$\mathcal{H}_\infty$ ROBUST CONTROL OF A MARINE DIESEL ENGINE EQUIPPED WITH POWER-TAKE-IN SYSTEM

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Abstract: This paper describes the application of multivariable control design to a set of linearized models of marine diesel engine. Control inputs are the fuel and the torque of the power-take-in system and measured engine parameters are the engine speed and the scavenging pressure. The models are defined for several loadings of engine operation, with the engine operated as generator with constant speed. The issues addressed are the derivation of a nonlinear engine model, the design of a robust $\mathcal{H}_\infty$ controller, the robustness check over the loading range and the nonlinear simulation for controller verification.

Keywords: H-infinity control, Diesel engines, Models

1. INTRODUCTION

In this paper, the design of a robust multivariable controller is presented for the control of a four-stroke marine diesel engine equipped with a Power Take-In (PTI) system. The PTI system considered is an electric motor directly coupled to the engine's turbocharger unit, assisting it in the lower engine operating region; an application which has potential benefit for the next generation four-stroke marine diesel engines.

Towards this direction, a six-cylinder marine diesel engine operated as generator was modeled and then a multivariable controller was designed and tested by simulation at LME/NTUA, thus addressing the issues of nonlinear process modeling, derivation of linear models appropriate for control, the design of robust controller and the robustness check over the loading range.

The efforts to improve the engine/turbocharger with various means of external assistance are well documented in the literature. In (Kolmanovsky and Stefanopoulou, 2000) an electrically powered motor coupled to the turbocharger shaft is investigated whether it improves the response of the system. The focus is on the minimum time problem, which is solved under the constraints of delivered maximum power and the total energy spent. In (Katrasnik *et al.*, 2003) various electric motor configurations for PTI were tested and also modeled in combination with the engine modeling, in an effort to fully investigate the PTI operations. Finally in (Panting *et al.*, 2001) a theoretical study of the assistance of a high speed electric motor, in relation with various engine parameters and re-matching of turbocharger components is presented.

The paper is organized as follows. At first the engine model is constructed where the engine variables are represented with engine maps. Following is the application of linearization, the background on the control methodology, the controller design and the preliminary work of controller verification on nonlinear model. Conclusions and future work are given in the last section.

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