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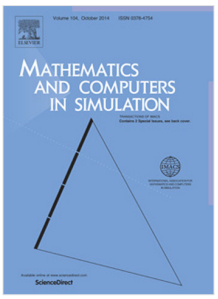

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Adaptive super twisting extended state observer based sliding mode control for diesel engine air path subject to matched and unmatched disturbance

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Abstract

This paper develops an Adaptive super twisting extended state observer (Asteso) based sliding mode control for diesel engine air path, system subject to matched and unmatched disturbances. The main advantage of the proposed Asteso observer is its capability to estimate simultaneously the matched and the unmatched disturbances affecting the Turbocharged diesel engine (Tde) air path without knowing precisely their bounds. The disturbances estimations provided by the Asteso is incorporated in a composite controller which has two main advantages in terms of alleviating the chattering problem and maintaining the nominal performance of the system in the absence of disturbances. Simulations results of the proposed controller on a recently validated experimental air path diesel engine model, shows the efficiency of the approach in terms of tracking performance and robustness facing model parametric uncertainties and Tde air path actuators faults.

Keywords: Adaptive super twisting extended state observer (Asteso), chattering reduction, nominal performance recovery, Sliding-mode control (Smc), Matched and unmatched disturbances, Turbocharged diesel engine (Tde)

1. Introduction

Comparing to gasoline engines, diesel engines has the advantage of producing the requested torque under an optimal compromise between fuel consumption and given exhaust legislation level. To meet the requirements of emission standards Euro V and VI, the emissions of diesel engines, particularly Oxides of Nitrogen (No_x) and Particulate matter (Pm) must be controlled at every engine cycles. For modern engines such as Turbocharged Diesel (Tde), controlling the No_x emissions primarily depends on two feedback variables namely the Exhaust Gas Re-circulation (Egr) and the Air fuel ratio (Afr) rates in the intake manifold.

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