Science & Technology Facilities Council

Application of the new turbo-machinery module to a mixed compressor and in-situ visualisation.

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EDF R&D

Overview

1. Rotating pipe (S. Rolfo)
2. *Code_Saturne* in-situ visualization (B. Lorendeau)

Acknowledgements

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2. *Code_Saturne* in-situ visualization (B. Lorendeau)

Rotating pipe: Test case description

Flow parameter

- Laminar flow $Re = 500$ (based on diameter and inlet bulk velocity)
  - Fully developed laminar inlet (parabolic profile)
- Middle section rotating at rotation rate $\alpha = V_\theta / U_B = 2.5$

Calculations definition

- Single domain with imposed wall velocity
- Code-Code coupling with 3 instances and sliding plane
  - Mesh rotation
  - Coriolis source force
- Turbo-machinery module with mesh joining
  - Mesh rotation and gluing at every time step
  - Coriolis source force with mesh joining at the start of the simulation
- Mesh with 256 cells in the cross section for 56 planes in the steamwise direction, for total length of $5D$

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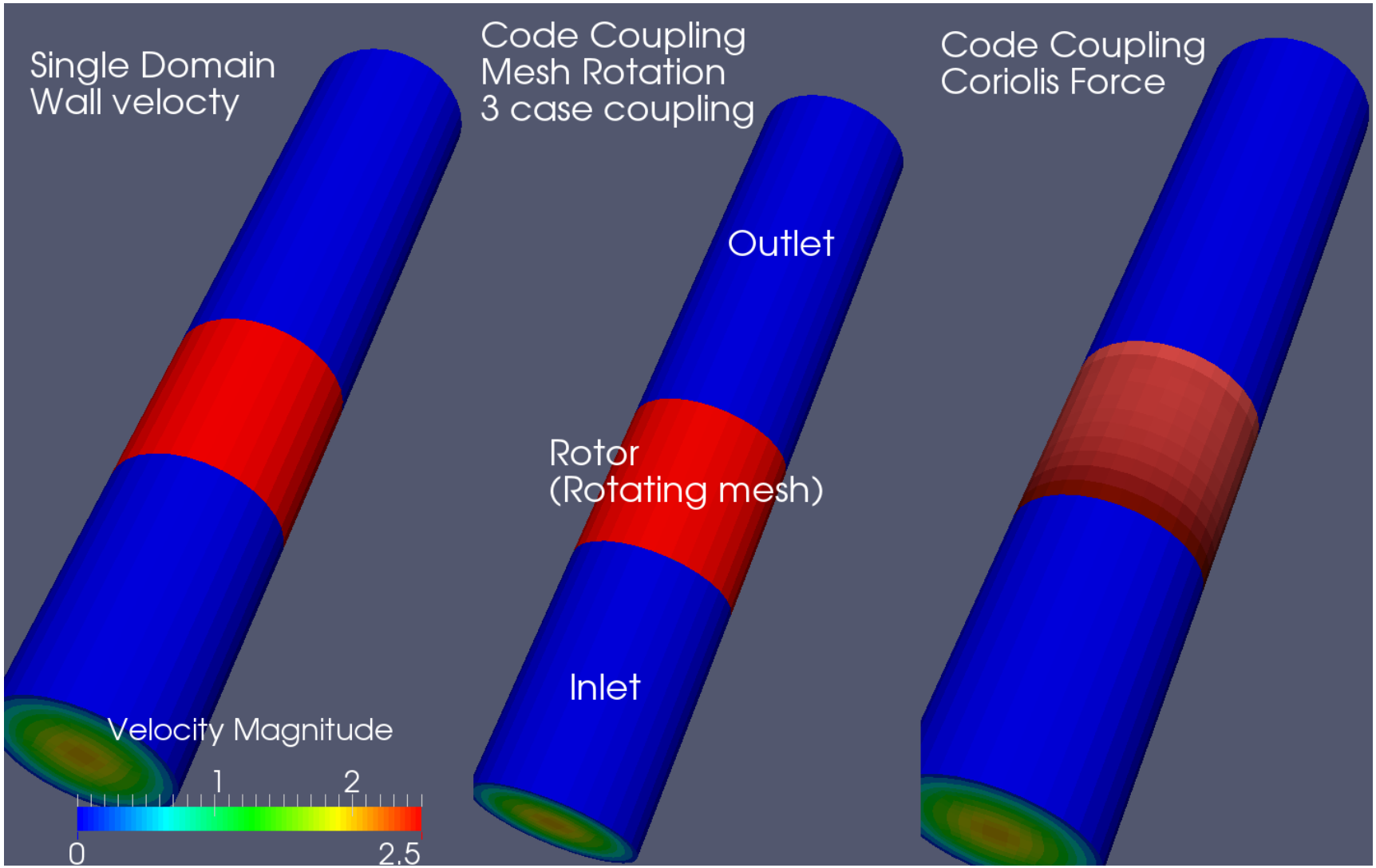
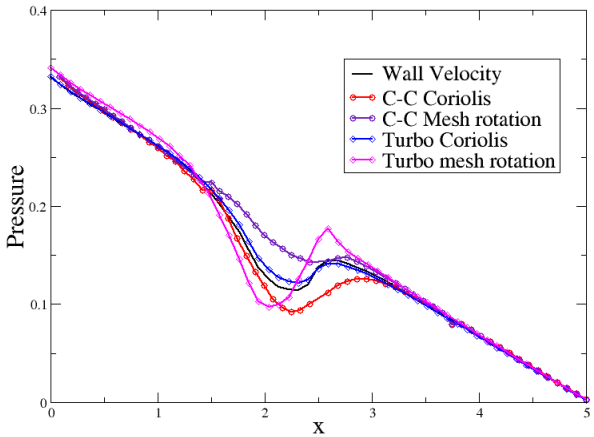
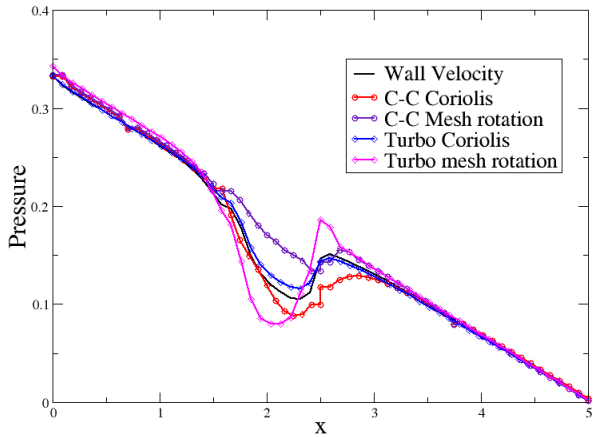
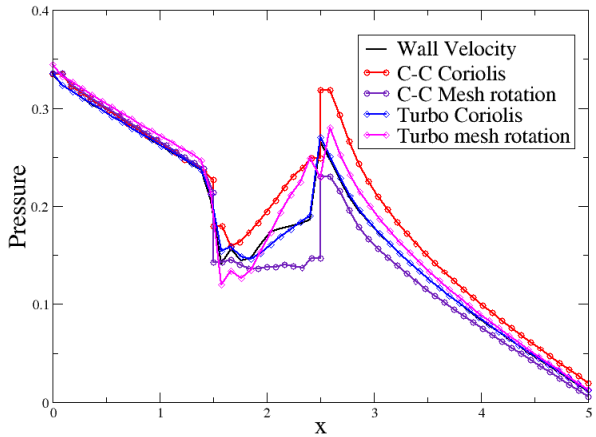
Rotating pipe: Test case view

