Dataset : Structure of high and low shear-stress events in a turbulent boundary layer

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Introduction

The dataset contains simultaneous particle image velocimetry (PIV) and wall-shear-stress sensor measurements in a flat plate turbulent boundary layer a Reynolds number Re_τ~4000. The PIV field-of-view covers 8δ (where δ is the boundary layer thickness) along the streamwise direction and captures the entire boundary layer in the wall-normal direction. Simultaneously, wall-shear-stress measurements were taken using a spanwise array of skin-friction sensors (spanning 2 δ). The experiments were performed in the R.J. Mitchell wind tunnel of the University of Southampton (Fig. 1).

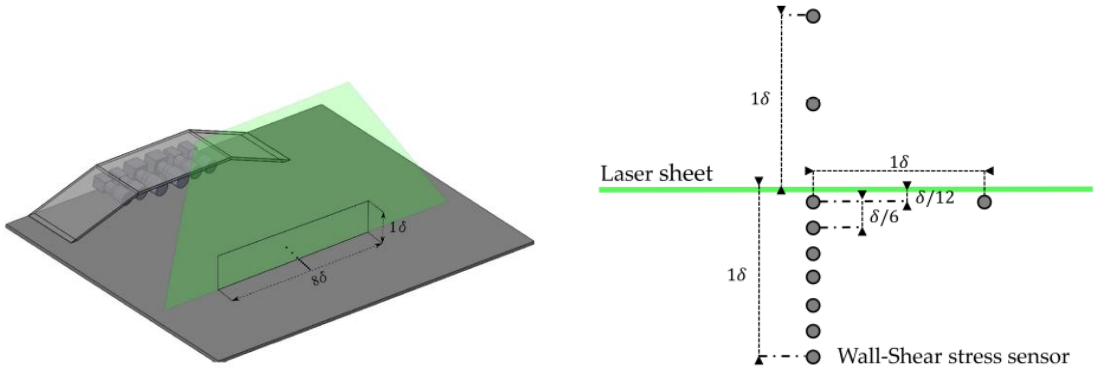

Figure 1 Experimental set-up

PIV Fields

4037 PIV Fields were recorded. This files are in “Matlab format” with the following variables:

- X : the longitudinal coordinates
- Y : the wall-normal coordinates
- U: the longitudinal velocity components
- V : the wall-normal velocity components

Exemple to visualize the PIV field “PIV00100.mat”

```
load(PIV00100.mat);
h=imagesc(X,Y-1,U');
axis equal
axis tight
set(gca,'YDir','normal')
```

Tau signal Files

The dataset of filtered wall-shear stress signals contains 3987 files. These files correspond to simultaneous measurement with the 3987 first PIV files (*PIV_field_00001.mat* to *PIV_field_*3987.*mat*).

Each file includes a variable "*t*" that corresponds to the time, and the filtered wall shear stress signal of the 10 sensors ("*Tau_filter")* as explained in the paper.

- "*t*" is an array with the value of time (array of 20000 values)
- "*Tau_filter*" is a 2D array with the value of the filtered wall shear stress signal. The number of columns (1 to 10) corresponds to the sensor number as display in Fig 2.

The positions of the sensors [1:9] relatively to the laser sheet are :

Z= [-104 -88 -72 -56 -40 -24 -8 56 104] mm

The sensor number 10 is located downstream of the spanwise array such that two sensors (7 and 10) are aligned in the streamwise direction and spaced by 100 mm.

The value "*t"=0 (at index 10001)* corresponds to the acquisition time (laser trigger) of the related PIV field.

Exemple to load and visualize the time evolution of the wall shear stress signal of sensor 1.

```
load(Tau_filteredsignal_01001.mat);
plot (t, Tau_filter( :,1)) ;
```

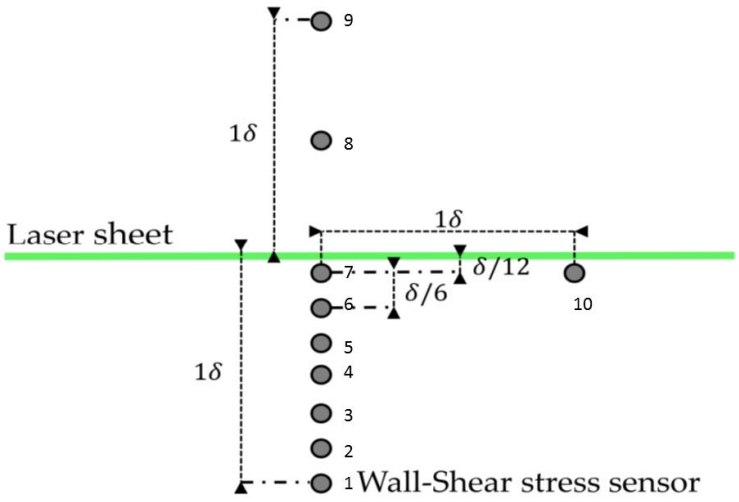

Figure 2 Sensors numbering