

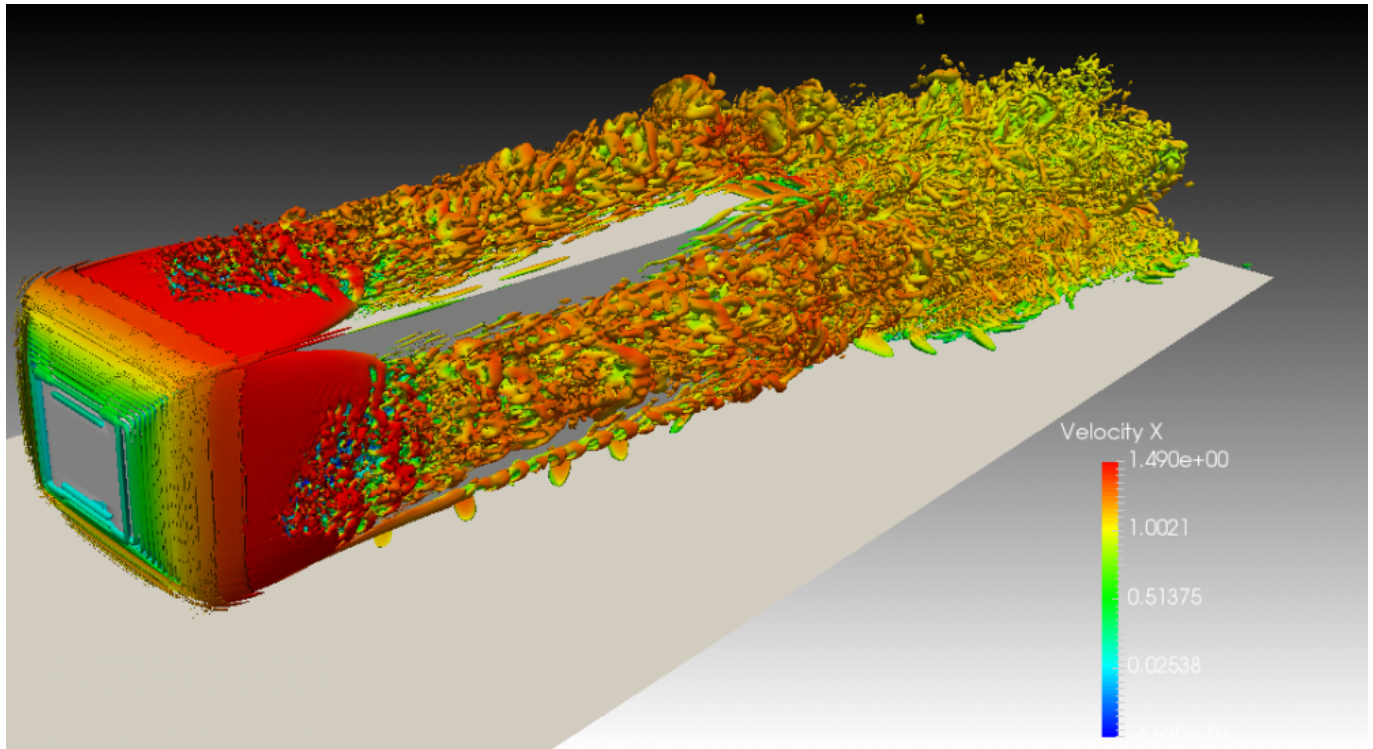
## 3D AHMED-BODY FLOW at \$Re\_H= 10000\$

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**Date** : July 2018

**Location** : DATABASE\_AHMEDBODY\_RE10000\_DNS

**Simulation type** : DNS ([Sunfluidh code](#))



[Videos are available here](#)

