

3D turbulent channel flow at $Re_{\tau} = 590$

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

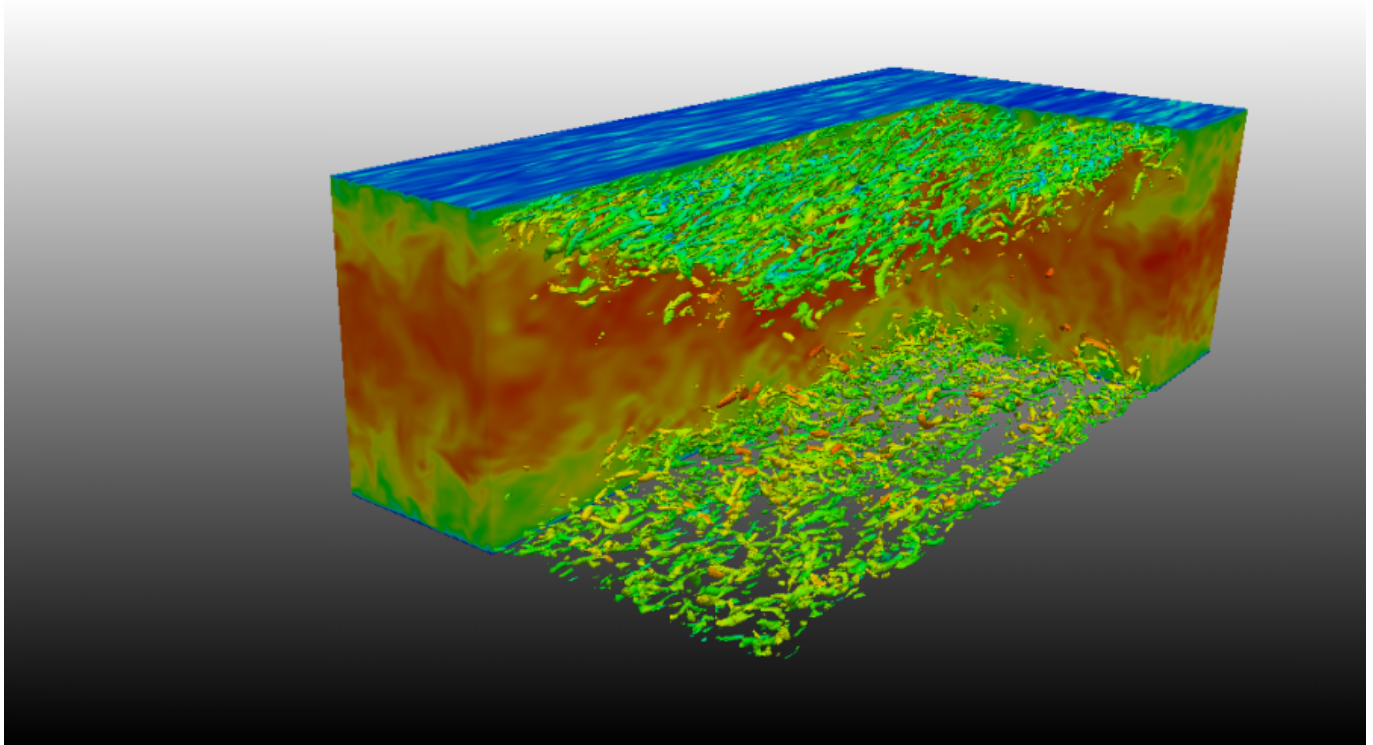
Date : May 2017

Simulation type : LES, Mansour's model ([Sunfluidh code](#))

Location : DATABASE_CHANNELFLOW_RETAU590_LES

Status : Restricted access

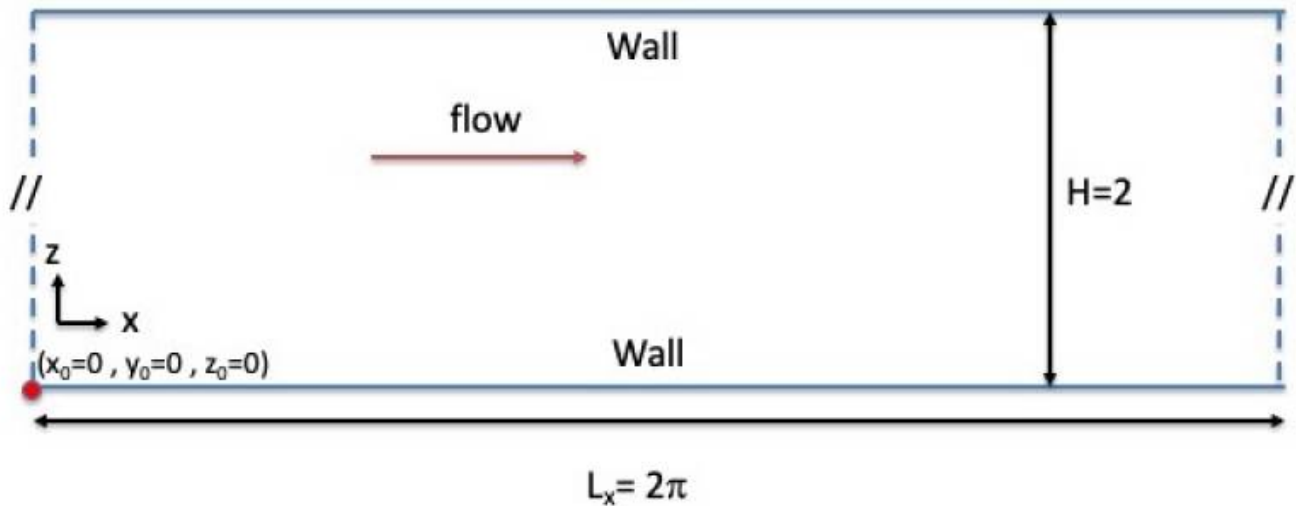
Data size : ~ 5.1 Tb



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Simulation settings

2D sketch



Referential : cartesian geometry

1. axes :
 - $x(i)$: downstream direction
 - $y(j)$: spanwise direction
 - $z(k)$: normal direction
2. origin :
 - $x_0 = 0$: left down corner
 - $y_0 = 0$: left down corner
 - $z_0 = 0$: left down corner

