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Unsteady separation in a forward-facing step flow[1] DAVID PEARSON, Imperial College London, PAUL GOULART, ETH Zurich, BHARATHRAM GANAPATHISUBRAMANI, University of Southampton, IMPERIAL COLLEGE LONDON TEAM, ETH ZURICH TEAM, UNIVERSITY OF SOUTHAMPTON TEAM — The structure and behaviour of the separation region upstream of a forward step is investigated using time-resolved 2D Particle Image Velocimetry. Conditional averages of the flow-field based on the amount of reverse flow present are used to determine the shape and size of the separated flow in relation to the separation point. It is shown that the separation is of 'open' form with no reattachment point for approximately 50% of the time. When a reattachment point forms on the step face the separation region can become unstable and expand up and over the step corner. This transfer of mass occurs approximately 10% of the time and is postulated to be caused by large-scale transverse motions at the step face. The conditional averages can be traced backward in time to investigate the upstream flow field prior to such events. It is found that the large scale separations are preceded by a region of low momentum flow convecting toward the step. This momentum deficit creates the conditions under which the separation expands. The size and shape of the momentum deficit, and the timescales over which it acts, is consistent with the large boundary layer structures observed in the literature.

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