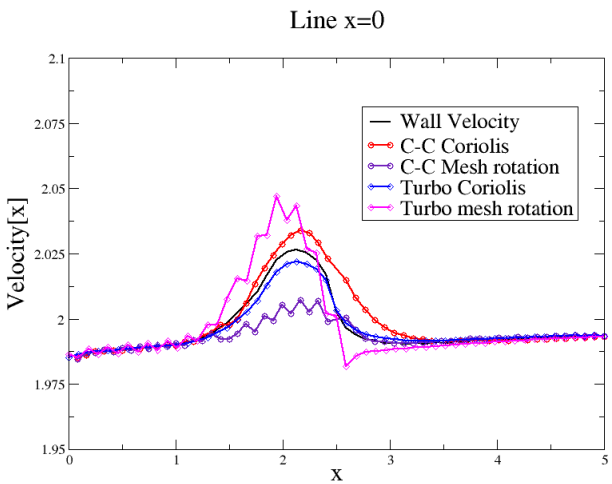


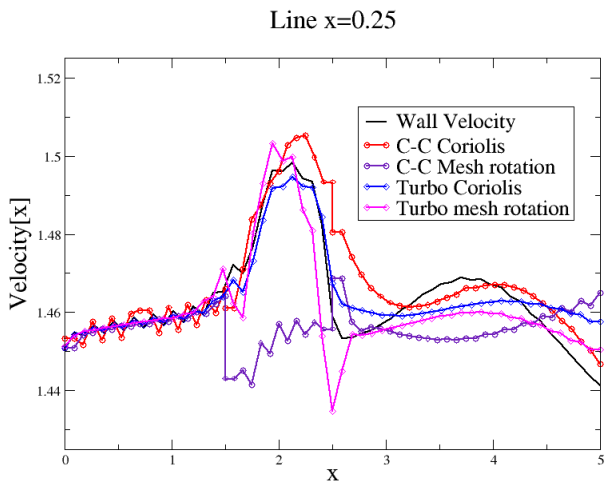
Comparison: Profiles along flow direction

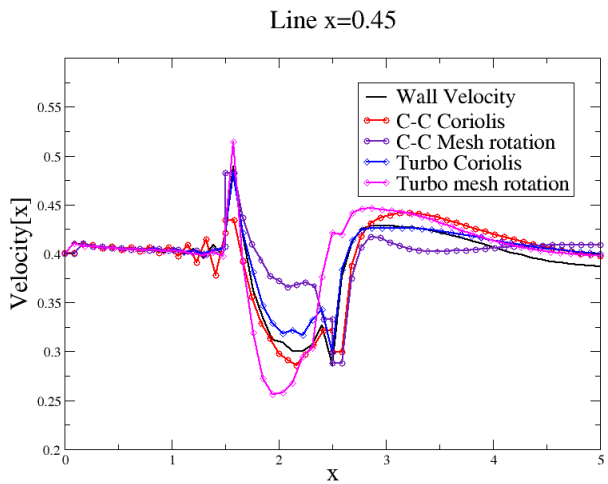












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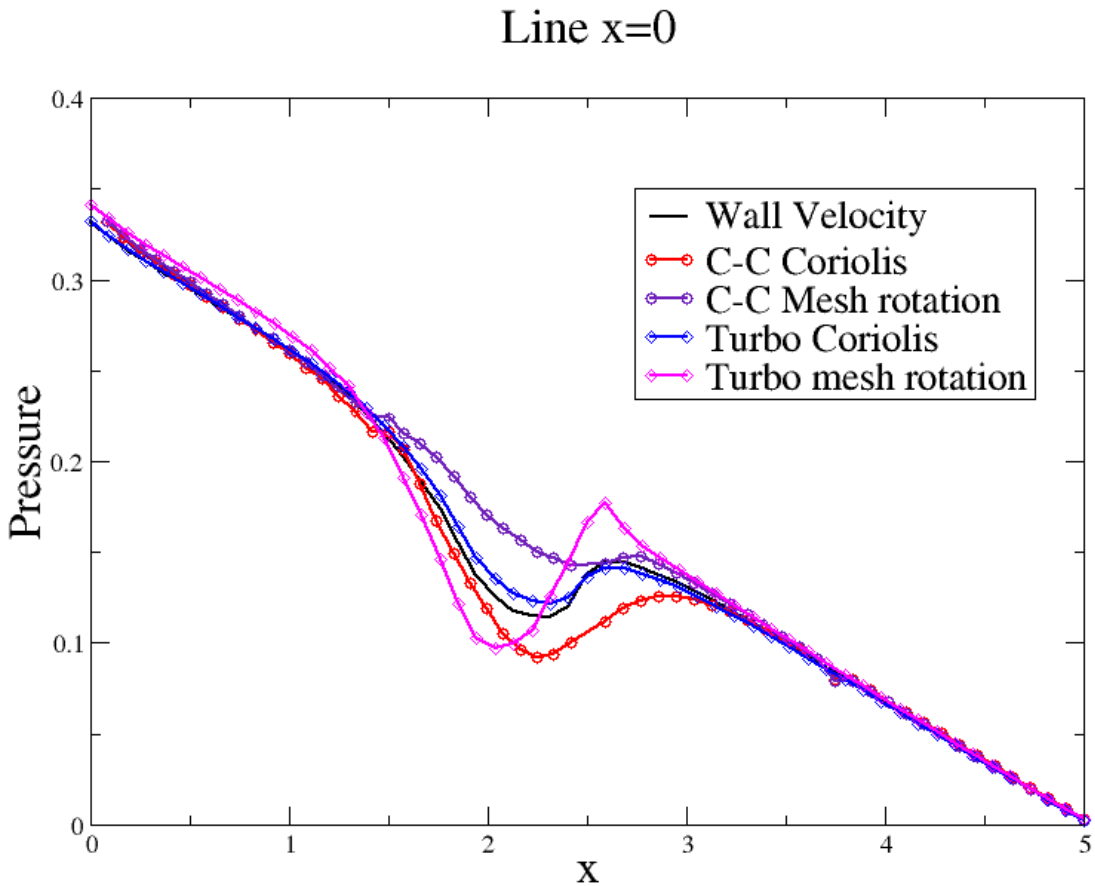
- C-C coupling with mesh rotation less sensitive to the rotation
- Turbo module with mesh rotation enhance the effect of the outlet interface
- Turbo module with frozen rotor is the closest to the imposed wall velocity
- Both methods with mesh rotation show fluctuations up-stream and in the rotor