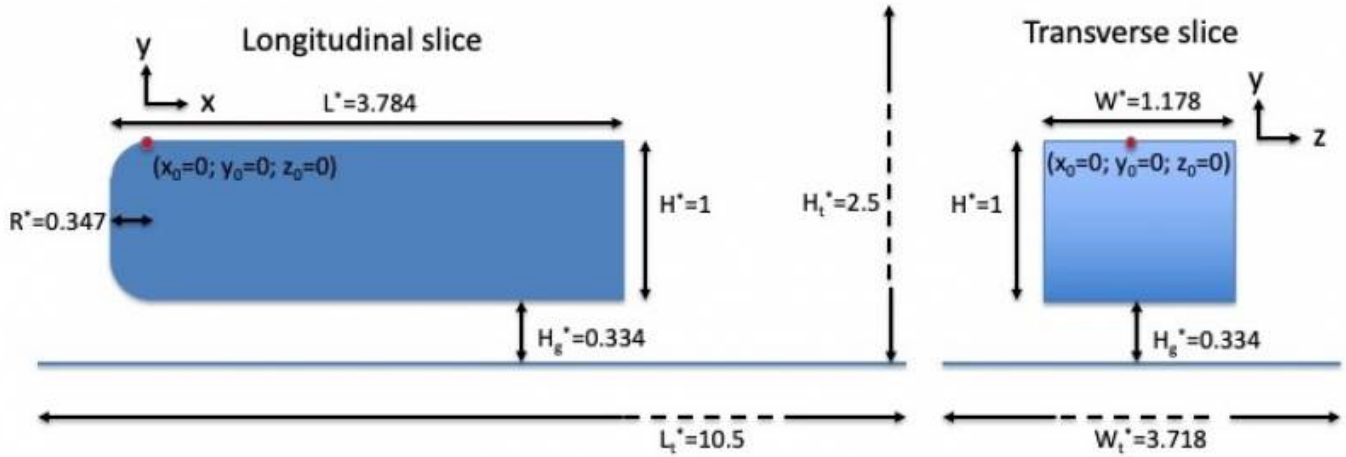
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### Simulation settings

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### 2D Sketch



## Referential : cartesian geometry

1. axes :
  - x : downstream direction
  - y : normal direction
  - z : spanwise direction
2. origin :
  - $x_0 = 0$  : upstream edge of Ahmed body top
  - $y_0 = 0$  : Ahmed body top
  - $z_0 = 0$  : mid-span of domain

## Reference scales

- Density : mass density of the fluid ( $\rho_0$ )
- Length : Ahmed body height ( $H$ )
- Velocity : inlet bulk velocity ( $U_0$ )
- Dynamic viscosity : dynamic viscosity of the fluid ( $\mu_0$ )
- Reynolds number :  $Re_H = \frac{\rho_0 \cdot U_0 \cdot H}{\mu_0} = 10000$

## Non-dimensionalised data

- velocity :  $U^* = \frac{U}{U_0}$
- density :  $\rho^* = \frac{\rho}{\rho_0} = 1$
- coordinates :  $x^* = \frac{x}{H}$ ,  $y^* = \frac{y}{H}$ ,  $z^* = \frac{z}{H}$

## Computational domain

1. **Domain scope**
  - Downstream direction(x) :  $L_t^* = 10.5$
  - Normal direction (y) :  $H_t^* = 2.5$
  - Spanwise direction (z) :  $W_t^* = 3.718$
  - Ahmed body size :  $L^* \times W^* \times H^* = 3.784 \times 1.178 \times 1$
  - Quarter rounded edges radius around the front face of the body :  $R^* = 0.347$

- Ground clearance :  $H_g^* = 0.334$

## 2. Boundary conditions

- Inlet : Uniform profil at  $X_{in}^* = -1.0$
- Outlet : Orlansky's type at  $X_{out}^* = 9.5$
- Wall conditions : Ahmed body, top and low walls of the domain
- Symmetry : lateral ends of the domain

## 3. Spatial resolution :

- Grid :  $512 \times 256 \times 256$  (33.554.432 cells)
- About cell-size
  - $\Delta x_{min}^* = 1 \times 10^{-1}$  quad  $\Delta x_{max}^* = 3.03588 \times 10^{-2}$  (downstream direction)
  - $\Delta y_{min}^* = 2 \times 10^{-3}$  quad  $\Delta y_{max}^* = 4.12564 \times 10^{-2}$  (normal direction)
  - $\Delta z_{min}^* = 2 \times 10^{-3}$  quad  $\Delta z_{max}^* = 4.59486 \times 10^{-2}$  (spanwise direction)

