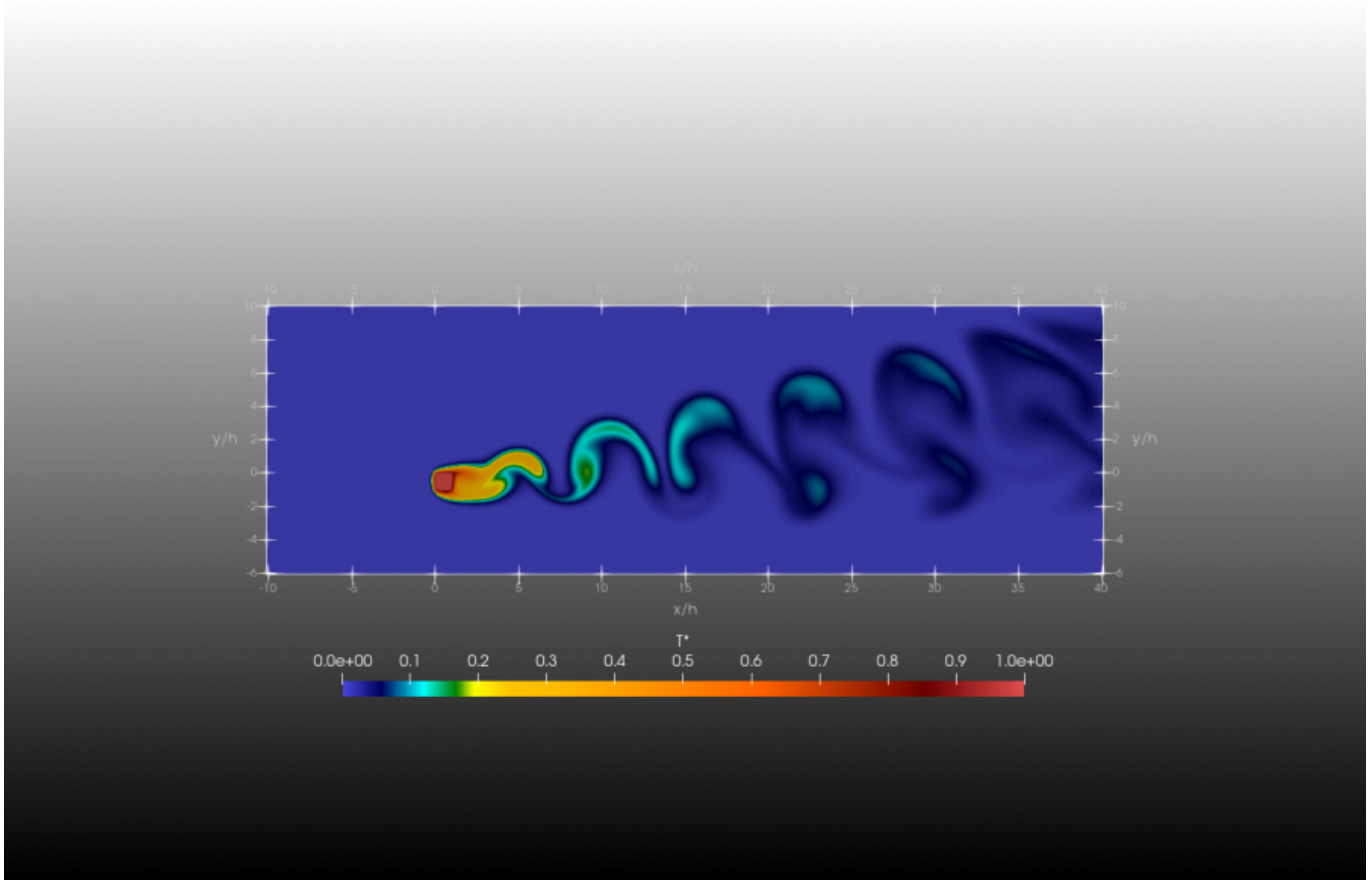
2D flow around a heated square-cylinder - $Re_{h}= 50$, $Ra= 5\; 10^6$

A heated square-cylinder is placed in a channel flow

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Date : June 2019
Simulation type : DNS (Sunfluidh code)
Location : /DATABASE_2DFLOW_AROUND_HEATED_SQUARECYLINDER_DNS
Status : Free access
Data size : ~ 3 Gb

