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The flow within and in the near external field of a fluidic precessing jet nozzle

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Abstract

This thesis examines the internal and near external flow fields of a nozzle which produces a naturally precessing fluidic jet (FPJ). The internal flow is investigated by phase-averaged Laser-Doppler anemometry (LDA) using a total pressure probe as a phase sensor, while the external flow is investigated primarily by phase-averaged Particle Image Velocimetry (PIV) using a pair of hot-wire probes as the phase sensor, and LDA. The internal flow results partially confirm the flow structure proposed by earlier investigators and demonstrate the effect of the reversed axial flow on the internal jet within the FPJ chamber. The results also support the presence of a driving vortex proposed in the literature.

A plethora of experimental techniques progressively reveal the characteristics and features of the external precessing jet. The characteristics of the jet at the exit plane are found to be sensitive to inlet conditions and to inlet Reynolds number. The structure of the flow emerging from the FPJ exit is revealed, and found to contain several significant vortical features. Based on the evidence gathered from all the experiments, a new flow structure of the external precessing jet is proposed.

Finally, the new experimental data are used to define Strouhal and Reynolds numbers based on the actual characteristics of the emerging jet. These allow the FPJ flow to be compared with other flows such as mechanical precessing jets.

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