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## Data Recording : information about data types

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### • Time series from probes

- Physical quantities : velocity components along x, y and z directions (u,v,w) and pressure (p)
- 3 probes
- Time step =  $5.5 \times 10^{-3}$  time unit
- Time range : 71 to 303 and 343 to 353 time units
- Locations (In horizontal mid-plan of the body wake)
  - $X_i = 4.384$  ,  $X_j = -0.5$  ,  $X_k = 0.3$
  - $X_i = 4.384$  ,  $X_j = -0.5$  ,  $X_k = 0.0$
  - $X_i = 4.384$  ,  $X_j = -0.5$  ,  $X_k = -0.3$
- File name (per physical quantity):  $x\_ins\_00000.d$  with  $x = u, v, w, p$

### • 3D snapshots

- Instantaneous fields : velocity components along x,y and z directions (U,V,W) and pressure (P)
- Recording rate : 0.5 time unit
- Time range from from 185 to 638 time units
- File name :  $res\_xxxxx\_yyyyyyy.d$  (xxxxx : MPI subdomain ID, yyyyyyy : Time ID)
  - MPI subdomain ID = 0 (No domain decomposition)
  - Time ID : 178 to 1084

### • Statistics

- fields : (i,j : indexes of direction x, y or z)
  - Mean fields of velocity components ( $\langle U_i \rangle$ ) and pressure ( $\langle P \rangle$ )
  - Mean fields of quadratic quantities ( $\langle P^2 \rangle$ ,  $\langle U_i U_j \rangle$ )
- Time startup = 43 time units
- Time range per file = 10 time units
- Total time range from 43 to 633 time units

- file name : rst\_XXXXX\_yyyyyyy.d (XXXXX : MPI subdomain ID, yyyyyyy : Time ID)
  - MPI subdomain ID= 0 (No domain decomposition)
  - Time ID : 1 to 59

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## Database organisation

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**Data size** : ~ 609 Gb

**Main directory** :

/vol/DATABASE\_MECA/RESTRICTED\_ACCESS/DATABASE\_AHMEDBODY\_RE10000\_DNS

For more details about files, see the [wiki doc of Sunfluidh](#)

### Directories & files

```
/GRID : contains all files about grid setup
input data file      : data_meshgen.d
report on grid features : report_meshgen.d
grid files for sunfluidh: maillx.d, mailly.d, maillz.d
check files (ASCII)  : check_mesh_I.d, check_mesh_J.d, check_mesh_K.d
                    (3 columns : indices, cell-face coordinates,
cell size)
/DATASETUP          : it contains input data file for sunfluidh : input3d.dat
/TIMESERIES         : contains time series recorded from probes
  /TIMESERIES_T071-305 : from time= 71 to 303 time units
  /TIMESERIES_T343-533 : from time=343 to 533 time units
  /TIMESERIES_T533-638 : from time=533 to 638 time units
  ASCII files : x_ins_00000_full.d with x= u,v,w,p
  also contains the space-averaged kinetic energy
  from time=326 to 561 (time step : 2.55D-02)
  ASCII file : space_averaged_ke.d
/SNAPSHOTS         : snapshots binary files res_XXXXX_yyyyyyy.d
/STATISTICS        : statistics binary files rst_XXXXX_yyyyyyy.d
/RESTART_AR        : backup/restart archives save_t318.tar, save_t518.tar,
save_t638.tar
                    contains any file to resume the simulation at time = 318,
518 and 638 time units
/FROM_COMPUTATION  : regroup some directories and files related to the
simulation
/SLICES            : slices ... not documented (old study)
                    Binary files : plan_id_dir_XXXXX_yyyyyyy.d
                    (nn : slice ID, dir : orientation, XXXXX : MPI subdomain ID,
yyyyyyy : Time ID)
```

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