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Siemens Industry Software NV
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Internship proposal

Aeroacoustic source localisation in confined spaces by image-source beamforming

Internship location: Siemens Industry Software NV, Leuven, Belgium

Duration: 4-6 months

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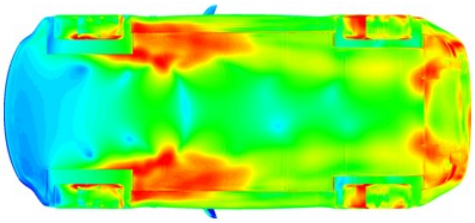
Project summary:

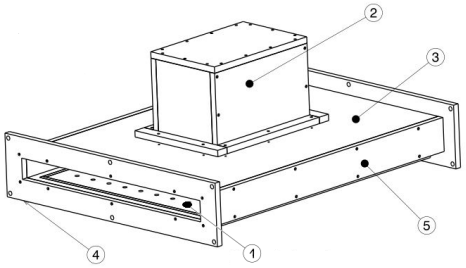
This project is part of project TUMULT (TUrbulent flow noise Modeling for Under- and upper- body Load and Transmission analysis), funded by the Flemish agency for innovation in science and technology, and in collaboration with the university of Leuven and the Von Karman institute of fluid dynamics. One of our tasks is to develop a method for identifying aeroacoustic sources of noise on a vehicle under-body by using a microphone array.

The internship aims at combining the image source method with inverse beamforming techniques for sound source localisation in enclosed spaces. Recent progress on generalised inverse beamforming[1] [2] has allowed to efficiently separate sources located very close to each other. However, beamforming relies on the assumption of free-field propagation. The image source method[3] [4] provides an adequate description of the sound field in enclosed or semi-enclosed spaces such as auditoriums or polygonal panels. Including complicating elements as part of the image sources (i.e. the random nature of the source and the existence of convection) will also be investigated.

The work will essentially focus on the implementation of the methods, with experimental work in collaboration with the Production engineering, Machine design and Automation group (PMA) at the university of Leuven.



(a) Simulated sound pressure distribution on the underbody of a vehicle [O. Szulc, Siemens Industry Software & IMP Polish Academy of Sciences]



(b) Test rig under development at KU Leuven. (1) Microphone array, (2) car cavity mock-up, (3)-(5) wind tunnel section.

Candidate profile and required skills:

A Masters student in mechanical engineering, applied physics, acoustics or related areas, with good knowledge of Fourier-based signal processing. Comfortable use of scientific computing (e.g. GNU Octave, Python, Matlab) and working proficiency in English is required.

Practical information: Siemens Industry Software provides the accommodation during the period of the internship.

[1] P.A.G. Zavala W. De Roeck, K. Janssens, J.R.F. Arruda, P. Sas, W. Desmet. Generalized inverse beamforming with optimized regularization strategy. Mechanical Systems and Signal Processing 25 (2011) 928939.

[2] C. Colangeli, P. Chiariotti, G. Battista, P. Castellini and K. Janssens. Clustering inverse beamforming for interior sound source localization: Application to a car cabin mock-up, 6th Berlin Beamforming Conference 2016.

[3] F.P. Mechel. Improved mirror source method in room acoustics. Journal of Sound and Vibration (2002) 256(5), 873-940.

[4] J. Cuenca , F. Gautier, L. Simon. The image source method for calculating the vibrations of simply supported convex polygonal plates. Journal of Sound and Vibration 322 (2009) 10481069.