Comparison of Uncertainty Parameterisations for $\mathcal{H}_\infty$ Robust Control of Turbocharged Diesel Engines

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Abstract

This paper investigates the effect of the uncertainty parameterisation type on the performance of $\mathcal{H}_\infty$ robust controllers for diesel engine airpath control. A comparison between the experimental and simulated frequency responses indicates that the main uncertainty lies in the three parameters commonly perceived as being difficult to model in this application. Different approaches to parameterise the observed uncertainty are compared and evaluated. Based on an extended $\mathcal{H}_\infty$ loopshaping procedure, two degrees of freedom controllers will be designed using μ synthesis tools; one for a general coprime factor uncertainty description, the others for application tailored uncertainty parameterisations. The controllers are compared based on μ analysis and experimental results.

Key words: Uncertainty, H-infinity control, structured singular value, robust performance, diesel engines

1 Introduction

The $\mathcal{H}_\infty$ loopshaping procedure described in (McFarlane and Glover, 1992) has become increasingly popular in recent years. This methodology comprises two steps: Firstly, the scaling and weighting of the multivariable plant with pre- and postcompensators to shape the frequency response. Thus, engineers can use their experience and knowledge of the plant characteristics to obtain a trade-off between performance and robust stability. Secondly, the stability

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