HYBRID H-INFINITY FUZZY LOGIC CONTROLLER DESIGN

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Abstract

Since there is a lot of parallelism between H-infinity and the interval type-2 fuzzy logic control and they may complement one another, a new hybrid controller is proposed which combines their capabilities. This controller is proposed to assure both robust stability and robust performance of uncertain and nonlinear systems. It is shown that this controller is more efficient in achieving better performance for coupled-nonlinear systems than if only one of them is used. Furthermore, it demonstrates high robustness capabilities in the presence of large uncertainties in the system parameters. The effectiveness of the proposed controller is verified using highly nonlinear, MIMO and uncertain human swing lag system under different test scenarios. The tests reveal that the proposed controller has significantly improved the system performance as compared with the implementation of the classical H-infinity controller. The tracking performance has been enhanced by (94.7%), while the disturbance rejection performance has been refined by (13.8%). However, the most considerable improvement has been recorded for the robustness to system parameters changes with (98%).

Nonlinear-coupled multivariable systems are increasingly posing a significant challenge to the control community. Complicated and usually multi-loop controllers are being employed to overcome the influence of the nonlinear interaction between input and output variables. For most of these control algorithms, the system performance is compromised with the robust stability to tackle the uncertainties produced by modelling errors and external disturbances. A controller is required to decouple and isolate the controlled variables such that a change in one variable will result in a minimal effect on other system variables. Furthermore, it is desirable that the proposed controller will have the capacity to deal with a wide spectrum of uncertainties and disturbances while maintaining the output performance of the system.

Fuzzy logic controllers (FLCs) have inspired a lot of research in this field with recorded success in dealing with poorly modelled dynamics. The significant implications of the uncertainties and disturbances cannot be dealt with using the crisp membership functions of the conventional fuzzy logic, which results in degradation in the efficiency.

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