



## **Coupled-Implicit Pressure-Based Solver in OpenFOAM: Validation and Performance**

Hrvoje Jasak, Vuko Vukcevic, Tessa Uroic

*Wikki Ltd and University of Zagreb, Croatia. h.jasak@wikki.co.uk*

Compared to the conventional segregated SIMPLE/PISO class of pressure-based solution algorithms for incompressible and compressible flows, block-implicit coupled solution of the momentum and pressure equations in a single matrix and linear solver call brings substantial advantages. The most notable of those are significant improvement in time-to-solution, improved parallel scaling, increased robustness and stability of the solution on industrial grade meshes. Experience with block-implicit coupled solution shows that it is beneficial both in steady and transient simulations and that the price of increased memory use is balanced by substantial performance benefit.

Implementation of the block-coupled solution for the pressure-velocity system uses the block-matrix infrastructure implemented by Jasak in the code and code design allows complete re-use of existing building blocks of discretisation. In addition, block-implicit versions of the gradient and divergence operator have been implemented, while the final block-matrix assembly is performed via an easy-to-use interface.

We shall present the code infrastructure and implementation of the block-implicit coupled solution algorithm, some validation cases relevant for racing car geometries and a performance comparison between the segregated SIMPLE/PISO algorithms and block-coupled solution. The work shall be completed with a demonstration of block-coupled solution for other coupled equation sets, most notably the use of the block matrix in strongly coupled turbulence models.