ACOUSTICS2008/2367
Numerical strategies for investigation of gust-airfoil interaction

Florent Margnat[a], Thomas Le Garrec[a], Djaafer Fedala[b], Xavier Gloerfelt[a] and Smaine Kouidri[c]

[a]Arts et Métiers Paris Tech - Sinumef Lab, 151 bd de l'Hopital, 75013 Paris, France

[b]Lab. d'Energétique et de Mécanique des Fluides Interne, Arts et Métiers ParisTech, 151 boulevard de l'Hôpital, 75013 Paris, France

[c]LIMSI-CNRS, BP 133, 91403 Orsay Cedex, France

The noise generated by the interaction between a gust and an airfoil in a uniform flow is investigated. This problematic is of major industrial interest, regarding fans, turbomachinery, or wind turbine applications. A two-dimensional symmetric Joukowski-type airfoil is immersed without incidence in a flow at Mach number 0.5, disturbed by a harmonic gust at 45° of incidence (4th CAA Workshop on Benchmark Problems, 2004). Our methodology is first to perform a high-order direct resolution of Euler's equations of the disturbed flow over the airfoil and the associated acoustic emission, which is taken as a reference simulation. Second, the near aerodynamic field is simulated with Fluent 6.3 solver based on finite volume method with second-order schemes. The aerodynamic data thus obtained are used for far field acoustic prediction, based on Ffowcs Williams and Hawkings analogy. Finally, following another hybrid approach, the noise is predicted by using integral formulations with source field from the DNS.

The aim of the study is to provide insight into the efficiency and validity of these numerical strategies commonly used. Comparisons with results of the CAA workshop are given, covering various wavenumbers values.