Reduced Order Modelling - Hands On Session

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Files available at:

`/work/demo-users/workshop-files/fluid_solver`

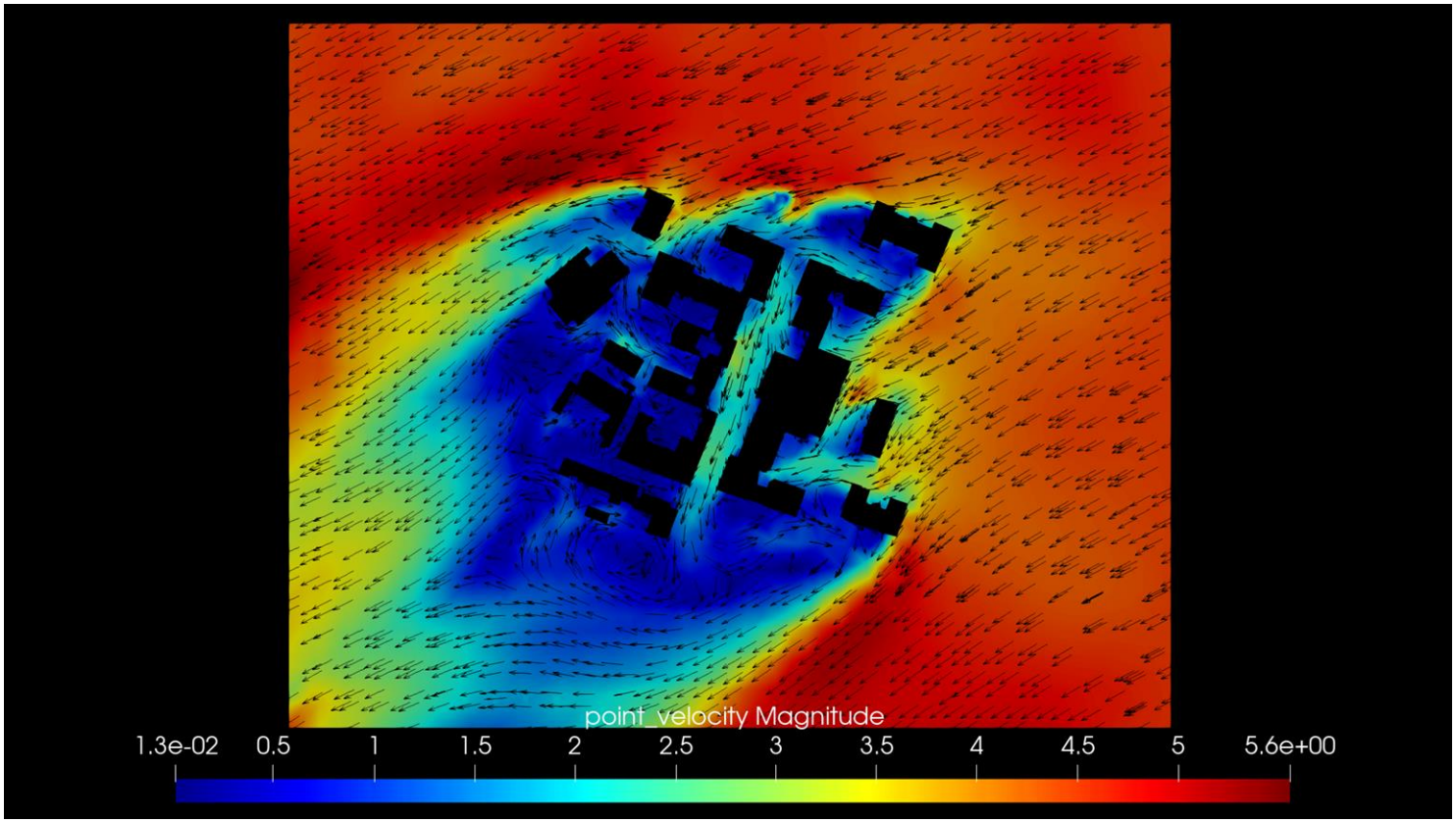
Session Outline

1. Running the full-order model simulations
2. Computing the SVD of **X**
3. Running the reduced-order simulations
4. Computing relative errors, between **FOM/ROM.**

