Institution of Mechanical Engineers

Experimental investigation on an advanced boosting system for automotive engines

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Abstract

The reduction of CO_2 and, more generally, GHG (Green House Gases) emissions imposed by the European Commission (EC) and the Environmental Protection Agency (EPA) for passenger cars has driven the automotive industry to develop technological solutions to limit exhaust emissions and fuel consumption, without compromising vehicle performance and drivability. Even if the Electric Vehicles and the Fuel Cell propulsion systems are taken into account as alternative solutions, the Well to Wheel energy balance is still now unfavourable. Therefore, Internal Combustion Engine (ICE) will play a fundamental role for the next two decades, thanks to the progressive electrification of the powertrain through Hybrid Electric Vehicles (HEV), and to the development of integrated technologies. Turbocharging (TC) is one of the most promising ways to achieve such targets, along with downsizing, Variable Valve Actuation (VVA) systems, and Gasoline Direct Injection. In this rapidly developing and challenging scenario, it follows that to remain competitive in terms of financial and technical aspects, the future development of electrically-driven and electrically-assisted boosting systems may also require adequate compatibility with the future "low carbon" vehicle. Ideally, the advanced boosting solution may offer multiple functional roles, where synergies with electrification solutions could be offered in addition to their conventional role of providing boost. To this aim, an experimental investigation on a turbocharger coupled to an electrically assisted boosting system was developed at the turbocharger test rig of the University of Genoa. In the paper, a description of the experimental set-up a description of the experimental set-up and measuring equipment used to test the e-booster coupled to the main turbocharger is reported. The e-booster system was maintained in an upstream configuration and the main instantaneous parameters, such as pressure, mass flow rate and turbocharger rotational speed were measured using high frequency response transducers. together with a preliminary result on the transient response of the system.

The set-up of the experimental system characterized by the e-booster (eSc) coupled to the main turbocharger is described, without the adoption of the engine in order to perform the investigation over an extended range. This layout allows to analyze the transient response of the main turbocharger in order to highlight the gain in the turbo lag when the eSc is working. After a sketch of the circuit configuration and the set-up of the control system, a description of the experimental technique and a preliminary result is reported.

UNIGE made up an experimental technique to provide experimental information on the time requested by the turbocharger to reach a compressor outlet pressure value with and without the presence of the eSc. The target is to properly control each variable to make reproducible and repeatable test performed with and without the eSc.

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Keywords: turbocharging, experimental investigation, performance, internal combustion engine, steady and unsteady flow.

Biography:
Silvia Marelli received MS Degree in Mechanical Engineering at the University of Genoa in 2004 and PhD Degree in Fluid Machines in 2008. Since 2011, she is part of the permanent staff of the University of Genoa as Assistant Professor in Fluid Machines. Since over 10 years, she works at test facility of the University of Genoa focusing her research activity to automotive engines intake and exhaust components performance, with special reference to turbocharging systems under steady and unsteady flow operation.

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