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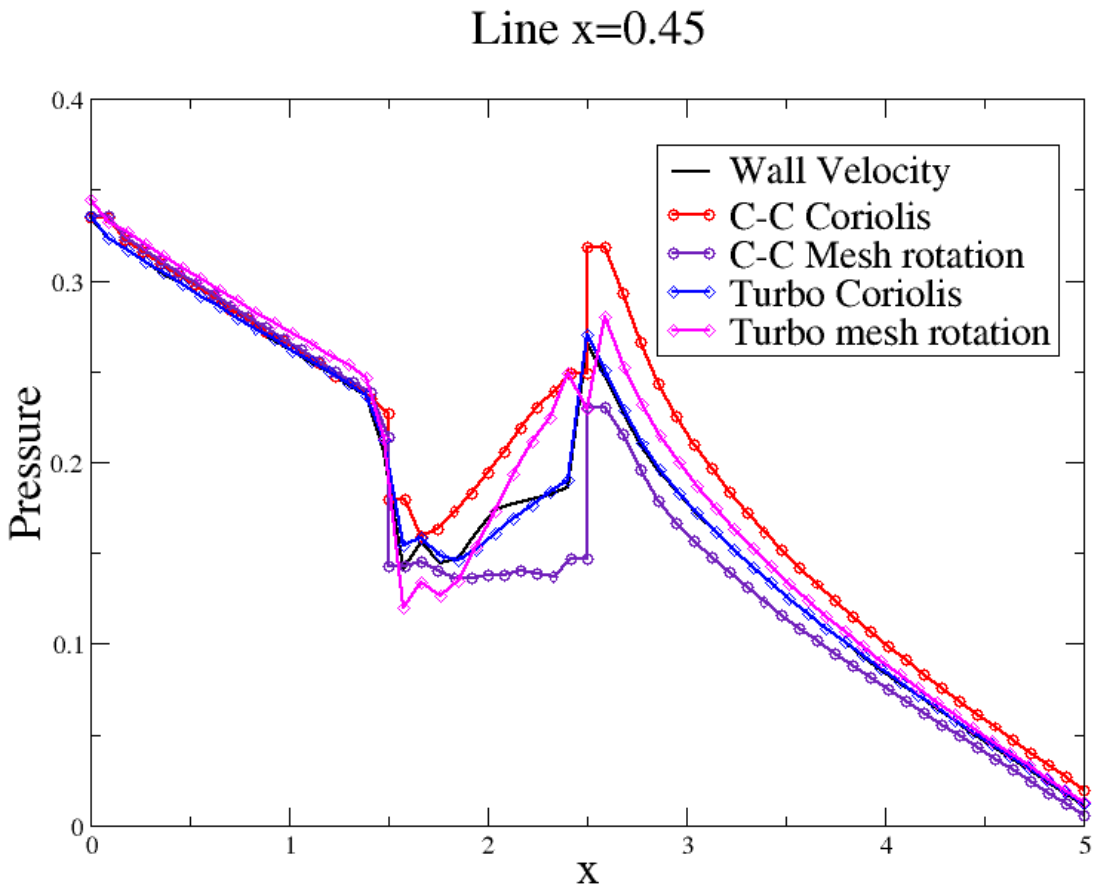

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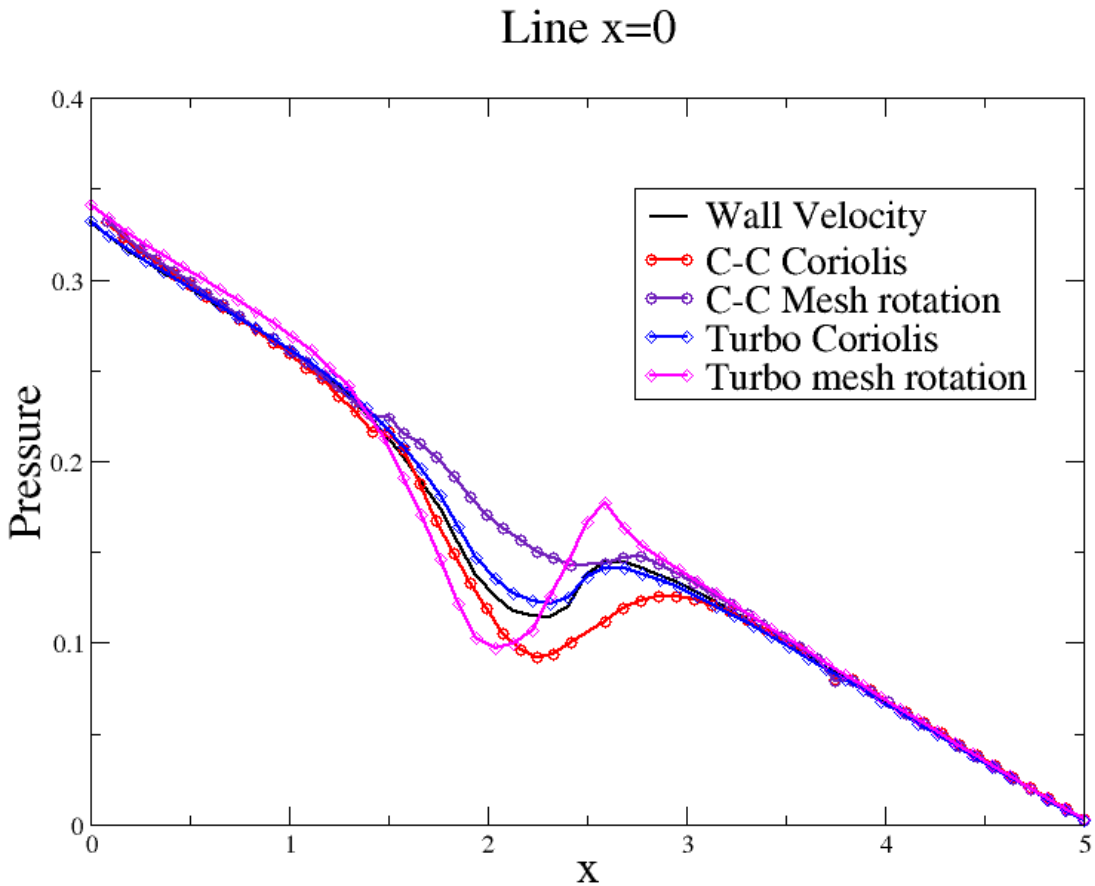

