News

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Novel concept of exhaust gas tract improves turbocharging in combustion engines

Technologie-Lizenz-Büro der Baden-Württembergischen Hochschulen GmbH

Turbochargers significantly increase engine performance and efficiency. Combustion engines currently possess various control elements that operate using different modes and restrictions. At the University of Stuttgart, a concept was developed to better control turbochargers, in particular turbochargers for gasoline engines. The innovative MEDUSA concept is suitable for turbocharging diesel and gasoline engines. This inexpensive and mechanically robust alternative to conventional concepts is truly interesting for automobile manufacturers. They will be interested to learn that MEDUSA is particularly well suited for engine downsizing and higher engine exit temperatures.

Conventional approaches for the gas flow onto the turbine wheel of a turbocharger all collect exhaust gas from each cylinder in a manifold which subsequently flows onto the rotor via a volute housing. At low engine speeds and loads, the best turbocharging results are currently achieved using the VTG control element (Variable Turbine Geometry). Adjustable guide vanes integrated in the turbine housing enable optimum boost pressure control and flow to the impeller across the entire operating range. However, the material of these guide vanes is generally not suitable for high temperatures, so that this method is not a viable option for modern downsized gasoline engines. This is where the so-called waste-gate turbochargers come into play. They are basically uncontrolled and only divert part of the engine mass flow around the turbine at operating points with higher output.

This is where the Medusa system enters into the picture. Medusa is being developed and tested at the Institute of Thermal Turbomachinery and Machinery Laboratory (ITSM) under the direction of Prof. Damian Vogt: In this case, the control does not take place via guide vanes, but via inflow channels that end in nozzles. These valves can be switched on or off and therefore - in contrast to current waste gate chargers - ensure an improved response behavior and higher dynamics in the partial load range.

The basic idea of the MEDUSA (Multiple Exhaust Duct with Source Adjustment) control concept is to divide the turbine inlet into several sectors along the circumference and to control the inflow of the various sectors individually by means of valves. This partial admission approach works similar to a Variable Nozzle Turbine (VNT) control system and allows an increase in the turbine inlet pressure at low engine mass flows by closing turbine inlet segments and thus restricting the effective flow area. As a result, higher turbocharger power output at low engine load conditions can be achieved and hence the gas acceptance behavior is significantly improved. On the other hand, the swallowing capacity of the turbine at full load is increased compared to conventional wastegate-turbochargers, so that the turbine wheel can be designed smaller, which in turn

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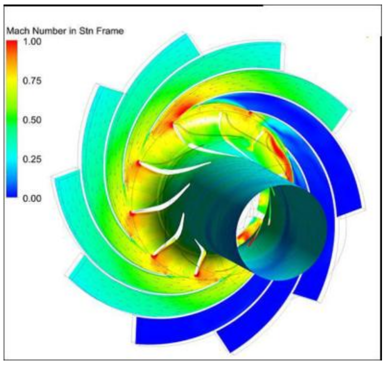

The basic idea of the MEDUSA control concept is to divide the turbine inlet into several sectors along the circumference and to control the inflow of the various sectors individually by means of valves. (Graphic: University of Stuttgart) leads to lower inertia and reduces the so-called turbo-lag.

The mechanical control unit used is very robust, especially at high exhaust temperatures, as the valves used are not integrated in the turbine housing, but are mounted externally. It is precisely this feature that makes using the MEDUSA charger in combustion engines so interesting, especially when it comes to economical, downsized engines, small engines or range extenders (as used in the field of electromobility). Recent tests on the engine test bench have shown that the method really works. Concrete performance data are now also available.

Patents for the MEDUSA charger have been granted in Europe under number EP 2 647 808 and in the USA (US 9,267,418), Japan and China. The University of Stuttgart has entrusted Technologie-Lizenz-Büro (TLB) GmbH with the commercial implementation of the invention and is looking for industrial partners for the market launch phase. TLB GmbH offers companies the opportunity to license the patented technology or possibly to purchase the industrial property rights.

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