Turbulence fields generated by a flapping active grid: Comparing hot-wire and particle image velocimetry

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Active grids have been used for decades to customize turbulent flows using various approaches of excitation[1][2][3]. In this experimental work, we excite an active grid with randomized and synchronized flapping motions to generate various flows. The flows are investigated using both particle image velocimetry (PIV) and a hot-wire to capture the temporal and the spatial turbulence evolution. A total of of six randomized flapping and two synchronized flapping protocols were investigated $60M$ downstream of the active grid (with the mesh length $M = 10\,\mathrm{cm}$) at a mean velocity of $10\,\mathrm{ms}^{-1}$. The PIV set-up has a field of view of $10M$ in the streamwise and $2.5M$ in the wall-normal directions. This allows for a detailed comparison of the instantaneous behaviour of the velocity field obtained by PIV with the temporally highly resolved hot-wire data. Figure 1 a) and b) show instantaneous velocity fields of a synchronized and a randomized actuation sequence captured by PIV, and c) and d) give two examples of velocities measured by hot-wire for the same excitation protocols. The fluctuation magnitude of these two cases is very different. The emerging structures in the synchronized case show both large temporal and spatial variations. This naturally begs the question, what is happening in the flow? This will be explored further in this study.

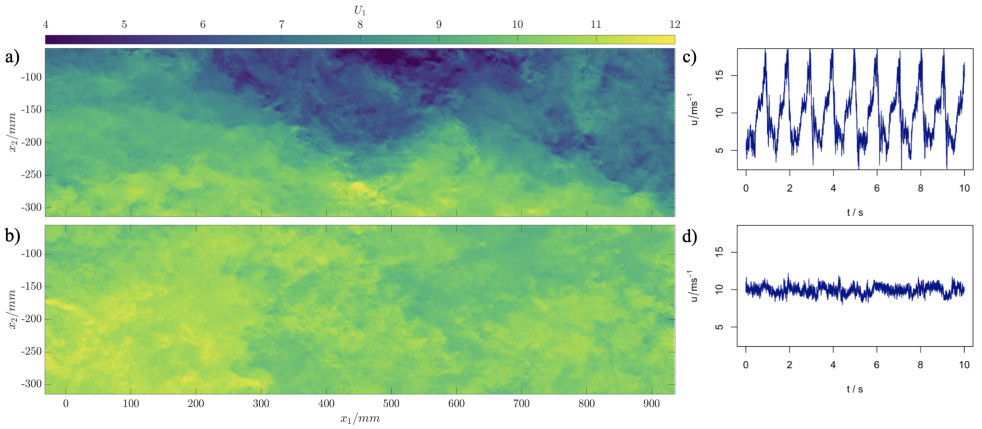

Figure 1: Examples of instantaneous stream-wise velocities measured using PIV (a,b) and hot-wire (c,d) for synchronized (a,c) and random (b,d) flapping.

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