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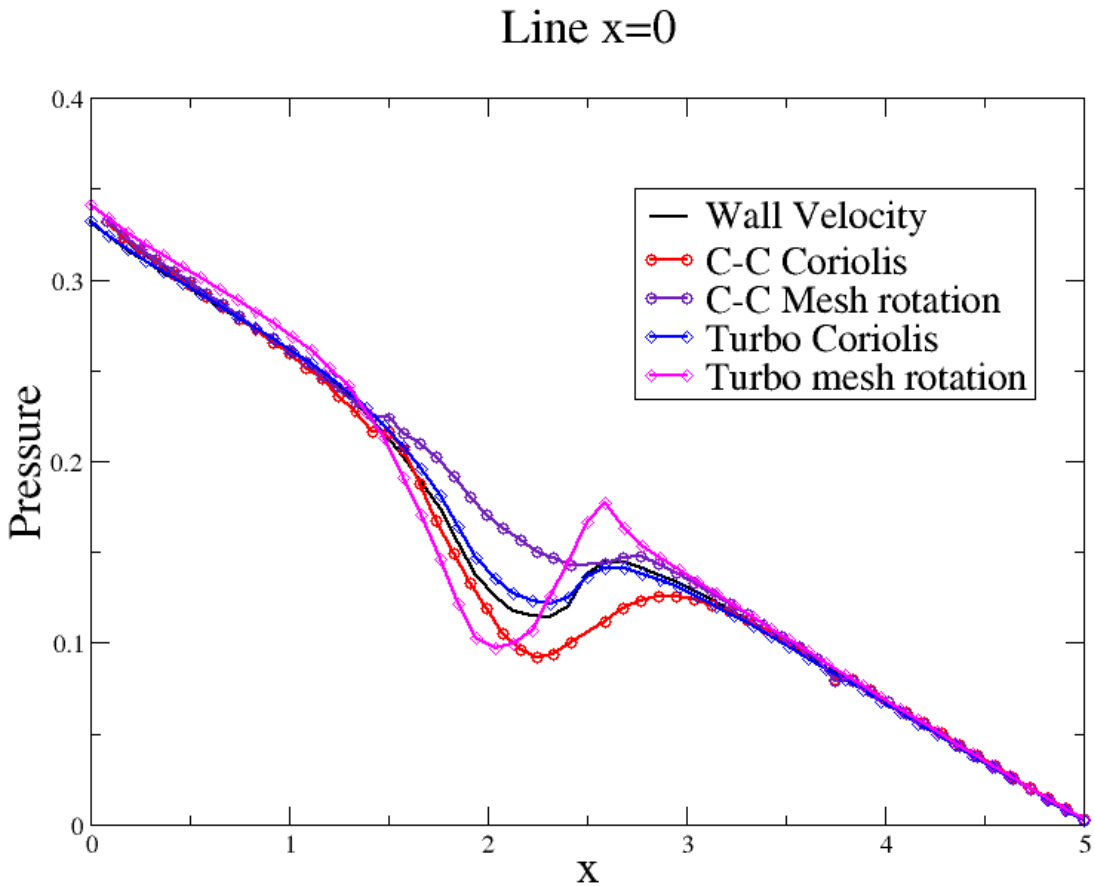

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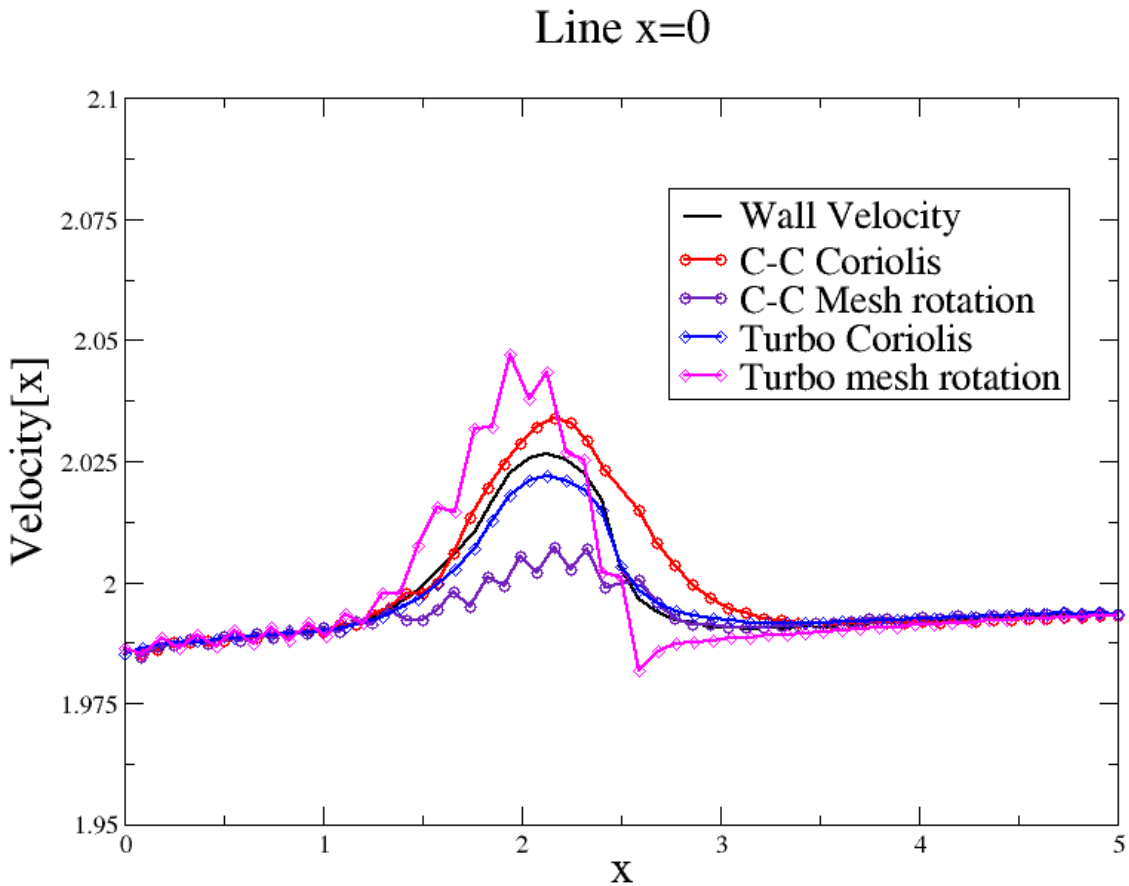

