

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

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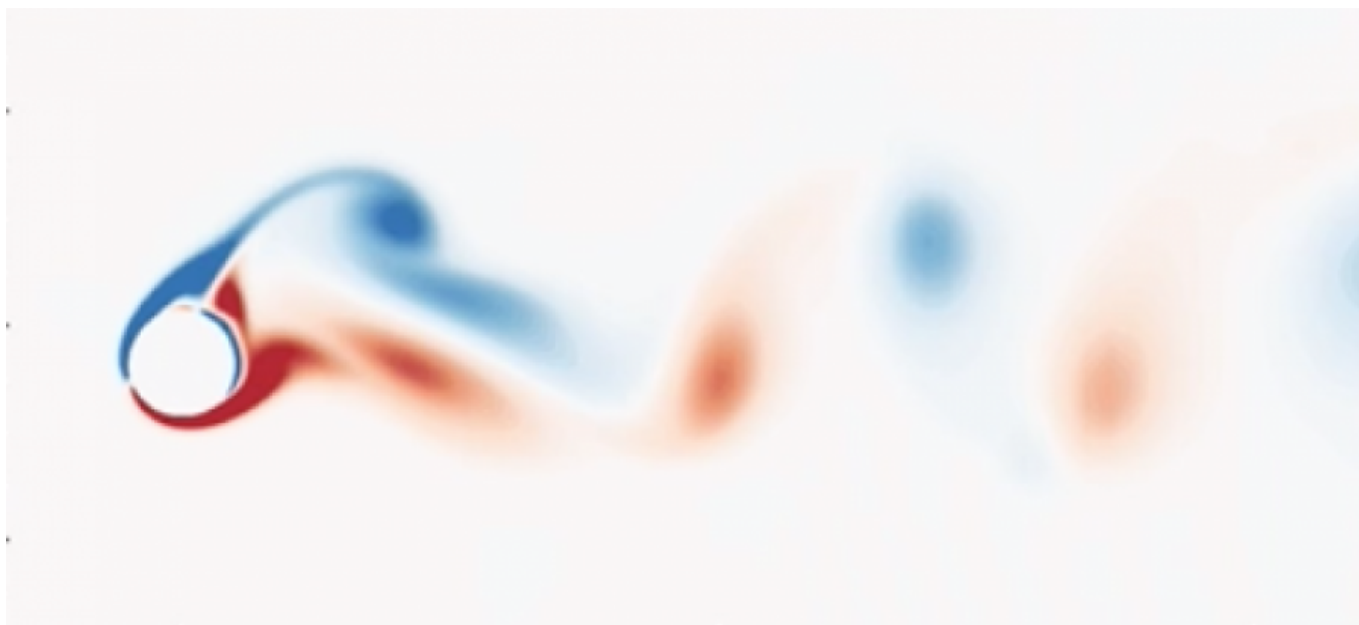
Date : July 2016

