Undergraduate Research Project Proposal

Robust control of nonlinear model of magnetic suspension system

In the last few decades, the demand for more complete models to represent dynamic systems is increasing, which caused a considerable research effort toward developing analysis and synthesis conditions capable of treating a linear system with uncertain parameters. At the same time, programs with specialized computational and numerical iterative algorithms were built to solve problems, such as stability analysis and control of dynamical systems.

The magnetic suspension, depicted in Figure 1, system is basically a suspension of an object supported by a magnetic field. This system is commonly found in high-speed trains, gyroscopes, magnetic bearings, and accelerometers, which can be modelled in terms of uncertain and nonlinear parameters. The main procedures to study this type of system are based on Lyapunov's theory and Zames-Falb multipliers, both developed as convex optimization programming, such as Linear Matrix Inequalities (LMIs).

This project aims to study the stability and robust control of uncertain nonlinear model of magnetic suspension system (continuous or discrete time) by means of LMIs. As a strategy, the stability certificate and performance computation are provided by Lyapunov functions or the existence of a Zames-Falb multiplier. Numerical experiments and simulations involving comparison with other conditions from the literature will be performed. The construction of a prototype is also planned.

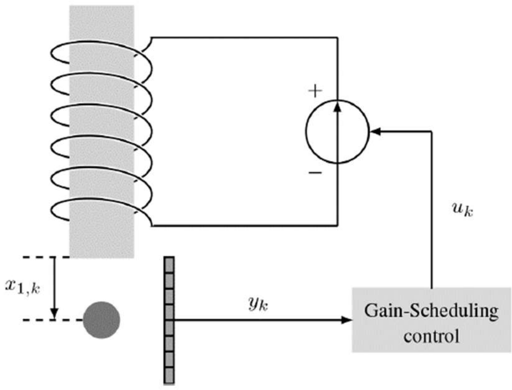

Figure 1: Diagram of a typical magnetic suspension adapted from [1].

Special requirements: Matlab. No ethical approval is required.

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References:

[1] Peixoto, M.L.C., Braga, M.F. and Palhares, R.M. (2020), Gain-scheduled control for discrete-time non-linear parameter-varying systems with time-varying delays. IET Control Theory Appl., 14: 3217-3229. https://doi.org/10.1049/iet-cta.2020.0900.