Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Aeroacoustic directivity via wave-packet analysis of mean or base flows[1] ADAM EDSTRAND, Florida State University, PETER SCHMID, Imperial College London, LOUIS CATTAFESTA, Florida State University — Noise pollution is an ever-increasing problem in society, and knowledge of the directivity patterns of the sound radiation is required for prediction and control. Directivity is frequently determined through costly numerical simulations of the flow field combined with an acoustic analogy. We introduce a new computationally efficient method of finding directivity for a given mean or base flow field using wave-packet analysis (Trefethen, PRSA 2005). Wave-packet analysis approximates the eigenvalue spectrum with spectral accuracy by modeling the eigenfunctions as wave packets. With the wave packets determined, we then follow the method of Obrist (JFM, 2009), which uses Lighthill's acoustic analogy to determine the far-field sound radiation and directivity of wave-packet modes. We apply this method to a canonical jet flow (Gudmundsson and Colonius, JFM 2011) and determine the directivity of potentially unstable wave packets. Furthermore, we generalize the method to consider a three-dimensional flow field of a trailing vortex wake. In summary, we approximate the disturbances as wave packets and extract the directivity from the wave-packet approximation in a fraction of the time of standard aeroacoustic solvers.

[1]ONR Grant N00014-15-1-2403

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Date submitted: 31 Jul 2017 Electronic form version 1.4