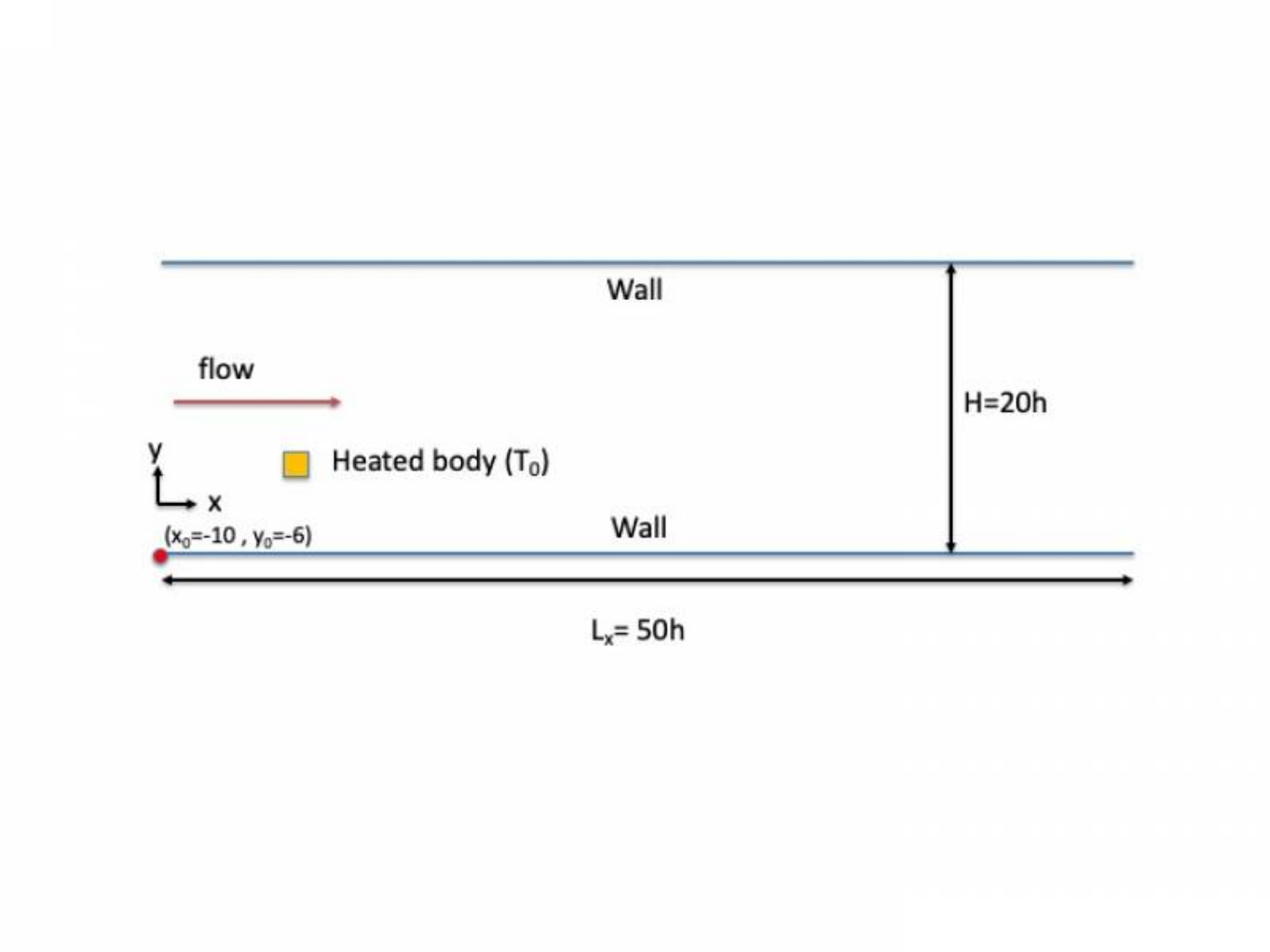


A video is available here

Come back to first page

Simulation settings

2D sketch



Referential : cartesian geometry

1. axes :
    - x(i) : downstream direction
    - y(j) : normal direction
2. origin : lower left corner of the computational domain
    - $x_0= 10h$
    - $y_0= -6h$

