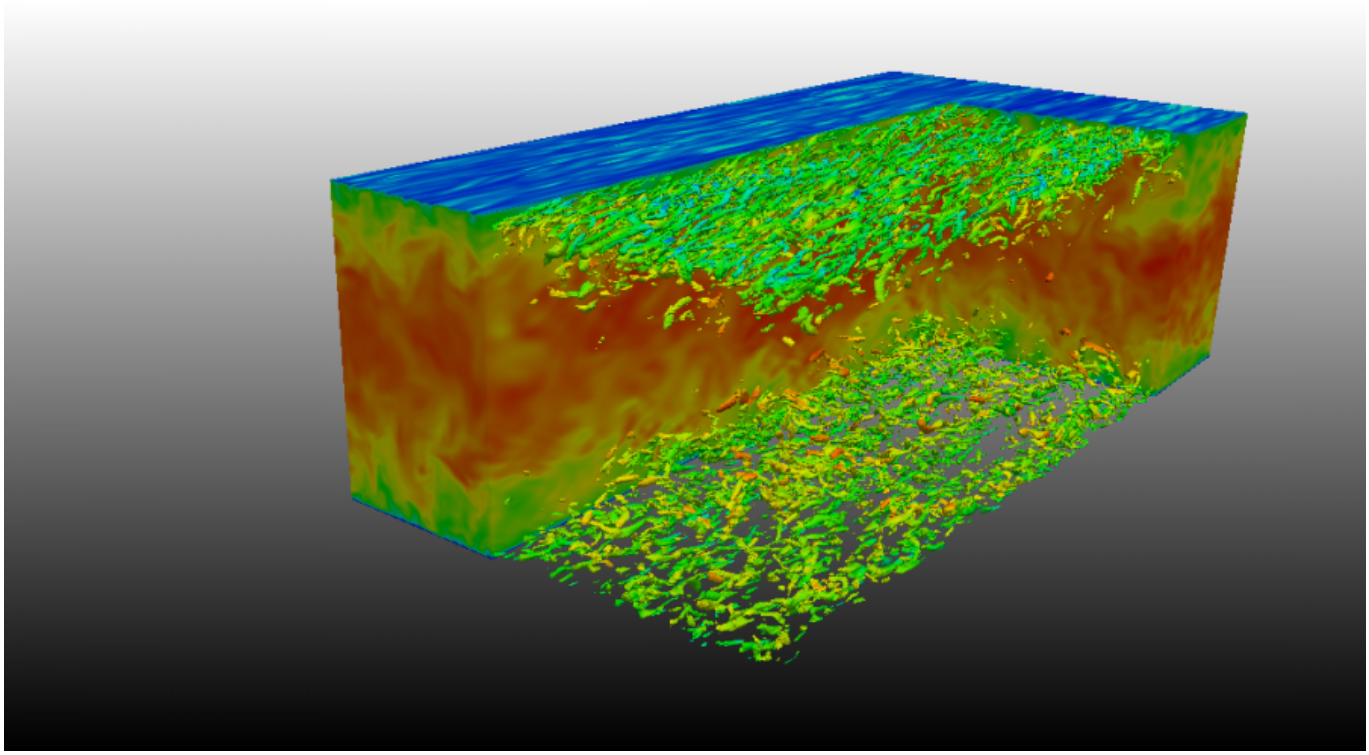
3D turbulent channel flow at $Re_{\tau}= 590$

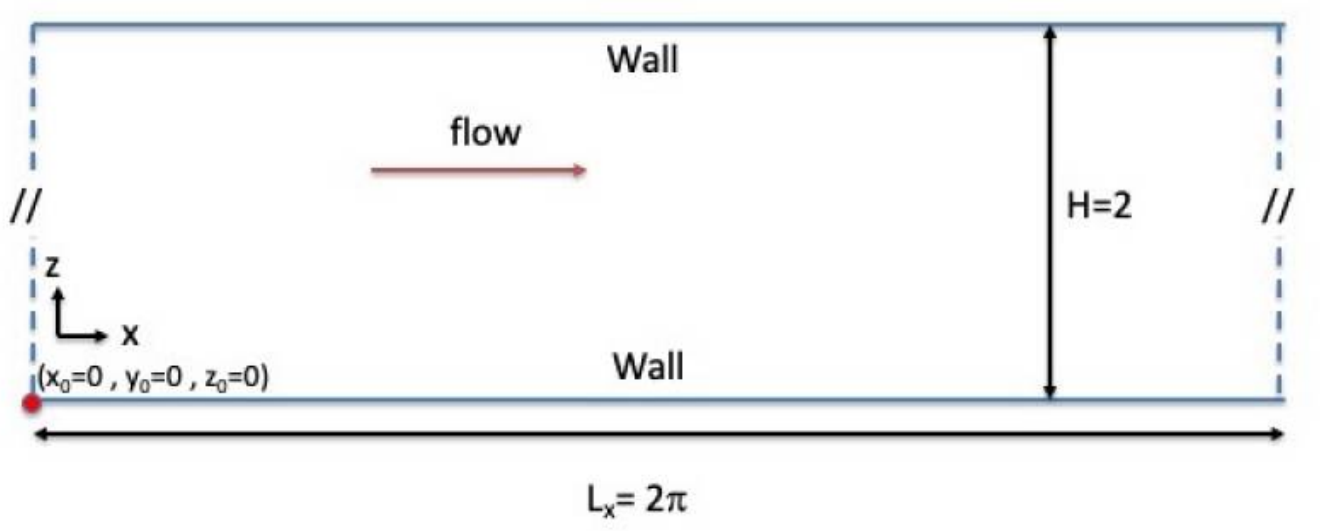
Author : Y. Fraigneau CNRS-LIMSI (yann.fraigneau@limsi.fr)
Date : May 2017
Location : DATABASE_CHANNELFLOW_RETAU590_LES
Simulation type : LES, Mansour's model (Sunfluidh code)



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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 : $\rho^*= \rho/\rho_0= 1$
- 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
     - $\Delta x_{min}^*= \Delta x_{max}^*= 2.45437 \,10^{-2}$ (downstream direction)
     - $\Delta y_{min}^*= \Delta y_{max}^*= 1.22718 \,10^{-2}$ (spanwise direction)
     - $\Delta z_{min}^*= 6\, 10^{-4} \quad \Delta z_{max}^*= 1.92765 \, 10^{-2}$ (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 $y=1.0$)
    - Xi= 1.00, Xj= 1.00 , Xk= 0.10 - MPI Subdomain ID : 20
    - Xi= 1.00, Xj= 1.00 , Xk= 0.25 - MPI Subdomain ID : 21
    - Xi= 1.00, Xj= 1.00 , Xk= 0.50 - MPI Subdomain ID : 21
    - Xi= 1.00, Xj= 1.00 , Xk= 0.75 - MPI Subdomain ID : 21
    - Xi= 1.00, Xj= 1.00 , Xk= 1.00 - MPI Subdomain ID : 21
    - Xi= 1.00, Xj= 1.00 , Xk= 1.25 - MPI Subdomain ID : 22
    - Xi= 1.00, Xj= 1.00 , Xk= 1.50 - MPI Subdomain ID : 22
    - Xi= 1.00, Xj= 1.00 , Xk= 1.75 - MPI Subdomain ID : 22
    - Xi= 1.00, Xj= 1.00 , Xk= 1.90 - MPI Subdomain ID : 23
- File name (per physical quantity): x_ins_yyyyy.d with x= u,v,w,p and 'yyyyy' 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_xxxxx_yyyyyyy.d (xxxxx : MPI subdomain ID, yyyyyyy : 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 (<Ui>) and pressure (<P>)
  - Mean fields of quadratic quantities (<P2>, <UiUj>)
  - Mean field of subgrid scale dynamic viscosity (mu_sg)
  - Mean field of square mu_sg (musg2)
- 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 To
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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