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A Pressure-Based Analysis of Vortex Ring Pinch-Off[1] KRISTY SCHLUETER, NOAH BRAUN, JOHN DABIRI, California Institute of Technology
— This study investigated the development of vortex rings over a range of maximum stroke ratios, and analyzed vorticity and pressure data for clues to the physical mechanisms underlying vortex pinch-off. An impulsive piston velocity profile and Reynolds number of 3000 were used for all cases. The formation number was consistently found to be 3.6 +/- 0.3. A recently developed algorithm was used to generate pressure fields by integrating the pressure gradient along several paths through the velocity field and taking the median to get explicit values for pressure. The formation time at the occurrence of a local maximum in the pressure between the vortex ring and the lip of the nozzle, known as the trailing pressure maximum, was found to occur concurrently with the formation number for each case, within the error associated with the temporal resolution of the data. This suggests that the trailing pressure maximum is an indicator of vortex ring pinch-off. This is consistent with the results of Lawson and Dawson (2014), who found that the appearance of the trailing pressure maximum was coincident with the formation number. This pressure based approach to determining vortex ring pinch-off will be applied to a biological flow to examine the efficiency of such a flow.

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