with desired specifications. For performance assessment, a PID controller is also designed using Ziegler Nichols (ZN) technique for all loading conditions. System responses namely hub angular position and deflection of both links of the flexible manipulator are evaluated in time and frequency domains. The performance of the LMI-PID controller is verified by comparing with the results using the ZN-PID controller in terms of time response specifications of hub angular position and level of deflection in time and frequency domains.

Keywords : LMI, PID, robust, control.