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New approach of a traditional analysis for predicting near-exit jet liquid instabilities GUILLERMO JARAMILLO[1], STEVEN COLLICOTT[2], Purdue University — Traditional linear instability theory for round liquid jets requires an exit-plane velocity profile be assumed so as to derive the characteristic growth rates and wavelengths of instabilities. This requires solving an eigenvalue problem for the Rayleigh Equation. In this new approach, a hyperbolic tangent velocity profile is assumed at the exit-plane of a round jet and a comparison is made with a hyperbolic secant profile. Temporal and Spatial Stability Analysis (TSA and SSA respectively) are the employed analytical tools to compare results of predicted most-unstable wavelengths from the given analytical velocity profiles and from previous experimental work. The local relevance of the velocity profile in the near-exit region of a liquid jet and the validity of an inviscid formulation through the Rayleigh equation are discussed as well. A comparison of numerical accuracy is made between two different mathematical approaches for the hyperbolic tangent profile with and without the Ricatti transformation. Reynolds number based on the momentum thickness of the boundary layer at the exit plane non-dimensionalizes the problem and, the Re range, based on measurements by Portillo in 2011, is 185 to 600. Wavelength measurements are taken from Portillo's experiment.

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