

## 2D flow around an oscillating cylinder - $Re_H = 185$



Numerical study based on the publication of Pham et al., Journal of Marine Science and Technology, Vol. 18, No. 3, pp. 361-368 (2010)  
The motion of the cylinder is vertical and forced with a sinusoidal function

**Author** : Y. Fraigneau CNRS-LIMSI (yann.fraigneau@limsi.fr)

**Date** : July 2016

**Location** : /DATABASE\_2DFLOW\_AROUND\_OSCILLATING\_CYLINDER\_DNS

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



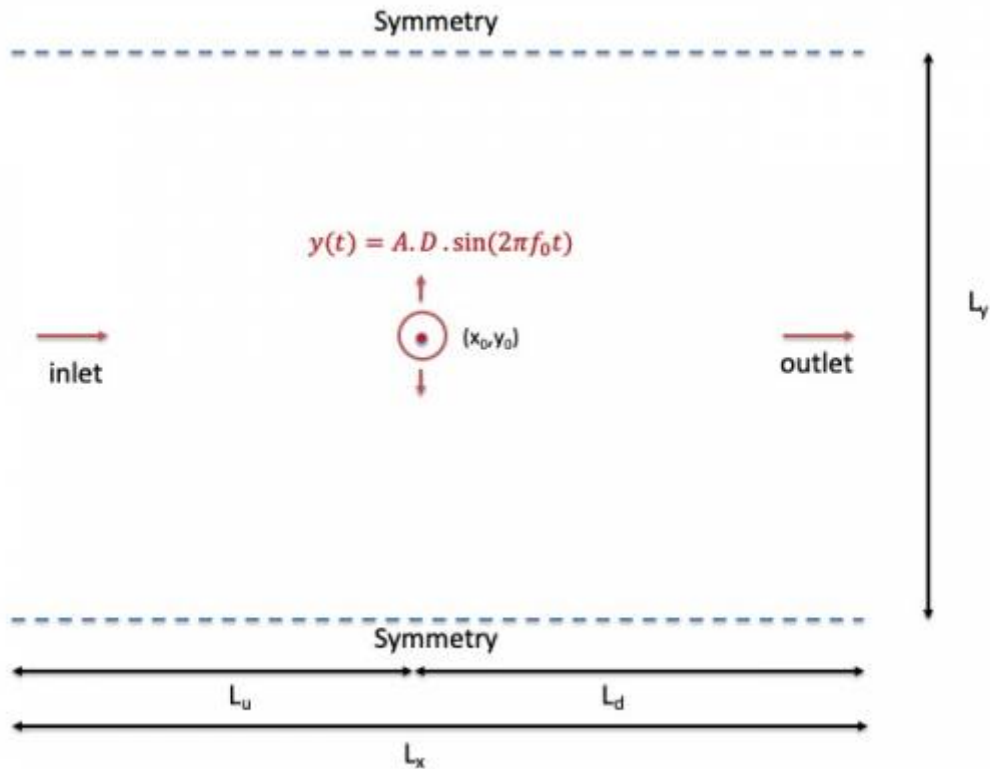
[Come back to first page](#)

---

### Simulation settings

---

### 2D sketch



## Referential : cartesian geometry

1. axes :
  - $x(i)$  : downstream direction
  - $y(j)$  : normal direction
2. origin :
  - $x_0 = 0$  : centre of cylinder body
  - $y_0 = 0$  : mid-height

## Reference scales

- Density : mass density of the fluid ( $\rho_0$ )
- Length : cylinder diameter ( $D$ )
- Velocity : velocity at inlet ( $U_0$ )
- Dynamic viscosity : dynamic viscosity of the fluid ( $\mu_0$ )
- Reynolds number :  $Re_H = \frac{\rho_0 \cdot U_0 \cdot D}{\mu_0} = 185$
- Strouhal number :  $St_0 = \frac{f}{f_0}$  (oscillating-cylinder frequency  $f$  over vortex-shedding frequency  $f_0$  when the cylinder is at rest)
- motion magnitude :  $A$

## Non-dimensionalised data

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

## Computational domain

### 1. Domain scope

1. computational domain size
  - Downstream direction(x) :  $L_x^* = 90.0$  (upward part  $L_u = 40$ , downward part  $L_d = 50$ )
  - Normal direction (y) :  $L_y^* = 80.0$
2. Oscillating cylinder (vertical oscillating motion around the mid-height of the domain)
  - centre position at rest :  $x_c = 0.0$  and  $y_c = 0.0$
  - diameter:  $D = 1$
  - oscillation frequency :  $St = 0.95$  or  $St = 1.2$
  - The cylinder is modeled with a pseudo-penalisation method (Pasquetti et al., Applied Numerical Mathematics, 2008)

### 2. Boundary conditions

- Inlet : imposed pressure uniform velocity ( $U_0 = 1$ )
- Outlet : Orlansky type
- ends condition : symmetry

### 3. Spatial resolution

- mesh size :  $480 \times 480$  (576.000 cells)
- About cell-size
  - $\Delta x^*$  : from  $0.0125$  to  $0.78785$  (downstream direction)
  - $\Delta y^*$  : from  $0.0125$  to  $0.65924$  (normal direction)

[Come back to first page](#)

---

## Data Recording : information about data types

---

### • Time series

- from probes
  - Physical quantities : velocity components along x and y directions (u,v) and pressure (p)
  - 1 probe
  - Time step =  $2 \cdot 10^{-2}$  time unit
  - Time range : 400 to 600 time units
  - Location :  $X_i = 3.5$ ,  $X_j = 0.0$
  - 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** : ~ 24 Go

**Main directory** : /vol/DATABASE\_MECA/DATABASE\_2DFLOW\_AROUND\_OSCILLATING\_CYLINDER\_DNS

For more details about files, see the [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= 0.2\$ - directory : CAS\_F0.95\_A0.5
- \$St= 1.20\$ and \$A= 0.2\$ - directory : CAS\_F1.2\_A0.2
- \$St= 1.20\$ and \$A= 0.2\$ - 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](#)

From:

<https://datasetmeca.lisn.upsaclay.fr/> - **CFD DATABASE**

Permanent link:

<https://datasetmeca.lisn.upsaclay.fr/doku.php?id=datasetmeca:flow2dpastosccylinder1&rev=1605718861>

Last update: **2020/11/18 18:01**

