ABSTRACT

The determination of flow velocity in complex flows is a fundamental task in fluid dynamics. PTV tracks the positions of small buoyant seeding particles through the image sequence to give the full-field velocity. 3D PTV requires the establishment of correspondences between particles from multiple images. As the seeding density increases, ambiguities in identifying the correspondences increase. Multicolour 3D PTV was investigated to reduce such ambiguities and then increase the spatial resolution.

In this thesis, for the first time mathematical models and numerical simulations were used to quantify the improvement of multicolour PTV and validated by experiments. Conclusions were also drawn on the optimal seeding density. It was concluded that at a certain seeding density, the probability of success and the optimal seeding density increase obviously when multiple colours were introduced. For the spatial matching, it was found that by using 5-colour particles the optimal seeding density increased about 4 times, and at the optimal seeding density of 5-colour condition, the probability of success was 40 times greater. Similar improvement has been found in the temporal matching. Then, the measurement of a 3D dynamic flow was described, at a high seeding density when conventional PTV was not able to produce long trajectories.