I. Running the FOM-s

`inlet velocity: (-4, -2, 0), t=100s`

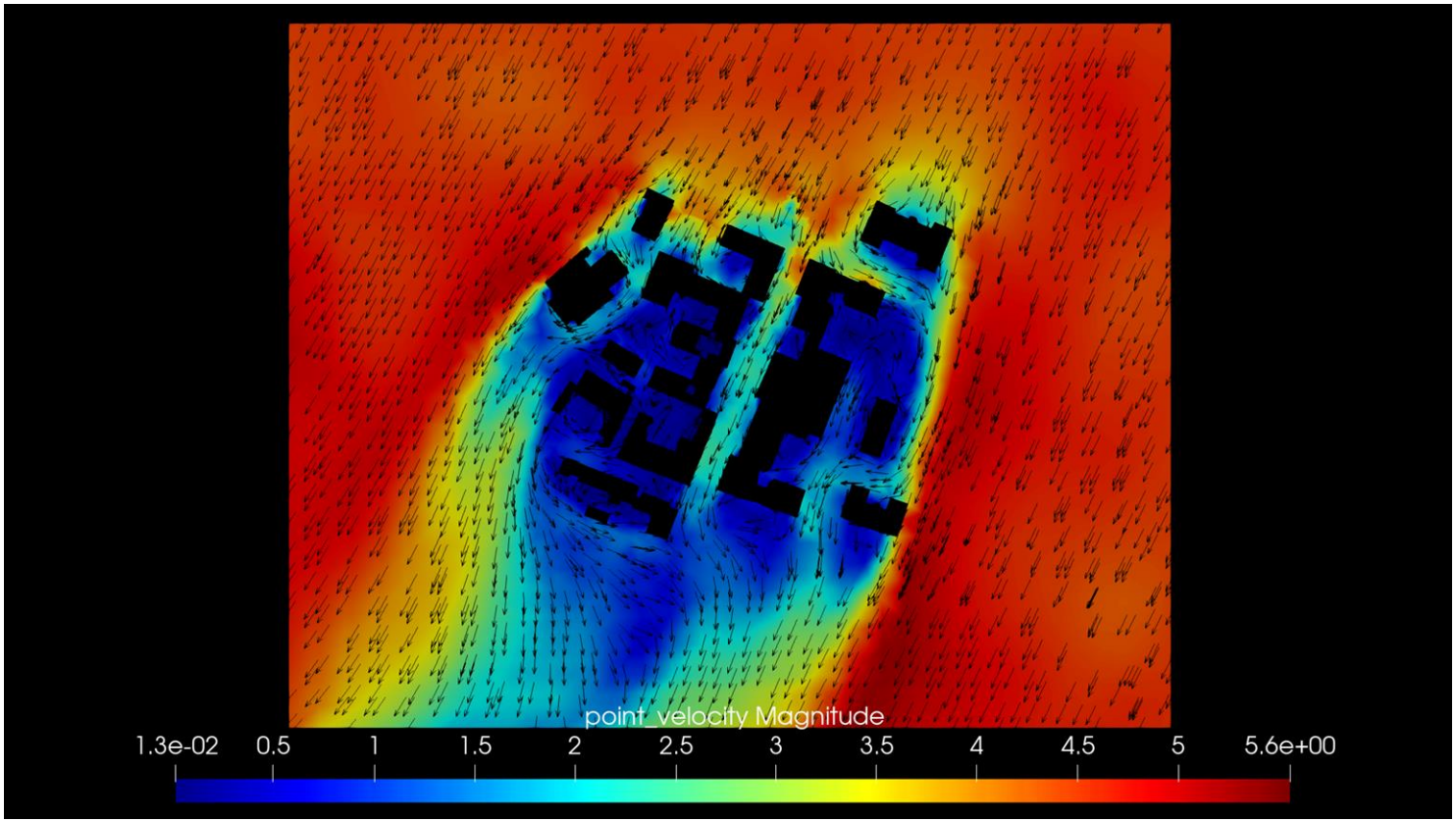
`./fluid_solver bologna_FOM_1.sim`



I. Running the FOM-s

`inlet velocity: (-2, -4, 0), t=100s`

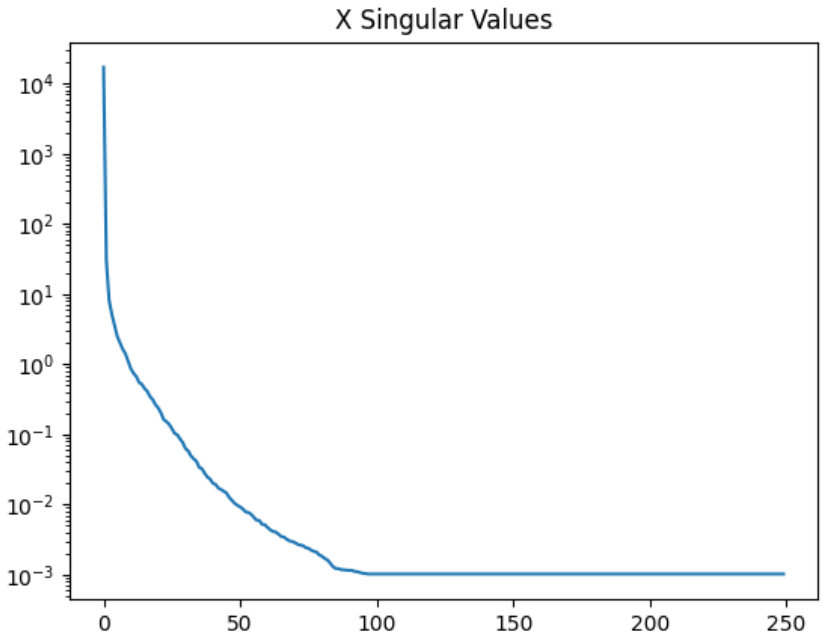
`./fluid_solver bologna_FOM_2.sim`



II. Configuring the SVD solver

Floating point precision matters!

