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Vratis

# New quality In Computational Fluid Dynamics

OpenFOAM compatible

## 01. Features

- Full GPU acceleration. All most time-consuming calculations are performed on the GPU card.
- Iteratively solves Navier-Stokes equations with Finite Volume Method.
- Support for 3D unstructured meshes in OpenFOAM format.
- Solves problems with geometries up to 9 millions cells (estimated for NVIDIA Tesla C2050 with 6GB RAM).
- Supported platforms: Linux 32bit / 64bit.

## 02. Numerical schemes

- Full implementation of Finite-Volume-Method
- 3D unstructured cells of any arbitrary shape.
- Linear Interpolation.
- Diagonal Preconditioner.

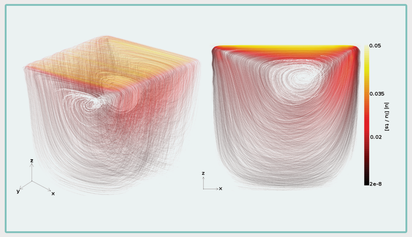
## 03. Version 1.0

- PISO (Pressure Implicit with Split Operator) - Transient solver for incompressible flow.
- SIMPLE (Semi-Implicit Method for Pressure-Linked Equation) - Steady-state solver for incompressible flow.
- Boundary condition : fixed-valued, fixed-gradient.
- Easy to use C-style interface.

## 04. Roadmap

- Multi-GPU support.
- Turbulence models: standard k-epsilon model (RANS).
- Support for 3D unstructured meshes in VTK format.

## 05. Results 1



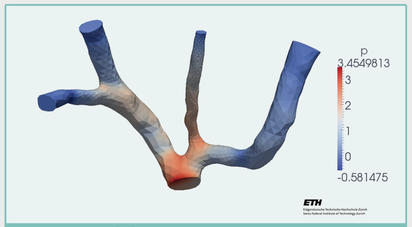




Fig. Pressure filed (kg m$^{-1}$s$^{-2}$) calculated for coronary arteries with OpenFOAM case (icofoam, diagonal preconditioner). The geomery was provided by LTNT lab of ETH Zurich.

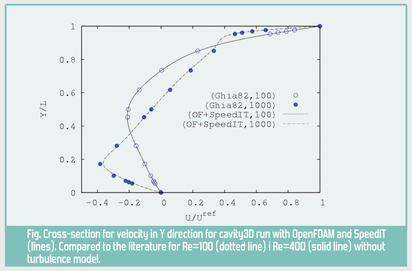



Fig. Cross-section for velocity in Y direction for cavity3D run with OpenFOAM and SpeedIT (lines). Compared to the literature for Re=100 (dotted line) i Re=400 (solid line) without turbulence model.

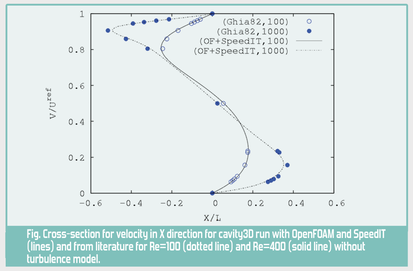



Fig. Cross-section for velocity in X direction for cavity3D run with OpenFOAM and SpeedIT (lines) and from literature for Re=100 (dotted line) and Re=400 (solid line) without turbulence model.

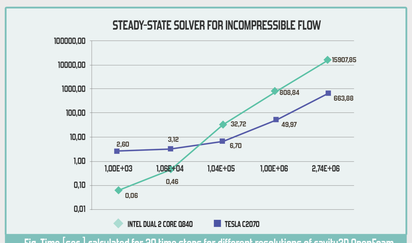



Fig. Time [sec.] calculated for 20 time steps for different resolutions of cavity3D OpenFoam case (icoFoam)

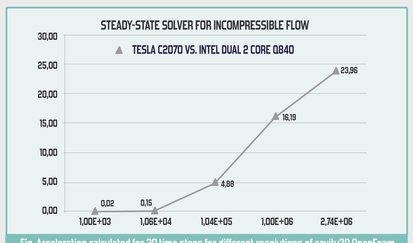



Fig. Acceleration calculated for 20 time steps for different resolutions of cavity3D OpenFoam case (icoFoam).

## 06. Results 2

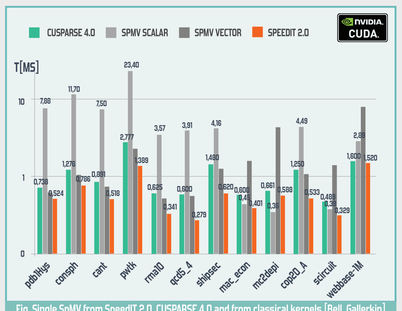



Fig. Single SpMV from SpeedIT 2.0, CUSPARSE 4.0 and from classical kernels [Bell, Gallerkin]. Double precision.

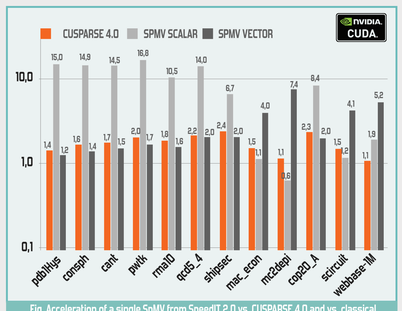



Fig. Acceleration of a single SpMV from SpeedIT 2.0 vs. CUSPARSE 4.0 and vs. classical kernels [Bell, Gallerkin]. Double precision.

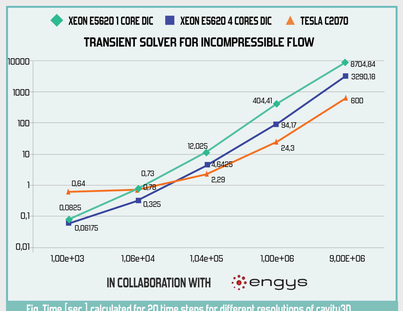
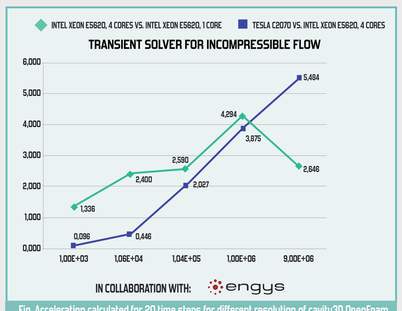



Fig. Time [sec.] calculated for 20 time steps for different resolutions of cavity3D OpenFoam case (icoFoam).

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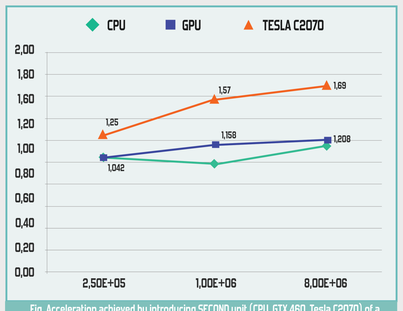


Fig. Acceleration achieved by introducing SECOND unit (CPU, GTX 460, Tesla C2070) of a given kind. Cavity3D OpenFOAM case (icofoam). Multi-GPU on CG Level. CPU = Intel Core 2 Quad CPU 8400 @ 2.66GHz, GPU = GTX 460 GTX.