ACOUSTICS2008/1058
Computation of Indirect Combustion Noise by a CAA Method

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Indirect combustion noise, which is generated by the acceleration of hot gases from a turbulent swirling flame, has become an important issue to understand turbo-machinery core noise. This indirect combustion noise it is dominated by a strong interaction of hydrodynamic and acoustic perturbations due to the transonic base flow in the turbine stages and combustion chamber exit nozzle. Current numerical simulation methods for the phenomenon based on compressible Large Eddy Simulation (LES) are very expansive. Thus LES applications are still limited to one design or few variations with immense computational costs. The most simple model fully covering indirect combustion noise, are the linearized non-isentropic Euler equations over an arbitrary mean flow. Therefore the gap between theory and LES is closed by a method adopted from Computational Aeroacoustics (CAA). It combines a high cost efficiency in terms of required points per wavelength with a high adaptability to realistic mean flow conditions. The CAA method is first validated with a simplified experiment and then applied to predict the acoustic properties of two model combustion chambers, one of them with transonic termination nozzle. By means of the acoustic intensity the sources of the noise are located.