3D turbulent channel flow at $Re_{\tau}= 180$

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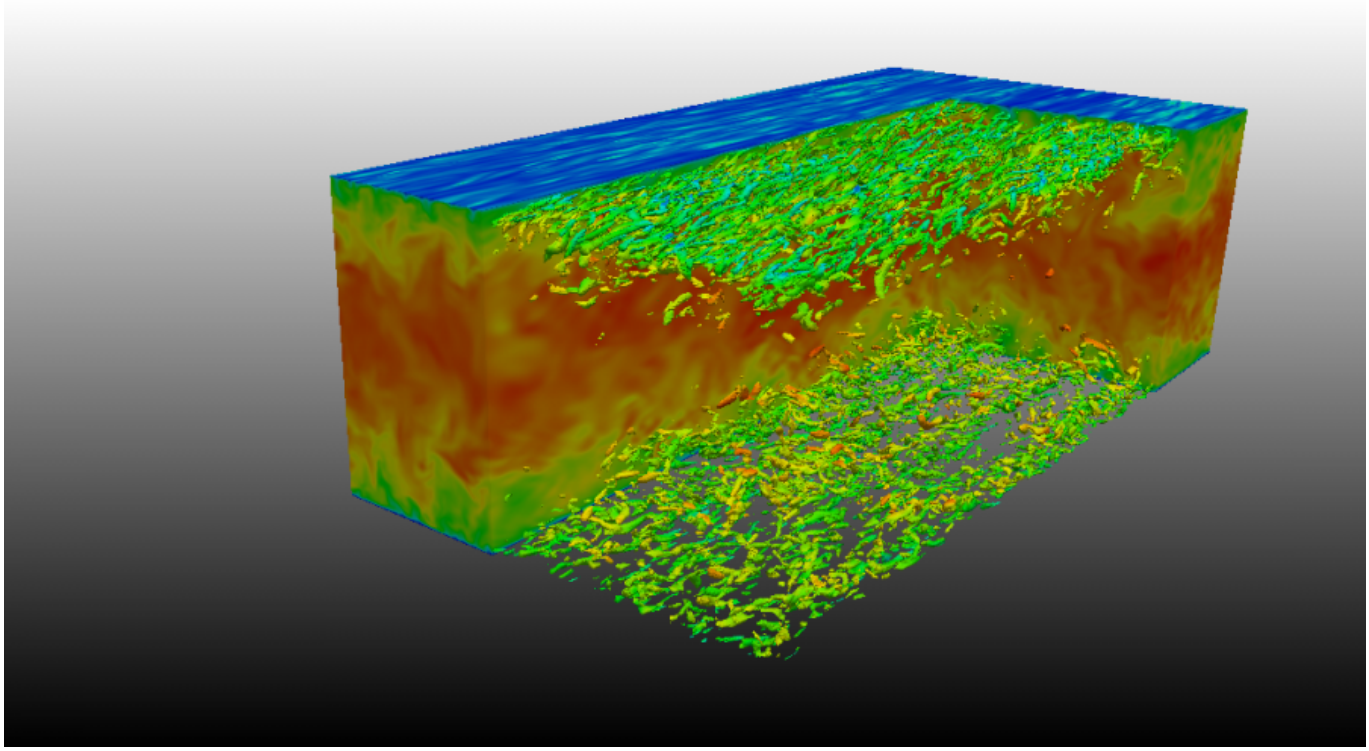
Location : DATABASE_CHANNELFLOW_RETAU180_DNS
Simulation type : DNS (Sunfluidh code)



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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 :
    - $x_0= 0$: 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 : $Re_H= \frac{\rho_0.u_*.h}{\mu_0}= 180$

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) : $L_x^*= 2\pi$
   - Normal direction (y) : $H^*= 2.0$
   - Spanwise direction (z) : $l^*= \pi$
2. **Boundary conditions**
   - Wall conditions : Top and low walls of the domain
   - Periodicity : lateral ends of the domain in x and z directions
3. **Spatial resolution** :
   - Grid : $96 \times 128 \times 96$ per subdomain (1.179.648 cells over the domain)
   - About cell-size
     - $\Delta x_{min}^*= \Delta x_{max}^*= 6.545 \,10^{-2}$ (downstream direction)
     - $\Delta y_{min}^*= 2.780\, 10^{-4} \quad \Delta y_{max}^*= 3.088 \,10^{-2}$ (normal direction)
     - $\Delta z_{min}^*= \Delta z_{max}^*= 3.2725 \, 10^{-2}$ (normal direction)

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)
  - 7 probes
  - Time step= 0.0126 time unit
  - Time range : 97.09 to 301.09 time units
  - Locations (In vertical plan at $z=1.57$)
    - Xi= 3.14, Xj= 0.25 , Xk= 1.57

        - Xi= 3.14, Xj= 0.75 , Xk= 1.57
        - Xi= 3.14, Xj= 1.00 , Xk= 1.57
        - Xi= 3.14, Xj= 1.25 , Xk= 1.57
        - Xi= 3.14, Xj= 1.50 , Xk= 1.57
        - Xi= 3.14, Xj= 1.75 , Xk= 1.57

- File name (per physical quantity): x_ins_00000.d with x= u,v,w,p

- **3D snapshots**
    - Instantaneous fields : velocity components in x, y and z directions (U,V,W) and pressure (P)
    - Recording rate : 0.3 time units
    - Time range from 97.39 to 301.09 time units
    - File name : res_xxxxx_yyyyyyy.d (xxxxx : MPI subdomain ID, yyyyyyy : Time ID)
        - MPI subdomain ID: 0
        - Time ID : from 11 to 690

- **Statistics**
    - fields : (i,j : indexes of direction x, y or z)
        - Mean fields of velocity components (<Ui>) and pressure (<P>)
        - Mean fields of square quantities (<P2>, <UiUj>)
    - Time average computation
    - Time startup = 100.0 time units
    - Time range per file = 25.0 time units
    - Total time range from 100.0 to 300 time units
    - file name : rst_xxxxx_yyyyyyy.d (xxxxx : MPI subdomain ID, yyyyyyy : Time ID)
        - MPI subdomain ID : 0
        - 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 301.09
  /FROM_COMPUTATION : regroups some files related to the simulation :
checkcalc_00000.dat and checkdata_00000.dat
```

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