Modeling and control of an engine fuel injection system

Abstract

Control of automotive exhaust emission has become an important research area to meet the more stringent automotive emission regulations. Beside the modification on internal combustion engine, control engineering is seen as another approach to improve and meet these requirements. This paper focuses on the design and development of a control system to reduce the harmful waste of automotive exhaust emission. The control system aims to regulate the amount of fuel injected into the combustion chamber such that the air to fuel ratio (AFR) is maintained within the allowable range. The control process in this paper is demonstrated based on an analytical engine model that clearly describes engine's air and fuel dynamic with no loss of engine system performance. Since the dynamics of the internal combustion engine and fuel injection systems are highly nonlinear, a linear model is obtained in this paper, based on a system identification approach to allow methodical application of linear control theories. The linear quadratic Gaussian (LQG) control strategy is employed in this paper. The LQG controller, designed based on the linear model of the engine system, results in good controlled output response and provides better controlled output response by reducing the transient effect occurred in LQG controller design.