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Mean Value Modelling of Maritime Diesel Engines

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Extended abstract

As the European emission standards have become more restricted, diesel engines are becoming obsolete especially within the automotive industry [1]. However, diesel engines will be used in maritime transportation for the upcoming decades. Emission minimization of NO_x, CO_2 and particulate matter is one of the major areas in maritime diesel engine control applications. Adhering to emission conditions set by International Maritime Organization (IMO) [2], current diesel engines requires efficient control, which itself requires accurate modelling.

In this work, a first principle mean value model for diesel engine airpath and engine dynamics are presented, that is, creating a nonlinear and linear models to examine the state variables of the systems, which are intake and exhaust manifold pressures, compressor power and engine speed. The airpath model consists of intake and exhaust manifold pressures, turbocharger power, engine speed and fuel injection ratio. Each dynamics is modeled and simulated separately utilizing MATLAB's Simulink. Some the models are achieved empirically due to nonlinearity of the system. On the other hand, such nonlinear models are required for mapping complex chemical and combustion reactions. Mean value model itself is a valid approach. However, it is not suitable for cylinder-wise control, since it does take the pulsating nature of the engine airpath in to account [3][4].

In general, modeling does not possess a single way approach for all dynamic systems. However, numerous valid and widely used approaches exist in the literature [5-9]. Each system and its features, such as physical quantities mentioned above, requires a careful and systematic approach, which affects the control design and behavior of control. In other words, the desired efficiency in control design of the engine is highly dependent on the generated mathematical models of the system. Mean value models are also part of the more accurate models to be developed for cylinder-wise control of the engine, which is a key challenge nowadays and in the years to come [10].

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