World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:14, No:11, 2020

Linear Parameter-Varying Control for Selective Catalytic Reduction Systems

Authors : Jihoon Lim, Patrick Kirchen, Ryozo Nagamune

Abstract : This paper proposes a linear parameter-varying (LPV) controller capable of reducing nitrogen oxide (NOx) emissions with low ammonia (NH3) slip downstream of selective catalytic reduction (SCR) systems. SCR systems are widely adopted in diesel engines due to high NOx conversion efficiency. However, the nonlinearity of the SCR system and sensor uncertainty result in a challenging control problem. In order to overcome the control challenges, an LPV controller is proposed based on gain-scheduling parameters, that is, exhaust gas temperature and exhaust gas flow rate. Based on experimentally obtained data under the non-road transient driving cycle (NRTC), the simulations firstly show that the proposed controller yields high NOx conversion efficiency with a desired low NH3 slip. The performance of the proposed LPV controller is then compared with other controllers, including a gain-scheduling PID controller and a sliding mode controller. Additionally, the robustness is also demonstrated using the uncertainties ranging from 10 to 30%. The results show that the proposed controller is robustly stable under uncertainties.

Keywords : diesel engine, gain-scheduling control, linear parameter-varying, selective catalytic reduction
Conference Title : ICET 2020 : International Conference on Engine Technologies
Conference Location : Venice, Italy
Conference Dates : November 12-13, 2020