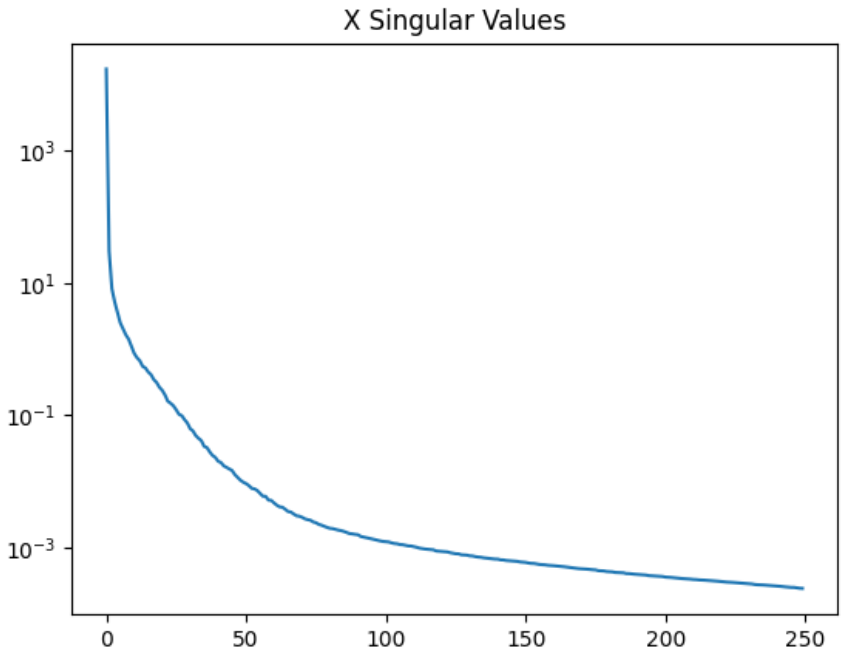
Singular values for np.float32



II. Configuring the SVD solver

Floating point precision matters!

Singular values for np.float64



II. Configuring the SVD solver

Different ways of computing the SVD:

- “QR” normalization: accurate but slow
- “LU” normalization: fast but prone to errors.
- none: pretty much never applicable in our case.

