ACOUSTICS2008/2579
Decomposition of the Lighthill source term and analysis of acoustic radiation from mixing layers

Florent Margnat[a], Véronique Fortuné[b], Peter Jordan[c] and Yves Gervais[d]
[a]Arts et Métiers Paris Tech - Sinumef Lab, 151 bd de l'Hopital, 75013 Paris, France
[b]Univ. Poitiers, CNRS Laboratoire d'Etudes Aérodynamiques, Bat. K - 22 avenue du recteur Pineau, 86022 Poitiers, France
[c]Univ. Poitiers, CNRS Laboratoire d'Etudes Aérodynamiques, 43, rue de l'Aérodrome, 86036 Poitiers, France
[d]Laboratoire d'Etudes Aérodynamiques (LEA), Université de Poitiers - ENSMA - CNRS, Bâtiment K, 40 Avenue du Recteur Pineau, 86022 Poitiers, France

Acoustic radiation from jet flow has been studied extensively by means of theoretical, experimental and numerical approaches over the past decades. Unfortunately, the mechanisms responsible for the production of sound by unbounded turbulence in subsonic flows remain unclear. For advancing our fundamental understanding of these mechanisms, the development of specific analysis tools is needed.
Our study is based on a decomposition of the Lighthill source term, which is known to contain all the existing links between the fluid flow and the acoustic field. Ten subterms are written with the help of physically meaningful quantities such as velocity, density, dilatation and vorticity.
The methodology is tested through the two-dimensional compressible mixing layer flow in spatial development, at a Reynolds number of 400 and a Mach number of 0.25. A direct numerical simulation of the flow and its acoustic radiation is performed and used as a reference solution. Acoustic field generated by each source terms is predicted computing the integral solution of Lighthill's equation.
Effect of the compressibility on the balance between the contribution of major subterms is of key importance. Directivity and convective effects are identified as well.