Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Sensitivity of wavepackets in jets to non-linear effects: the role of the critical layer GILLES TISSOT, Instituto Tecnológico de Aeronáutica, São José dos Campos, SP, Brazil, MENGQI ZHANG, Institut PPRIME, Poitiers, France, FRANCISCO C. LAJÚS JR., Universidade Federal de Santa Catarina, Florianópolis, SC, Brazil, ANDRÉ V. G. CAVALIERI, Instituto Tecnológico de Aeronáutica, São José dos Campos, SP, Brazil, PETER JORDAN, Institut PPRIME, Poitiers, France, TIM COLONIUS, California Institute of Technology, Pasadena, CA 91125, USA — Linear instability waves, or wavepackets, are key building blocks for the jet-noise problem. It has been shown in previous work that linear models correctly predict the evolution of axisymmetric wavepackets up to the end of the potential core of subsonic turbulent jets. Beyond this station linear models fail, and non-linearity is the likely missing piece. The essential underlying nonlinear mechanisms are unknown, and it remains unclear how these should be incorporated in a reduced-order model. The non-linear interactions are considered in this work as an "external" harmonic forcing added to the standard linear model. This modelling framework is explored using three complementary problems: a direct forcing, a resolvant analysis and a 4D-Var data assimilation approach. In all of the problems considered, the critical layer is found to be relevant: it is the position where the sensitivity of the linear waves to non-linearity is greatest. Furthermore, forced perturbations are tilted by shear, in a manner that suggests an Orr-like mechanism. The ensemble of results suggest that the critical layer may play a central role in the modelling of wavepackets in subsonic turbulent jets, and indeed may be the key to remedying the shortcomings of linear reduced-order models.

Gilles Tissot
Instituto Tecnológico de Aeronáutica, São José dos Campos, SP, Brazil

Date submitted: 16 Jul 2015 Electronic form version 1.4