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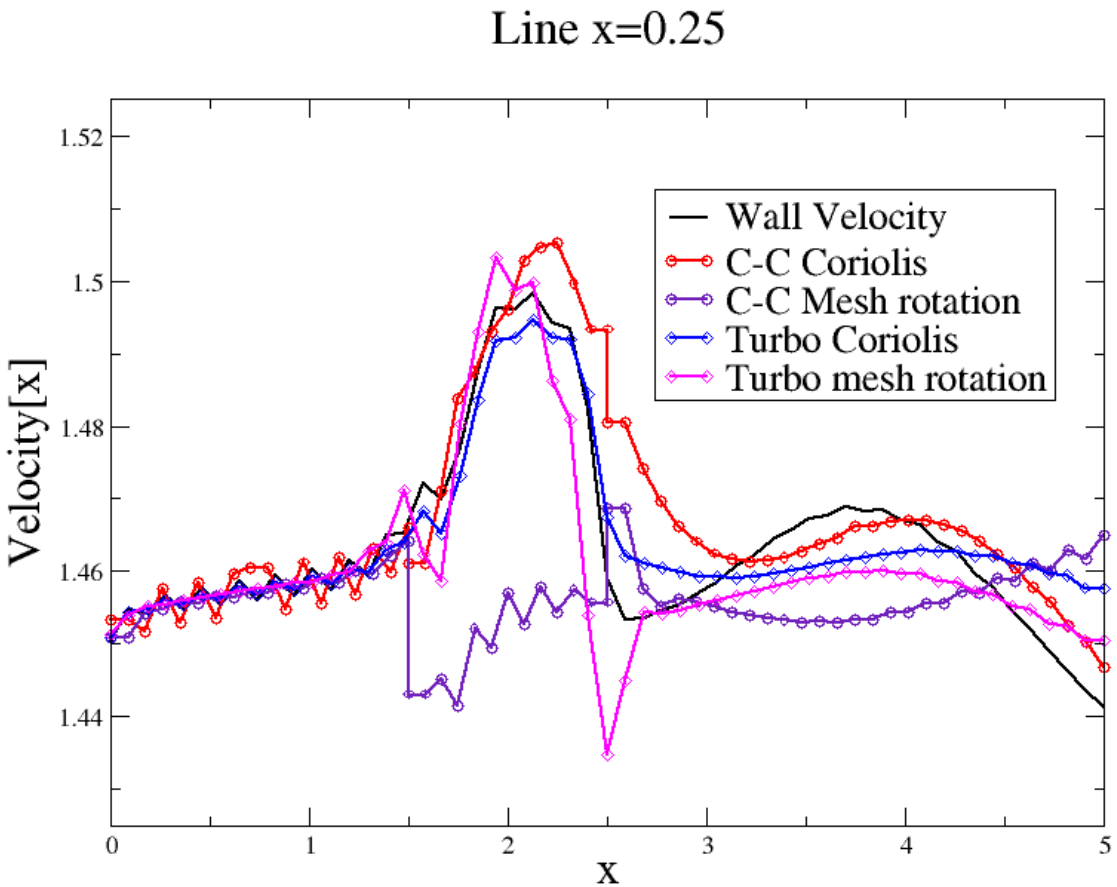

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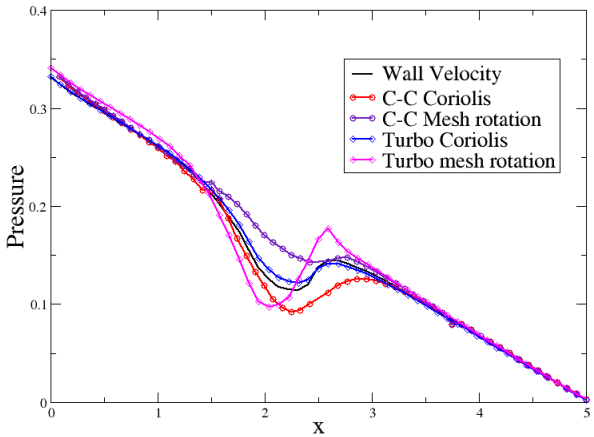