Reference scales

- Density : mass density of the fluid (ρ_0)
- Length : half height of the channel ($h = \frac{H}{2} = 1$)
- Velocity : wall friction velocity (u_*)
- Dynamic viscosity : dynamic viscosity of the fluid (μ_0)
- Reynolds number : $Re_H = \frac{\rho_0 u_* h}{\mu_0} = 590$

Non-dimensionalised data

- velocity : $U^* = \frac{U}{u_*}$
- 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) : $L_x^* = 2\pi$
 - Spanwise direction (y) : $l^* = \pi$
 - Normal direction (z) : $H^* = 2.0$
2. **Boundary conditions**

- Wall conditions : Top and low walls of the domain
- Periodicity : lateral ends of the domain in x and y directions

3. Domain decomposition (128 MPI subdomains)

- Along the downstream direction : 8
- Along the normal direction : 4
- Along the spanwise direction : 4

4. Spatial resolution

- Grid : $32 \times 64 \times 64$ per subdomain (16.777.216 cells over the domain)
- About cell-size
 - $\Delta x_{\min} = \Delta x_{\max} = 2.45437 \times 10^{-2}$ (downstream direction)
 - $\Delta y_{\min} = \Delta y_{\max} = 1.22718 \times 10^{-2}$ (spanwise direction)
 - $\Delta z_{\min} = 6 \times 10^{-4}$ $\Delta z_{\max} = 1.92765 \times 10^{-2}$ (normal direction)

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Data Recording : information about data types

• Time series from probes

- Physical quantities : velocity components along x , y and z directions (u, v, w) and pressure (p)
- 9 probes
- Time step = 0.001 time unit
- Time range : 16.64 to 199.44 time units
- Locations (In vertical plan at $y=1.0$)
 - $X_i = 1.00, X_j = 1.00, X_k = 0.10$ - MPI Subdomain ID : 20
 - $X_i = 1.00, X_j = 1.00, X_k = 0.25$ - MPI Subdomain ID : 21
 - $X_i = 1.00, X_j = 1.00, X_k = 0.50$ - MPI Subdomain ID : 21
 - $X_i = 1.00, X_j = 1.00, X_k = 0.75$ - MPI Subdomain ID : 21
 - $X_i = 1.00, X_j = 1.00, X_k = 1.00$ - MPI Subdomain ID : 21
 - $X_i = 1.00, X_j = 1.00, X_k = 1.25$ - MPI Subdomain ID : 22
 - $X_i = 1.00, X_j = 1.00, X_k = 1.50$ - MPI Subdomain ID : 22
 - $X_i = 1.00, X_j = 1.00, X_k = 1.75$ - MPI Subdomain ID : 22
 - $X_i = 1.00, X_j = 1.00, X_k = 1.90$ - MPI Subdomain ID : 23

- File name (per physical quantity): $x_ins_yyyy.d$ with $x = u, v, w, p$ and 'yyyy' the MPI subdomain ID

• 3D snapshots

- Instantaneous fields : velocity components in x , y and z directions (U, V, W) and pressure (P)
- Recording rate : 0.01 time units
- Time range from from 16.64 to 199.44
- File name : $res_xxxx_yyyyyy.d$ (xxxx : MPI subdomain ID, yyyyyy : Time ID)
 - MPI subdomain ID: from 0 to 127
 - Time ID : from 9 to 18288

• 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 ($\langle P^2 \rangle$, $\langle U_i U_j \rangle$)
 - Mean field of subgrid scale dynamic viscosity (μ_{sg})
 - Mean field of square μ_{sg} (μ_{sg}^2)
- Time average computation
- Time startup = 20.0
- Time range per file = 5.0
- Total time range from 20.0 to 199.44
- file name : rst_XXXXX_yyyyyyy.d (XXXXX : MPI subdomain ID, yyyyyyy : Time ID)
 - MPI subdomain ID : from 0 to 127
 - Time ID : from 1 to 35

Database organisation

Data size : ~ 5.1 Tb

Main directory :

/vol/DATABASE_MECA/RESTRICTED_ACCESS/DATABASE_CHANNELFLOW_RETAU590_LES

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

Directories & files

```
/GRID : contains all ASCII 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           : ASCII files
input data file for sunfluidh : input3d.dat
/TIMESERIES : contains time series recorded over the time range [16.64 ;
199.44]
                  ASCII files : x_ins_yyyyy.d   with x= u,v,w,p
                  time series files are sliced in storage directories CAS-
MPI200-n (n from 5 to 50)
/SNAPSHOTS : snapshots binary files res_XXXXX_yyyyyyy.d
            files stored in archive files : res_yyyyyyy.tar for each
time ID
/STATISTICS : statistics binary files files rst_XXXXX_yyyyyyy.d
            files stored in archive files : res_z.tar , z is an ID
number (from 1 to 35)
/RESTART_AR : backup/restart archive save.tar at time 199.44
/FROM_COMPUTATION : regroups some directories and files related to the
simulation
```

directories : CAS-MPI128-n with n= 5 to 50 (from simulation 5 to 50)
each directory contains files
checkcalc_00000.dat and checkdata_00000.dat

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