INTERROGATING LOCAL SHEAR EFFECTS ON COHERENT STRUCTURE IDENTIFICATION IN TURBULENT FLOWS

SRV by Chris Keylock (Sheffield) to work with Oliver Buxton (Imperial)

This project is about the identification of flow structures using local methods and a desire to improve existing methods by designing a new approach that intrinsically contains a physically-based threshold (above this value a true flow structure exists) rather than the issue with most current approaches where the choice of a threshold is either qualitative or empirical. During this SRV we worked on these ideas and their application to an experimental dataset.

We took a careful look at the existing near-wake data (obtained using tomographic PIV, see Figure 1) because a difficulty with velocity gradient tensors obtained experimentally is that the trace is not necessarily zero (as it should be for an incompressible flow) because of finite precision in the experiment compounded by taking derivatives. Oliver has published work in the past showing how this can impact on subsequent calculations of dynamically relevant quantities. Hence, we spent some computational time undertaking an optimisation to reduce such errors by an order of magnitude.

Our preliminary results are sufficiently interesting, and the timing has been suc h, that it has been possible for an MSc student to assist us in looking into the results in further detail. We anticipate publishing this research in a suitable fluid mechanics journal once it is completed.

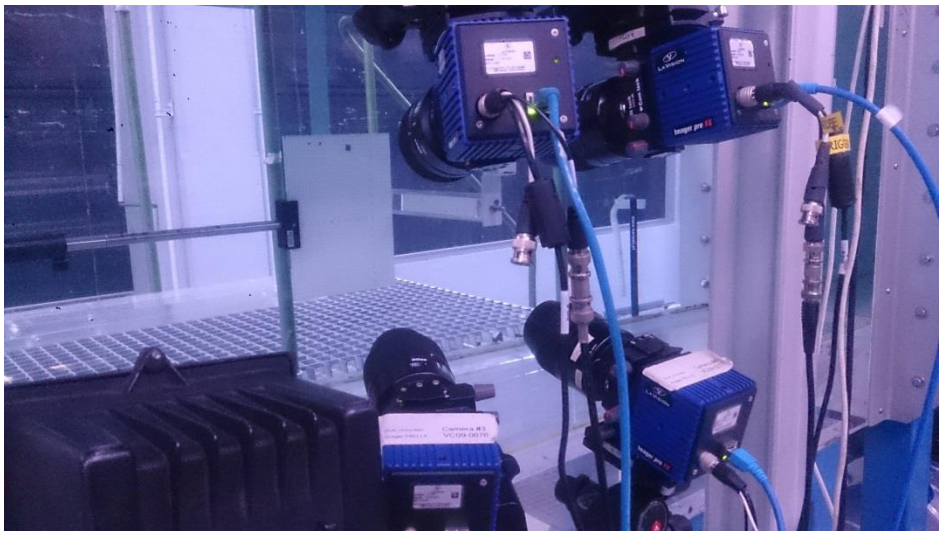

Figure 1. Calibration process for tomographic PIV. Cameras (foreground) with a calibration plate held in the channel (white rectangle). Wakes are generated by the square bar to the right of the calibration plate.