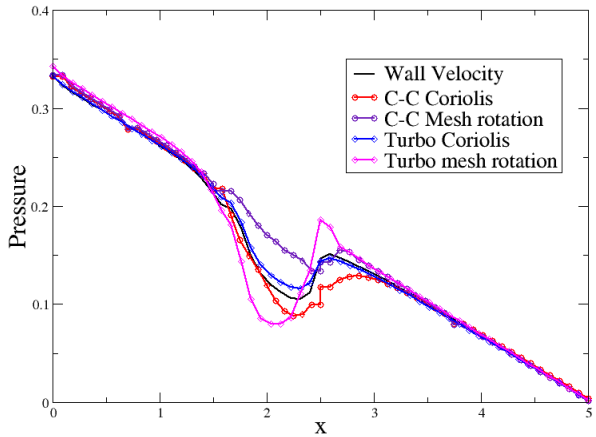

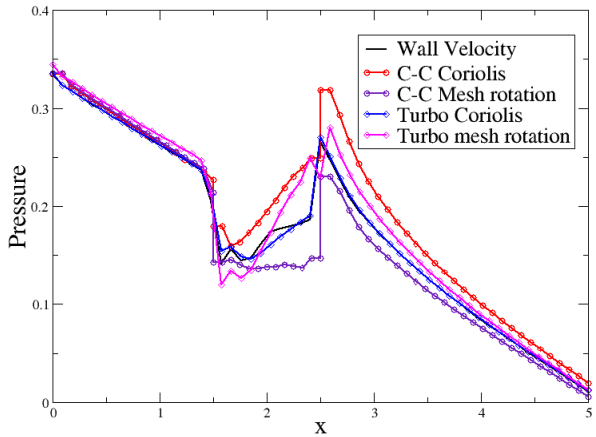

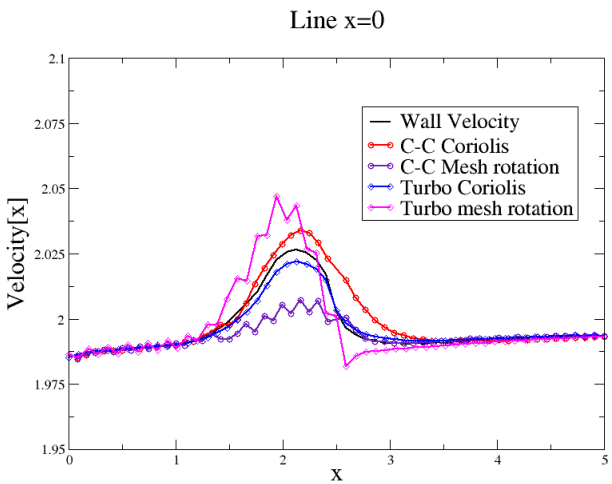

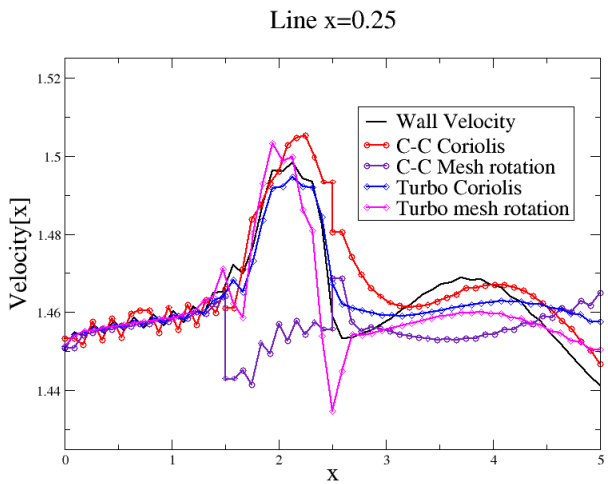

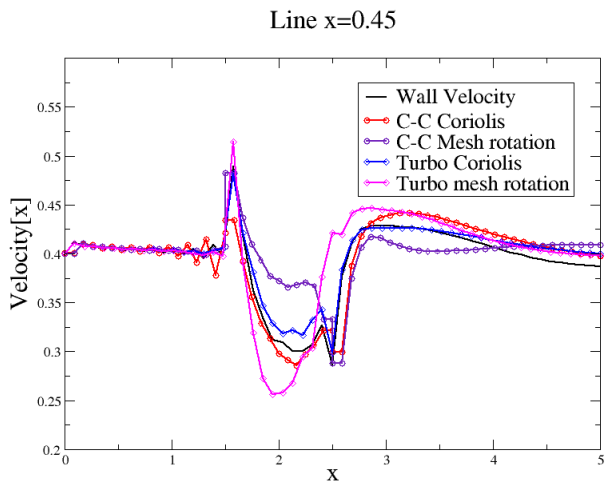

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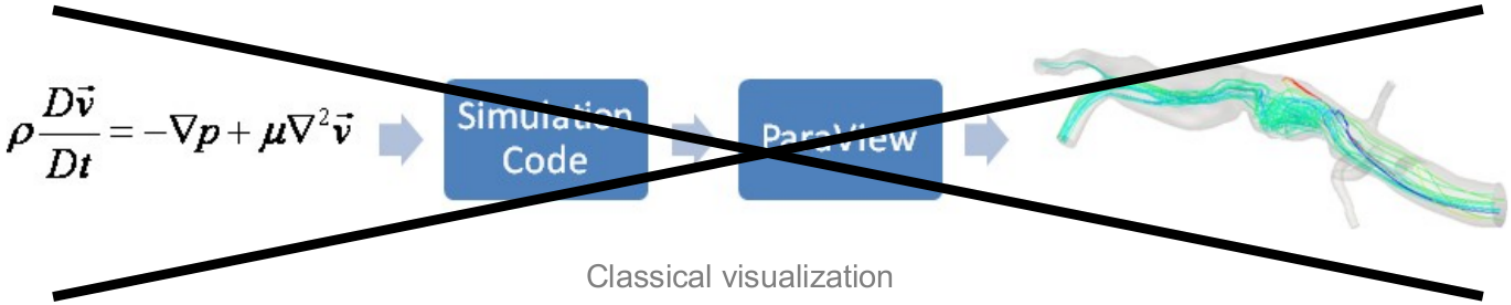
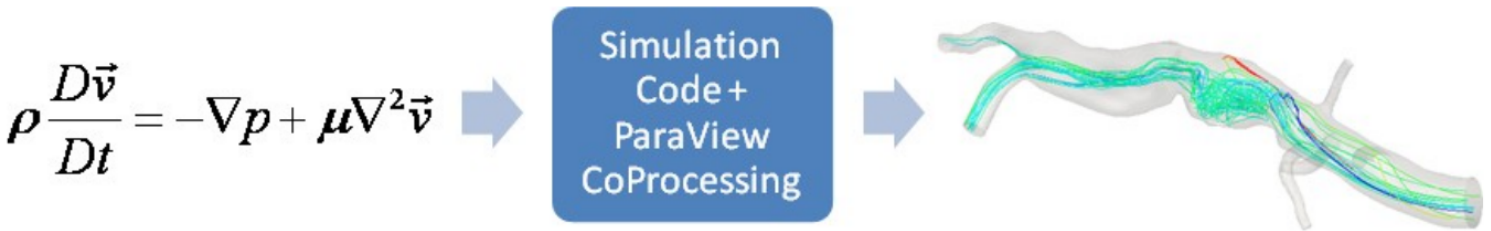
In-Situ Visualization



