in Germany | OCT 23-25, 2018

Windnoise prediction
from academic validation towards industrial application

Dr. Sebatien Vilfayeau[1], Alexander Kabat vel Job[2], Ali Dawi[2], Fred Mendonca[3]

[1]Engineering System International Gmbh, Siemenstrasse 12, 62263, Neu-Isenburg, Germany
[2]Volkswagen AG, Brieffach 011/1697, 38440 Wolfsburg, Germany
[3]ESI-OpenCFD, Unit 6, The Courtyard, Eastern Road, Bracknell, RG12 2XB, UK

The calculation of wind noise in automotive applications is becoming increasingly important. The emergence of electric vehicle, in which engine noise is substantially reduced, and the concurrent reduction of rolling noise lead into a growing importance of wind noise prediction in the product development process. In addition, a reliable CFD solution for wind noise prediction is of great interest in order to reduce expensive and time-consuming wind-tunnel studies and to identify appropriate solutions at an early stage of the development process.

This talk will especially focus on aeroacoustic calculations with OpenFOAM [1] in the scope of industrial applications and the resulting constraints, such as stability on automatically generated meshes (with collapsed layers, grid refinement interfaces, etc), several days simulation time (at least for incompressible), deterministic results on different HPC architecture (in order to capture accurately design change), and formatted data for vibro-acoustics calculations.

Two different methods for aeroacoustic calculations will be presented, a hybrid and a direct one.

The hybrid method (incompressible) involves a CFD simulation as a first step for the calculation of noise generation and its propagation as second step. One way to estimate the radiated acoustic field are integral formulations such as the Kirchhoff or Fwocks-Williams Hawkins surface integrals, which can be utilized for the extrapolation of acoustic waves to any observer locations outside the source region. The noise sources can be provided by a well-established incompressible CFD simulation, assuming that hydrodynamic surface pressure fluctuations are responsible for noise generation. The hybrid method is first validated with a full-scale test body of the SAE fullback type 4 and then with a real production car [2].

The direct method (compressible) enables a simultaneous calculation of hydrodynamic as well as acoustic pressure fluctuations and their propagation. The direct method is validated with a two square cylinders in tandem arrangement [3] and then with a more complex case: the SAE generic vehicle model [4].

[1] https://www.openfoam.com/

[2] A. Kabat vel Job, M. Hartmann, J. Sesterhenn, *Prediction of the Interior Noise Level for Automotive Applications Based on Time-Domain Methods, Inter Noise (2016).*

[3] A.H. Dawi, R.A.D. Akkermans , *Direct and integral noise computation of two square cylinders in tandem arrangement, JSV, vol. 436 (2018).*

[4] A.H. Dawi, R.A.D. Akkermans, *Spurious noise in direct noise computation with a finite volume method for automotive applications, IJfHFF, vol. 72 (2018).*