PANEL METHOD FOR TURBULENCE-AIRFOIL INTERACTION NOISE PREDICTION

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In turbofan engines and contra-rotating open rotors (CROR), airfoil-turbulence interaction typically configures as the main noise source generation mechanism. For an airfoil free of flow separation, the noise sources are mainly localized around the leading and trailing edges. The first is the main noise source when the incoming flow turbulence level exceeds a certain level. For lower levels of incoming turbulence, the scattering of self-generated boundary layer turbulence at the trailing edge dominates. The present work focuses on the incoming turbulence problem, relevant to the interaction between the wakes shed by the upstream rotor of a CROR and convected across the downstream rotor plane.

An unsteady vortex based panel code to predict the airfoil response to a turbulent inflow has been developed and coupled to a code based on the Curle analogy to predict the far-field noise. The code is validated against the flat plate analytical results given by the Amiet theory. Preliminary results show the agreement of the airfoil response function and the sound pressure level for reduced frequencies up to 8. It is expected to compare the computed results with experimentally obtained data. Then an attempt will be made to model in the panel code the effect of locally-reacting porous patches distributed over the airfoil pressure and/or suction sides, which is not readily possible following conventional linearized airfoil theories.

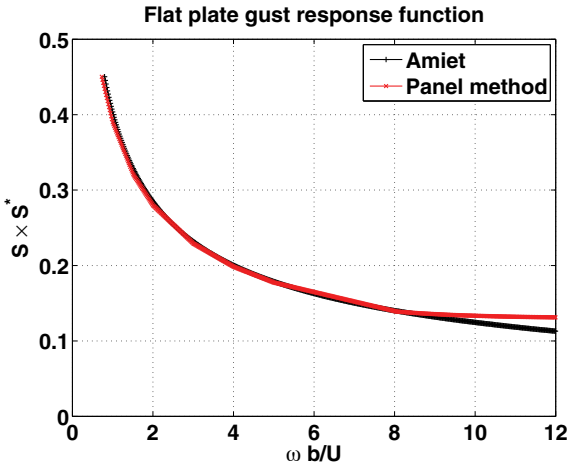

Figure 1: Panel's code airfoil gust response function compared with Amiet's theory

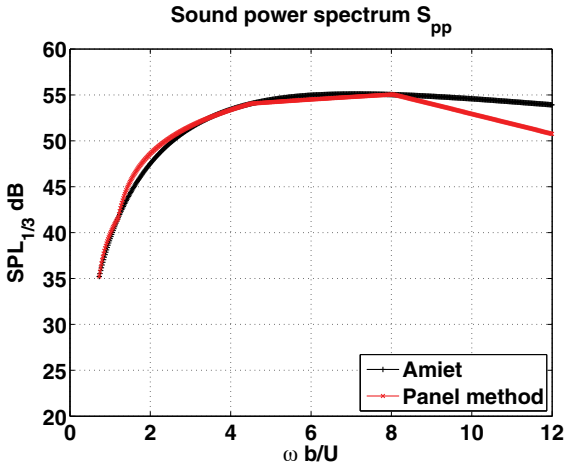

Figure 2: Sound pressule level predicted by the panel code coupled with the Curle analogy compared with the analytical results of Amiet