Classical visualization



In-situ or coprocessing visualization

Integration of Catalyst into Code_Saturne

- Tightly coupled solution
- Designed for tackling bad I/O performances
- Allows users to visualize their data at simulation-time

How to use it

Play the video

Advantages & Downsides

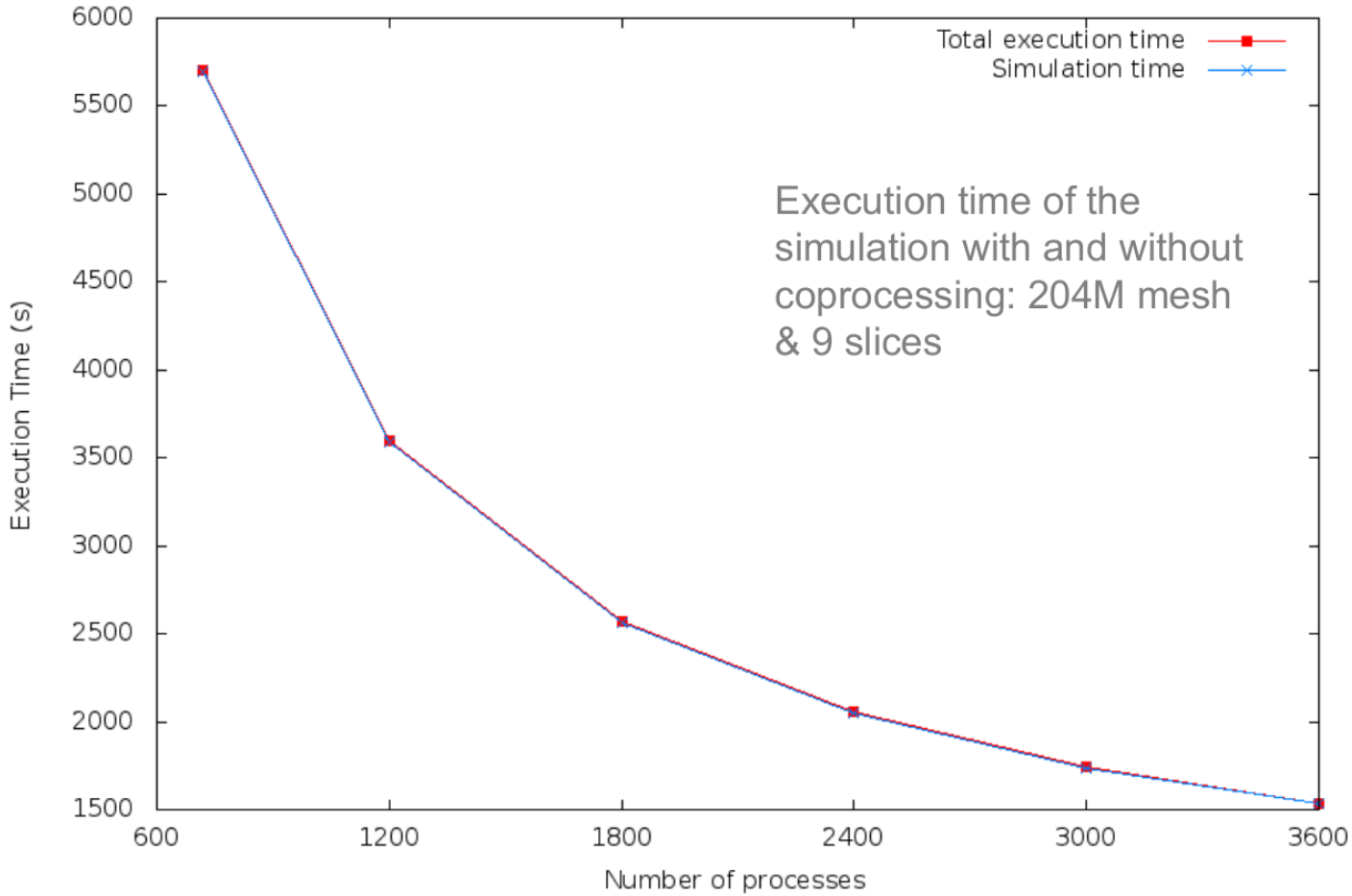
Advantages

- Faster simulation
- Video generation
- Reduction of data volume
- Visualize during simulation

