

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

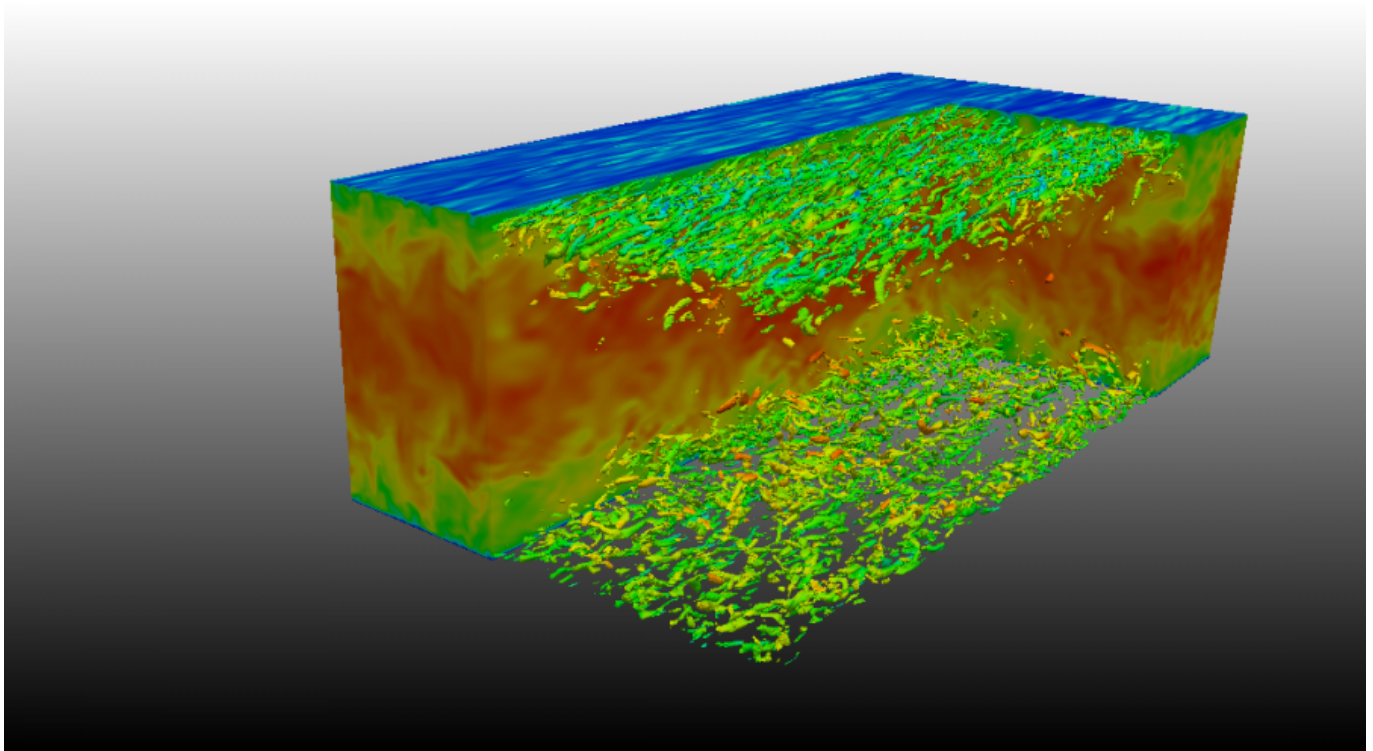
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**Date** : June 2020

**Simulation type** : DNS ([Sunfluidh code](#)) **Location** : DATABASE\_CHANNELFLOW\_RETAU180\_DNS

**Status** : Free access

**Data size** : ~ 13 Gb



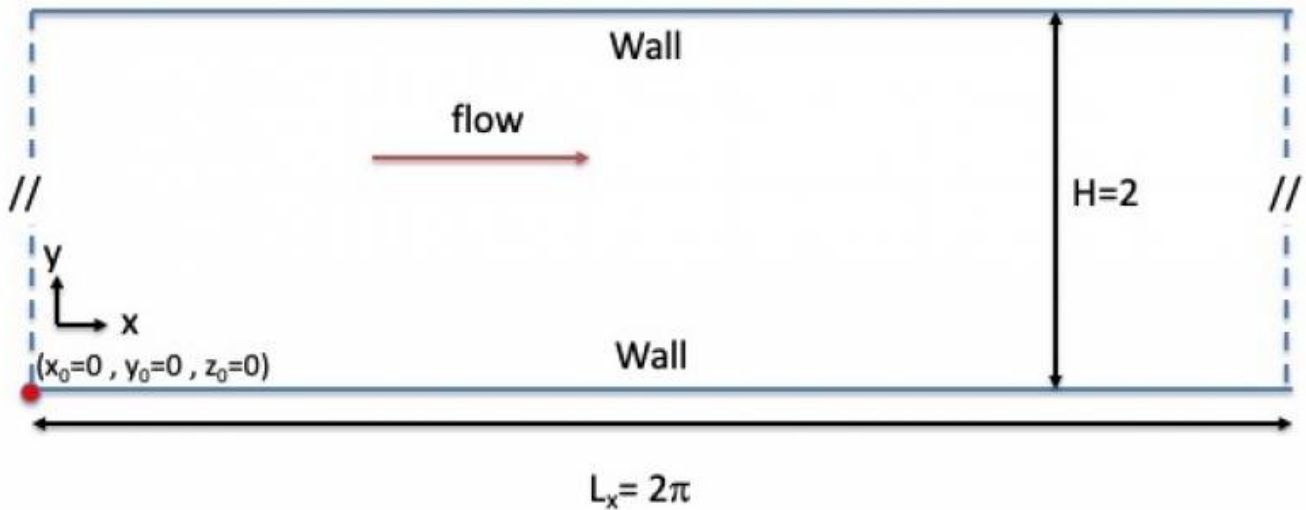
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**Simulation settings**

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**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 ( $\rho_0$ )
- Length : half height of the channel ( $h = \frac{H}{2} = 1$ )
- Velocity : wall friction velocity ( $u_*$ )
- Dynamic viscosity : dynamic viscosity of the fluid ( $\mu_0$ )
- Reynolds number :  $Re_H = \frac{\rho_0 \cdot u_* \cdot h}{\mu_0} = 180$

### 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 ( $x$ ) :  $L_x^* = 2\pi$
  - 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
  - $\Delta x_{\min} = \Delta x_{\max} = 6.545 \cdot 10^{-2}$  (downstream direction)
  - $\Delta y_{\min} = 2.780 \cdot 10^{-4} \quad \Delta y_{\max} = 3.088 \cdot 10^{-2}$  (normal direction)
  - $\Delta z_{\min} = \Delta z_{\max} = 3.2725 \cdot 10^{-2}$  (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  $z=1.57$ )
  - $X_i = 3.14, X_j = 0.25, X_k = 1.57$
  - $X_i = 3.14, X_j = 0.75, X_k = 1.57$
  - $X_i = 3.14, X_j = 1.00, X_k = 1.57$
  - $X_i = 3.14, X_j = 1.25, X_k = 1.57$
  - $X_i = 3.14, X_j = 1.50, X_k = 1.57$
  - $X_i = 3.14, X_j = 1.75, X_k = 1.57$
- 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 ( $\langle U_i \rangle$ ) and pressure ( $\langle P \rangle$ )
  - Mean fields of quadratic quantities ( $\langle P^2 \rangle$ ,  $\langle U_i U_j \rangle$ )
- 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** : ~ 13 Gb

**Main directory** : /vol/DATABASE\_MECA/DATABASE\_CHANNELFLOW\_RETAU180\_DNS

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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