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Inertial instabilities in a mixing-separating microfluidic device[1]
ALLYSSON DOMINGUES, ROBERT POOLE, DAVID DENNIS, University of Liverpool — Combining and separating fluids has many industrial and biomedical applications. This numerical and experimental study explores inertial instabilities in a so-called mixing-separating cell micro-geometry which could potentiality be used to enhance mixing. Our microfluidic mixing-separating cell consists of two straight square parallel channels with flow from opposite directions with a central gap that allows the streams to interact, mix or remain separate (often referred to as the 'H' geometry). A stagnation point is generated at the centre of symmetry due to the two opposed inlets and outlets. Under creeping flow conditions (Reynolds number $[Re \sim 0]$) the flow is steady, two-dimensional and produces a sharp symmetric boundary between fluids stream entering the geometry from opposite directions. For $Re > 30$, an inertial instability appears which leads to the generation of a central vortex and the breaking of symmetry, although the flow remains steady. As Re increases the central vortex divides into two vortices. Our experimental and numerical investigations both show the same phenomena. The results suggest that the effect observed can be exploited to enhance mixing in biomedical or other applications.

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