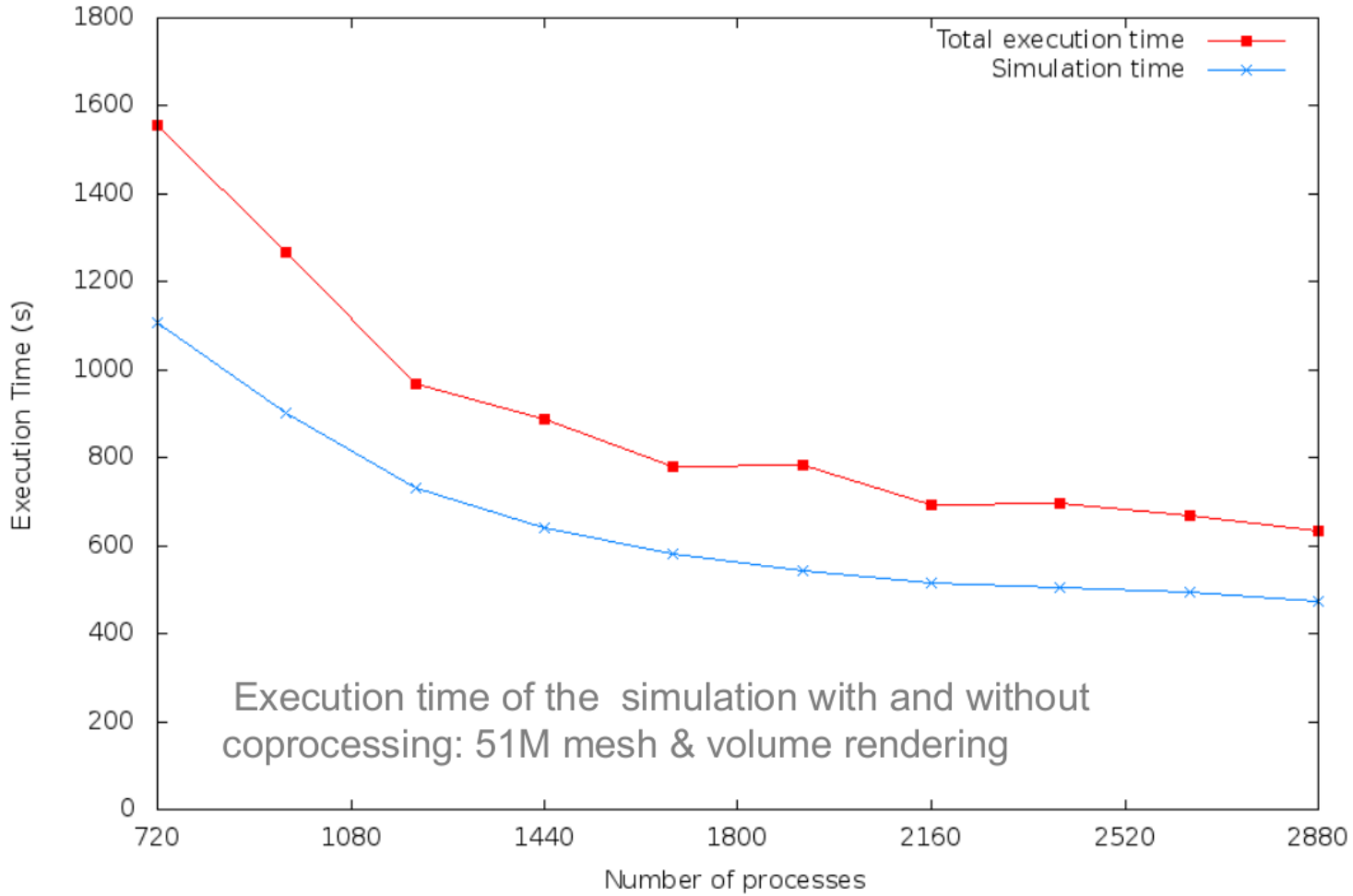
Downsides

- Not for exploration
- Limited Interactivity
- Memory usage

Performances on 200M

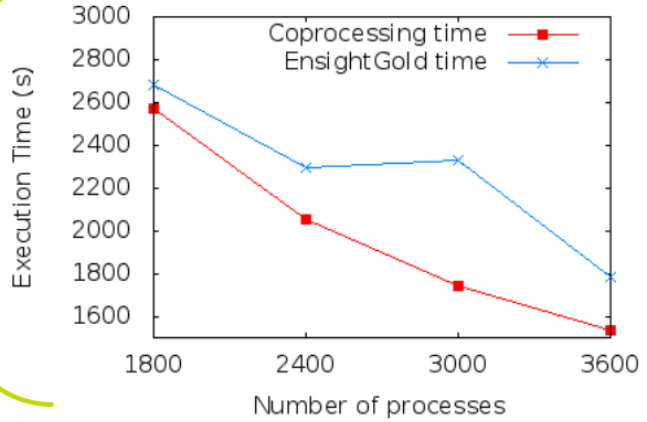


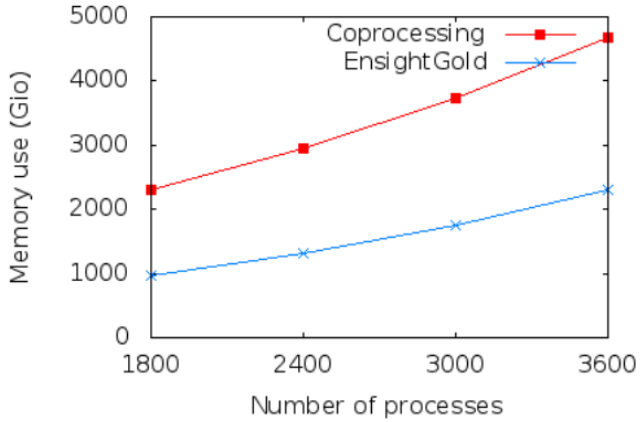
Performances on 50M



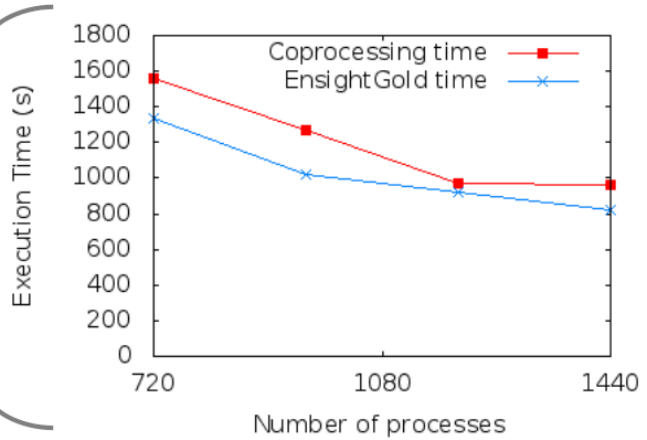
Comparison Charts

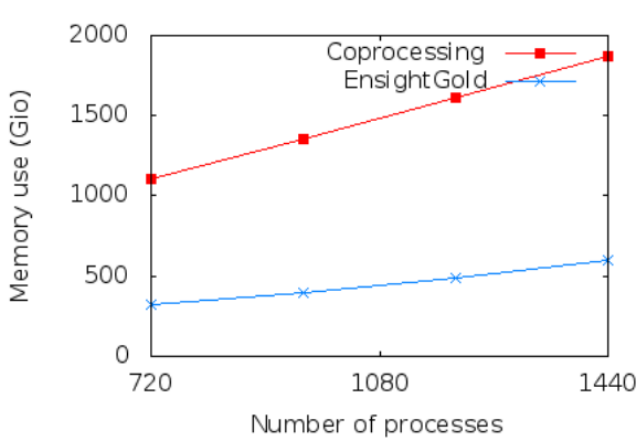
-Size: 204M
&
- 9 Slices





- Size: 51M
&
· Volume Rendering





Future Work

Integration of Catalyst into Code_Saturne

- Makes simulation and visualization works together
- runs a pre-defined VTK pipeline on the simulation data

- Scaling and processing time very satisfactory
- Memory management being optimized
- Further tests on BlueGene Q with 500 millions of hexaedrons
- Further tests on the Live Visualization