

3D planar jet through oscillating bodies at $Re_H = 1000$



The motion of bodies is vertical and forced with a sinusoidal function
Three different frequencies are considered

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Date : April 2019

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

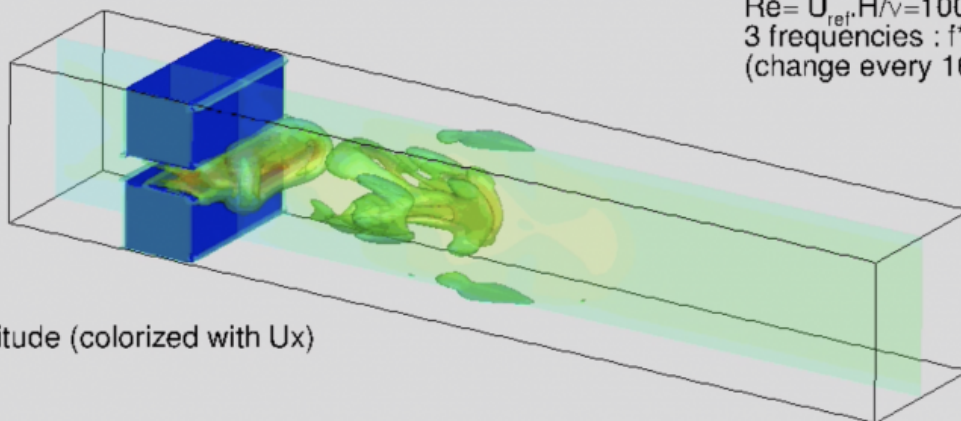
Location : DATABASE_JET_TROUGH_OSCILLATING_BODIES_DNS

Status : Free access

Data size : ~ 2.3 Gb

flow through oscillating bodies

$Re = U_{ref} H / \nu = 1000$
3 frequencies : $f^* = 0.25, 0.5, 1$
(change every 16 time units)



vorticity magnitude (colorized with U_x)
3/4 front view

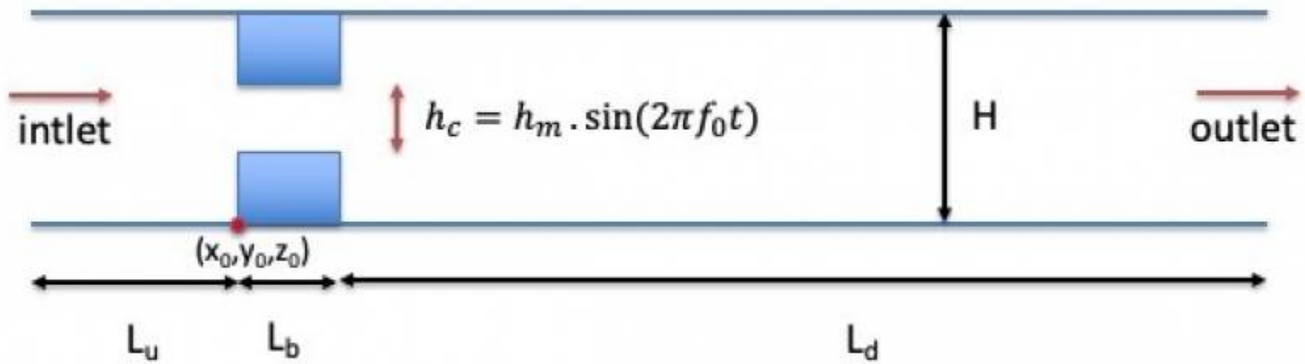
$t^* = t \cdot U_{ref} / H = 8.103$

[A video is available here](#)

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Simulation settings

2D sketch



Referential : cartesian geometry

1. axes :

- $x(i)$: downstream direction
- $y(j)$: normal direction
- $z(k)$: spanwise direction

2. origin :

- $x_0 = 0$: upstream edge of the oscillating bodies
- $y_0 = 0$: lower horizontal wall of the duct
- $z_0 = 0$: left vertical wall of the duct

Reference scales

- Density : mass density of the fluid (ρ_0)
- Length : duct height (H)
- Pressure : pressure variation between inlet and outlet, respectively ($\Delta P_0 = P_i - P_o$)
- Velocity : velocity scale ($U_0 = \sqrt{\frac{P_i - P_o}{\rho_0}}$)
- Dynamic viscosity : dynamic viscosity of the fluid (μ_0)
- Body oscillation frequency : f_0 , 3 frequencies are considered over the time range of the simulation ($f_0 = 0.25$, $f_0 = 0.50$, $f_0 = 1.0$)
- Reynolds number : $Re_H = \frac{\rho_0 \cdot U_0 \cdot H}{\mu_0} = 1000$
- Strouhal number : $St_0 = \frac{H \cdot f_0}{U_i}$

Non-dimensionalised data

- velocity : $U^* = \frac{U}{U_0}$
- pressure : $P^* = \frac{P}{\Delta P_0}$
- 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

1. Duct

- Downstream direction (x) : $L^* = 6.0$ (upward duct $L_u = 1$, downward duct $L_d = 4.5$)

- Normal direction (y) : $H^* = 1.0$
- Spanwise direction (z) : $L^* = 1.0$
- 2. Oscillating bodies (couple of parallelepiped bodies oscillating vertically in opposite phase)
 - Upstream edge position : $x_1 = x_2 = 0.0$
 - length (x): $L_b = 0.5$
 - height (y): Body's heights vary in regard to time t in such a way the clearance h_c between bodies evolves as $h_c = h_m \sin(2\pi f_0 t)$
 - width (z) : $L_z = 1.0$
 - bodies are modeled with a pseudo-penalisation method (Pasquetti et al., Applied Numerical Mathematics, 2008)

2. Boundary conditions

- Inlet : imposed pressure condition ($P_i = 1$)
- Outlet : imposed pressure condition ($P_o = 0$)
- Wall conditions : usual no-slip conditions on walls

1. Spatial resolution

- Regular grid : $180 \times 80 \times 40$ (576.000 cells)
- About cell-size
 - $\Delta x = 0.0333$ (downstream direction)
 - $\Delta y = 0.0125$ (normal direction)
 - $\Delta z = 0.0250$ (spanwise direction)

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Data features

- **3D snapshots**
 - Instantaneous fields : velocity components in x, y and z directions (U,V,W), the pressure (P) and the phase function related to the body motions (TRACE)
 - Recording rate : 0.05 time unit
 - Time range from from 0.0 to 100.0 time units
 - File name : res_XXXXX_YYYYYYY.d
 - MPI subdomain ID: 0
 - Time ID : from 1 to 2000

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Database organisation

Data size : ~ 2.3 Gb

Main directory : /vol/DATABASE_MECA/DATABASE_JET_TROUGH_OSCILLATING_BODIES_DNS

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

Directories & files

```
/DATASETUP      : ASCII files  
  input data file for sunfluidh : input3d.dat  
/SNAPSHOTS     : snapshots binary files res_XXXXX_yyyyyyy.d
```

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Last update: **2021/12/15 17:19**

