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Evolution of the pressure thrust in a starting jet LEI GAO, Nanyang Technological University, SIMON C.M. YU, Singapore Institute of Technology, JORG SCHLUTER, Nanyang Technological University — It is known that the nozzle exit over-pressure is responsible for the improved propulsive performance of a starting jet. To illustrate the detailed evolution of the pressure thrust during the vortex ring formation process, starting jets with a straight nozzle configuration are investigated numerically for different velocity programs. It is found that the remarkable over-pressure contribution to the unsteady jet thrust is mainly associated with the initial acceleration phase of the starting flow. If the vortex ring does not gain appreciable translational velocity at the end of the acceleration phase, it will induce a locally lower pressure region near the nozzle edge due to a mechanism similar to that for the leading edge suction force on a delta wing. As a result of the lower pressure at the nozzle exit plane, the pressure thrust contributes adversely to the total jet thrust. This negative pressure thrust diminishes rapidly as the leading vortex ring translates downstream away from the nozzle exit. Finally, after the leading vortex ring pinches off from the trailing jet, its effect on the pressure variation at the nozzle exit plane becomes negligible and the propulsive characteristics of the flow approaches that of a steady jet.

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