Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Identifying benefits of PANS-modeling over LES for engine flows
BRANISLAV BASARA, ZORAN PAVLOVIC, AVL List GmbH — Large-Eddy Simulation (LES) has been frequently used for engine flows providing reliable and accurate results. On the other hand, the limitations of Reynolds-Averaged Navier-Stokes (RANS) models are very well known and some of them are possible to compensate with e.g. modelling in combustion (knock), or they are just ignored like cycle-to-cycle variations etc. Most of limitations are removed by applying LES but leading to much higher computational costs. Up to now, it has not been clear if some of hybrid RANS-LES models could improve engine calculations with a moderate increase of computational costs. The Partially-Averaged Navier-Stokes (PANS) approach (Girimaji, 2006) is designed to resolve a part of the turbulence spectrum adjusting seamlessly from RANS to DNS. In other to optimize the basic PANS method for moving geometries, Basara, Pavlovic and Girimaji (2018) introduced an additional equation for the scale supplying variable. In this approach, the main resolution parameter, the unresolved to total kinetic energy ratio, can be calculated in-situ enabling simple and cost-effective calculations of engines. Cycle-to-cycle variations have been achieved with amplitudes of cycle relevant variables that are depending on the ratio between unresolved and total kinetic energy. Nevertheless, benefits in PANS calculations are also expected to come from the proper modelling of the wall including the heat transfer even for larger y+ values as RANS models are applied there. This should have a positive impact on the emission predictions. The work presented here will try to provide answers on all these questions.

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Date submitted: 26 Jul 2019 Electronic form version 1.4