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Numerical investigation of a pressure wave supercharger

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Abstract

The paper aims at a numerical investigation of the evolution of velocity, pressure and temperature field along the wave rotor channels for a pressure wave supercharger. Since in literature most of the studies are made considering the working fluid as incompressible and inviscid in a 2D field, the present study is using the compressible and viscous terms in unsteady Navier-Stokes equations for fluid in 3D field. The geometry was drawn in CAD software using measurements made on a real model of the CX-93 pressure wave supercharger. The simulation was conducted using a CFD code for unsteady 3D k-e, k-co model approach to reproduce data such as pressures, temperature and mass flows which are usually measured in real engine pressure wave supercharging. The computational domain for uRANS was modeled as a moving rotational domain with adaptive meshing. Results such as velocity, pressure and temperature field in the rotor channels were obtained for exhaust gas inlet pressure of 0.28 MPa and 1465 K temperature at different rotational speeds. The air inlet state considered was: 0,098 MPa and 293 K. Supercharging by means of a pressure wave supercharger, in order to improve the performance of an internal combustion engine, appears to be a promising solution since the exhaust gas generates a benefice boost of intake air with significant advantages when compared to the conventional turbocharging. The numerical modelling of the complex phenomena occurring within the narrow channels might be a useful tool for improving the pressure exchange between the working fluids, either by modifying the input parameters or by optimizing the geometry of the rotor, ports or pockets.

wave rotor channels, pressure wave supercharger, working fluids, rotor, ports, pockets

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