Complementary README file for the linked data

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October 8, 2017

1 General Comments

All data attached is from time-resolved Planar PIV experiments performed in the recirculating water tunnel located at the Experimental Fluids Laboratory, which is part of the Aerodynamics and Flight Mechanics Research Group, in the Faculty of Engineering and the Environment of the University of Southampton. Further details on the experimental setup and processing parameters can be found in the linked PhD Thesis (Laskari, 2017).

The data includes the coordinates X and Y of the 2D velocity grid in the streamwise and wall-normal direction respectively (unscaled, inner, and outer normalised in files `Grid_Velocity_mm.mat`, `Grid_Velocity_inner.mat` and `Grid_Velocity_outer.mat`, respectively) and 2C-2D velocity vectors (under the folder Velocity for each independent Run, stored in 37 consecutive sets). Estimated pressure values based on the Taylor's hypothesis method proposed in Laskari (2017), are also included (under the folder Pressure for each independent Run, stored in 37 consecutive sets) at a subset of the velocity grid (unscaled, inner, and outer normalised in files `Grid_Pressure_mm.mat`, `Grid_Pressure_inner.mat` and `Grid_Pressure_outer.mat`).

2 Experimental details

For the data acquisition, the LaVision software DaVis 8.2 was used to acquire 383145 images (in 35 independent time-resolved Runs of 10,947 images, covering approximately 480 seconds of flow in total) at 800 Hz, which were subsequently processed with the same software using iterative correlation with a final interrogation window of 16 pixels $\times$ 16 pixels (1.4 mm $\times$

Friction velocity Re number	Re_τ	5300
Friction velocity	U_τ	$3.60 \cdot 10^{-2}$ [m $\cdot$ s^{-1}]
Viscosity	ν	$0.935 \cdot 10^{-6}$ [m^2 $\cdot$ s^{-1}]
Time-step (viscous units)	dt^+	1.73
Time-step (outer units)	dtU_∞/δ	$9 \cdot 10^{-3}$
Domain Length	$L_x \times L_y$	$0.5\delta \times 1.8\delta$

Table 1: Nominal flow conditions and domain size

1.4 mm) and an overlap factor of 50%. Approximately 96% of the final vectors were a first choice, while the total percentage of interpolated vectors was below 1%. The nominal flow conditions, based on the 383,145 vector fields were: $U_\infty = 0.99$ m/s, $\delta = 0.14$ m ($\delta_{99} = 0.12$ m), $Re_\tau = 5300$, while the resulting field of view (FOV) was approximately $0.5\delta \times 1.8\delta$ in the streamwise and wall-normal direction respectively (Table 1). The friction velocity was computed using the Clauser chart method (Clauser, 1954), while the boundary layer height was estimated based on Jones' integral (Jones et al., 2001). The dataset was additionally filtered in time, using a moving-average filter with a window length of 3 points in time resulting in an effective timestep of $dt^+ = 5.1$. Further to that, and based on the initial vector overlap (50%), a spatial 2D Gaussian filter with a 3×3 point kernel was also applied (with a standard deviation of $\sigma_G^+ = 50$), such that the effective spatial resolution of the data remained largely unaltered.

References

Clauser, F. H. (1954). Turbulent boundary layers in adverse pressure gradients. *Journal of the Aeronautical Sciences*, 21(2):91–108.

Jones, M. B., Marusic, I., and Perry, A. E. (2001). Evolution and structure of sink-flow turbulent boundary layers. *Journal of Fluid Mechanics*, 428:1–27.

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