II. Configuring the SVD solver

M = 500

N = 190975

HPE2, strong CPU: 53s

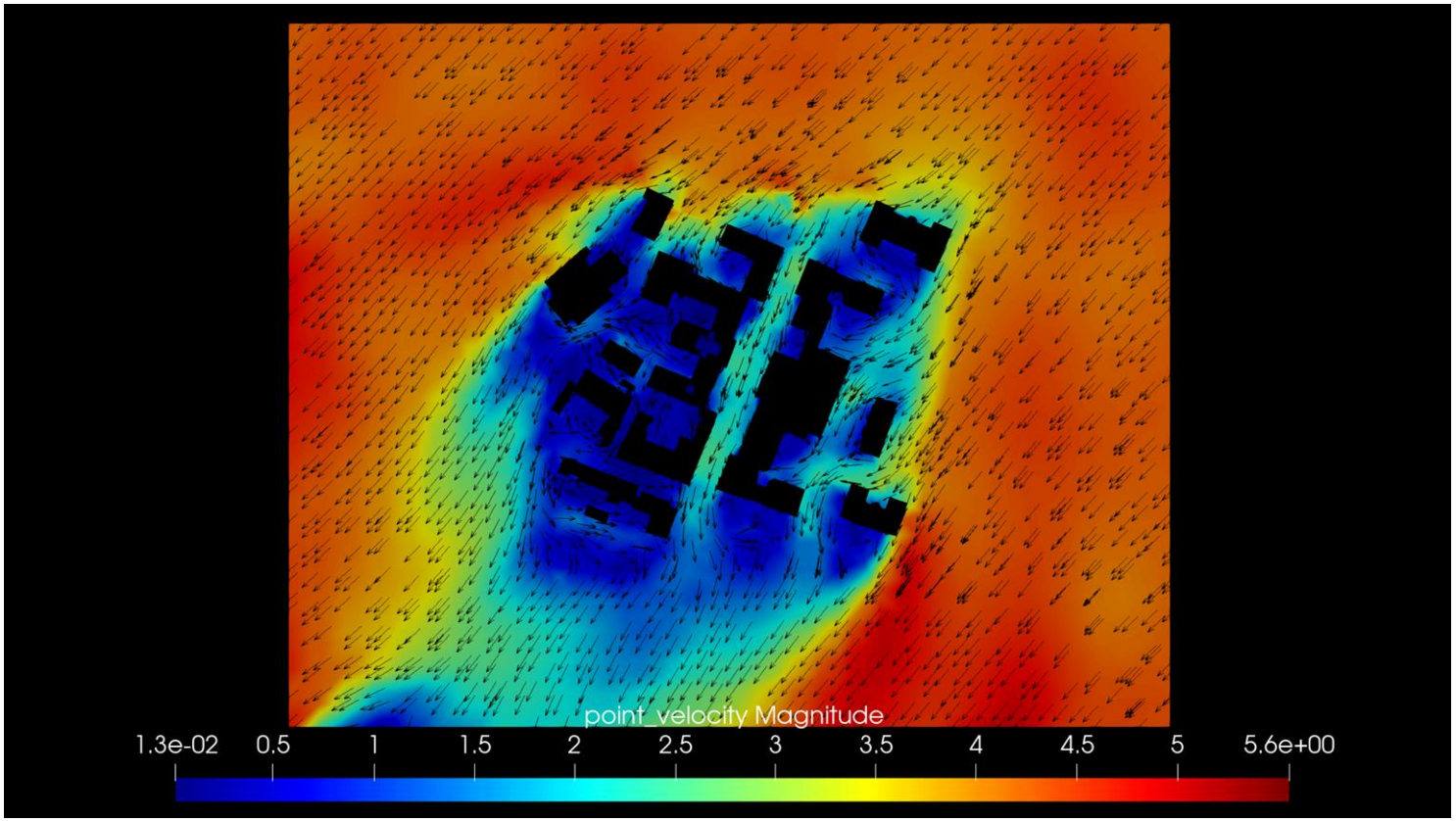
HPE2, A100 40GB (Nvidia Tesla GPU): 12s

Local Desktop: 5min

III. Running the ROM

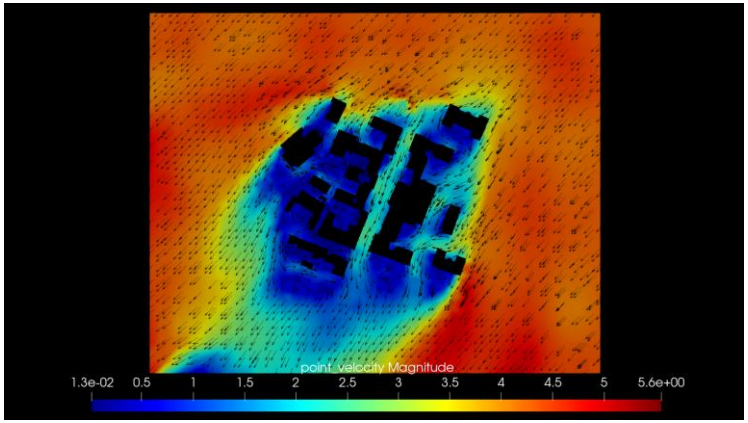
`inlet velocity: (-3, -3, 0), t=10s`

`./fluid_solver bologna_ROM.sim`

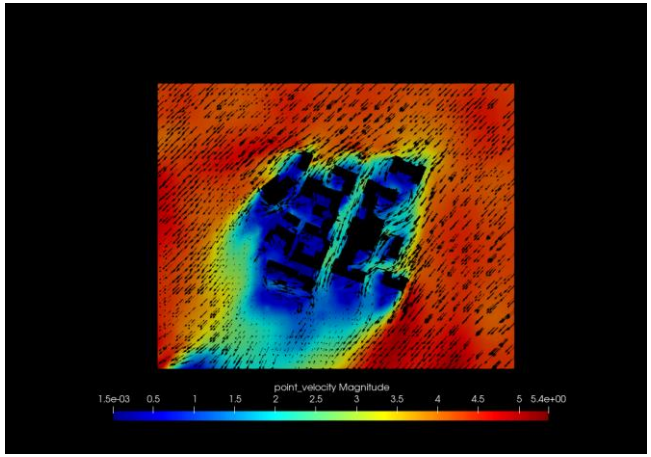


III. Comparing results

ROM, r=80; inlet (-3, -3, 0),t = 100s



FOM, (-3, -3, 0), t=100s



IV. Computing relative errors

$$|| X\_FOM - X\_ROM || = ?$$

$$|| X\_FOM - X\_ROM || / || X\_FOM || = ?$$