Reference scales

- Density : mass density of the fluid (ρ_0)
- Lengths : cylinder size (h) and $H_u= 10h$ the distance between the domain's top and the square-cylinder's top.
- Velocity : velocity at inlet (U_0)
- Dynamic viscosity : dynamic viscosity of the fluid (μ_0)
- thermal diffusivity : (κ_0)

- Reynolds number : $Re_H= \frac{\rho_0.U_0.h}{\mu_0}= 50$
- Rayleigh number : $Ra= \frac{\rho_0.\beta.g\Delta T.H_u^3}{\mu_0 \kappa_0}= 5\;10^6$

Non-dimensionalised data

- velocity : $U^*=\frac{U}{U_0}$
- density : $\rho^*= \rho/\rho_0= 1$
- coordinates : $x*=\frac{x}{h}$, $y^*=\frac{y}{h}$
- temperature : $T^*=\frac{T-T_c}{T_h-T_c}$ (T_h and T_w are respectively the temperature imposed at the cylender's walls and the temperature at the inlet and channel's walls)

Computational domain

1. **Domain scope**
    1. computational domain size (channel flow)
        - Downstream direction(x) : $L_x^*= 50.0$ (upward part $L_u= -10$, downward part $L_d=40$)
        - Normal direction (y) : $L_y^*= 20.0$
    2. heated square cylinder
        - size: $h^*= 1$
        - temperature T_h^*= 1

1. **Boundary conditions**
    - Inlet : imposed pressure uniform velocity ($U_0=1$)
    - Outlet : Orlansky type
    - Bottom and top conditions : walls at (T_c^*=0)
2. **Spatial resolution**
    - mesh size : $512 \times 256 $ (131.072 cells)
    - About cell-size
        - $\Delta x*$: from 0.03125 to 0.723 (downstream direction)
        - $\Delta y*$: from 0.03125 to 0.187 (normal direction)

Come back to first page

Data features

- **Time series**
    - from probes
        - Physical quantities : velocity components along x and y directions (u,v) and pressure (p)
        - 1 probe
        - Time step= $2 \,10^{-2}$ time unit
        - Time range : 400 to 600 time units
        - Location : Xi= 3.5 , Xj=0.0
        - File name (per physical quantity): x_ins_00000.d with x= u,v,p

    - about cylinder motion
        - center position as a function of time (ASCII file ibm_position01.dat)
        - cylinder velocity as a function of time (ASCII file ibm_velocity01.dat)
        - global force components applied to the cylinder (ASCII file ibm_force01.dat)
        - force contributions exerted on the moving cylinder (ASCII file ibm_force_contribution01.dat, the four last columns can be ignored)

- **3D snapshots**
    - Instantaneous fields : velocity components in x, y and z directions (U,V), the pressure (P) and the phase function related to the body motion (TRACE)
    - Recording rate : 0.4 time unit
    - Time range from from 200.0 to 600.0 time units
    - File name : res_xxxxx_yyyyyyy.d
        - MPI subdomain ID: 0
        - Time ID : from 3 to 502

Come back to first page

Database organisation

Data size : ~ 7 Gb
Main directory : /vol/DATABASE_MECA/DATABASE_2DFLOW_AROUND_OSCILLATING_CYLINDER_DNS
For more details about files, see the wiki doc of Sunfluidh

Intermediate directories (four cases of study)

- $St= 0.95$ and $A= 0.2$ - directory : CAS_F0.95_A0.2
- $St= 0.95$ and $A= 0.5$ - directory : CAS_F0.95_A0.5
- $St= 1.20$ and $A= 0.2$ - directory : CAS_F1.2_A0.2
- $St= 1.20$ and $A= 0.5$ - directory : CAS_F1.2_A0.5

Endpoint directories & files

```
  /DATASETUP       : ASCII files
                     input data file for sunfluidh : input3d.dat
  /GRID            : ASCII files
                     input data file         : data_meshgen.d
                     grid files for sunfluidh: maillx.d, mailly.d, maillz.d
  /SNAPSHOTS       : snapshots binary files res_xxxxx_yyyyyyy.d
  /TIMESERIES      : ASCII files
                     u_ins_00000.d , v_ins_00000.d and p_ins_00000.d
(timeseries of the velocity components and pressure from probe)
                     ibm_position01.dat, ibm_velocity01.dat (about cylinder
motion)
                     ibm_force01.dat, ibm_force_contribution01.dat (about
forces exerted on the cylinder)
```

Come back to first page

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Last update: **2021/12/15 12:17**