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Numerical Approach to Boost an Internal Combustion Engine

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Abstract : Due to the drastic environmental and energy regulations regarding the reduction of exhaust emissions and fuel consumption, added to the increasing demand for powerful performance, several automotive manufacturers are constantly obliged to redesign their existing products and/or develop novel powertrain techniques to respond to the aforementioned restrictions. In this aspect, an implemented approach is proposed in the present work to boost a 1.5 L, three-cylinder Diesel engine with a new turbocharger, based on 1D preliminary design codes, 3D design, and numerical assessment of a suitable radial turbine followed by an accurate selection procedure of an adequate centrifugal compressor. Furthermore, to investigate the effect of the turbine's rotor position on the simulation convergence, stability, and calculation time; two combinations (rotor blade- volute) have been assessed. Consequently, significant results are obtained when comparing the original turbocharged engine and the new one at the engine's full load and rated speed (@4500rpm) conditions. A maximum improvement in terms of brake-specific fuel consumption, thermal efficiency, total-to-static turbine efficiency, and total-to-total compressor efficiency equal 6.5% (corresponding to a decrease of 2.3 litre/hr in fuel consumption), 7%, 10.9%, and 19.9%, respectively.

Keywords : CFD investigation, engine boosting, turbine design, turbocharger, rotor blade positioning
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