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

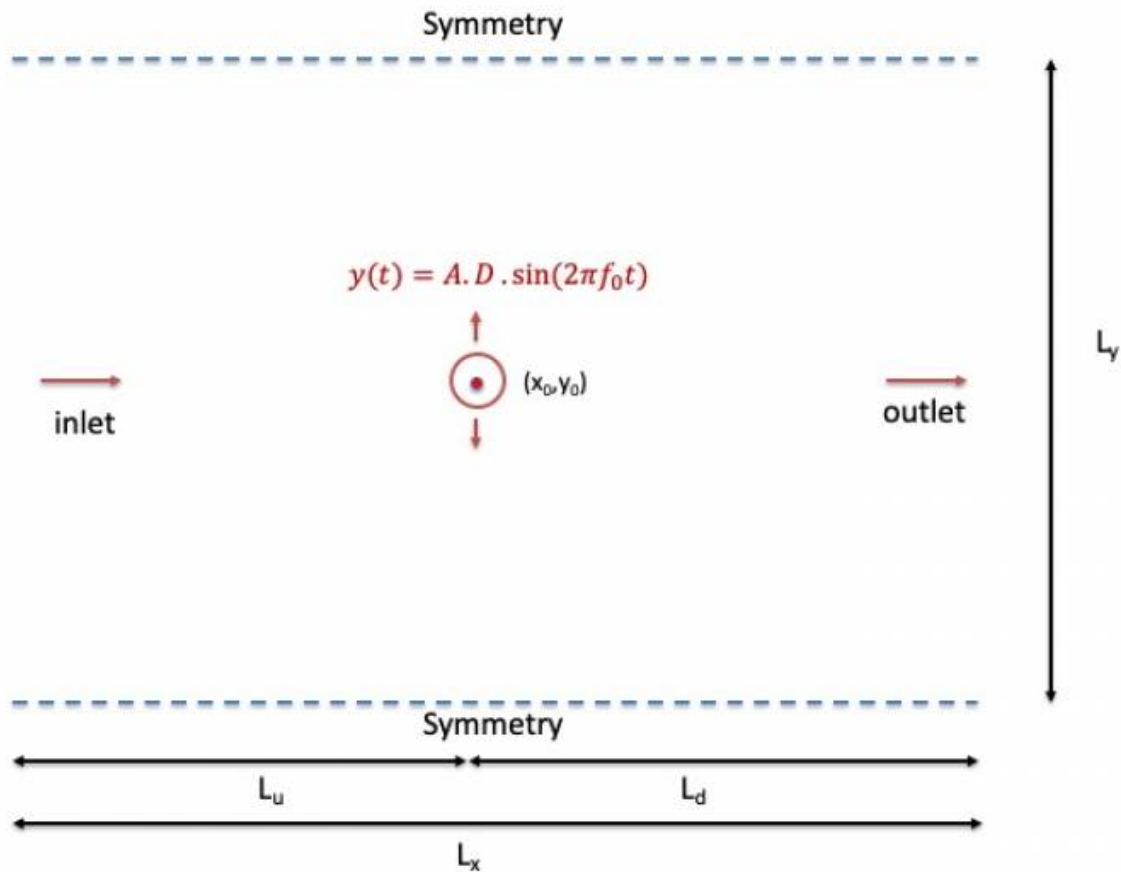
Location : /DATABASE_2DFLOW_AROUND_OSCILLATING_CYLINDER_DNS

Status : Free access for laboratory members, on request for external members

Data size : ~ 7 Gb



[A video is available here](#) [Come back to first page](#) --- ===== Simulation settings ===== --- ===== 2D sketch =====



=== Referential : cartesian geometry === - axes : * $x(i)$: downstream direction * $y(j)$: normal direction - origin : * $x_0 = 0$: centre of the cylinder * $y_0 = 0$: mid-height === Reference scales === * Density : mass density of the fluid (ρ_0) * Length : cylinder diameter (D) * Velocity : velocity at inlet (U_0) * Dynamic viscosity : dynamic viscosity of the fluid (μ_0) * Reynolds number : $Re_H = \frac{\rho_0 U_0 D}{\mu_0} = 185$ * 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 : $A \times D$ (where A is the motion factor) === 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 === - Domain scope - **computational domain size** * **Downstream direction(x) : $L_x^* = 90.0$ (upward part $L_u = 40$, downward part $L_d = 50$)** * **Normal direction (y) : $L_y^* = 80.0$** - **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)** - Boundary conditions * **Inlet : imposed pressure uniform velocity ($U_0 = 1$)** * **Outlet : Orlansky type** * **Bottom and top conditions : symmetry** - Spatial resolution * **mesh size : 480×480 (576.000 cells)** * **About cell-size * Δx^* : from 0.0125 to 0.78785 (downstream direction) * Δy^* : from 0.0125 to 0.65924 (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 : $X_i = 3.5$, $X_j = 0.0$** * **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 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

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/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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