Abstract Submitted
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Vortex ring dynamics and mixing in crossflow[1] RAJES SAU, Graduate Research Assistant, University of Minnesota, KRISHNAN MAHESH, Associate Professor, University of Minnesota — DNS is used to study the effect of crossflow on the dynamics, entrainment and mixing of vortex rings issuing from a nozzle. Three distinct regimes are found to exist, depending on the velocity ratio (r) and stroke ratio (L/D). A hairpin vortex forms instead of a complete vortex ring at velocity ratios below approximately 2. More interestingly, for large L/D, a series of hairpin vortices are shed downstream. The shedding characteristics are periodic for very low Re (e.g. 300). For higher velocity ratios, two regimes are obtained depending upon L/D. Lower stroke ratios yield a coherent asymmetric vortex ring, while higher stroke ratios yield an asymmetric vortex ring accompanied by a trailing column of vorticity. These two regimes are separated by a transition stroke ratio whose value decreases with decreasing velocity ratio. For very high values of r, the transition stroke ratio approaches the 'formation number' defined by Gharib et al. (1998). In the absence of trailing vorticity, the vortex ring tilts towards the upstream direction, while the presence of a trailing column causes it to tilt downstream. This behavior is explained. The trailing column is found to contribute significantly to the overall mixing and entrainment. There is an optimal length of the trailing column for maximum entrainment. A classification map which categorizes the different regimes of ring dynamics, structure and entrainment is presented.

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