PhD Position on

"Recognition, separation and characterisation of new noise sources in vehicles"

In the framework of the H2020 Marie Sklodowska Curie project PBNv2 – Next generation Pass-By Noise approaches for new powertrain vehicles (ETN GA721615, https://www.h2020-pbnv2.eu/) – the engineering school INSA-Lyon (France, https://www.insa-lyon.fr/en/) is searching for a candidate to join the team working on the subject "Quality of source field reconstruction from the point of view of acoustic perception". Hosted by the Laboratory of Vibration and Acoustics (LVA, http://lva.insa-lyon.fr/en/) of INSA-Lyon, the PhD position will start on September 2017 for three years. Lyon (http://www.onlylyon.com/en/) is one of the biggest French cities.

Description of work

The goal is to develop acoustical techniques dedicated to finely understanding vehicle noise sources on an experimental basis and hence to feed the transfer path. The central idea is to expand the overall radiated noise measured on an array of microphones into a "causal sum" of spatial distributions of acoustical sources originating from distinct physical phenomena. The ambition is to respond to an everlasting industrial need for identifying, localising, and ranking superposed noise sources of various origins.

Innovative aspects: identification and ranking of individual vehicle noise sources. Source field reconstruction using iPTF inverse method and coupling to analysis of psychoacoustic effects.

Research program

The separation of noise sources follows a multistep process, which starts with the measurement of the radiated acoustical field by an array of sensors, the inversion of a model of acoustic propagation to recover the particle velocity on the skin of the object of interest, and finally the decomposition of the velocity distribution into its components of different origins.

The research program will address all these aspects, with a special focus on the recent iPTF method which has demonstrated a very good ability to solve the inverse problem based on a finite element model of a virtual cavity that surrounds the object of interest, even in reverberant environments [1]-[3]. One objective will be to investigate the effect of modelling errors on the inversion and, in particular, to quantify to which degree the finite element model can be coarsened while still returning results which are judged qualitatively good enough from a perceptual point of view. To reach this objective, some numerical and real experiments will be carried out to apply the source reconstruction process on a source of complex shape (a part of an engine for example). Then the reconstructed field will be used to estimate the radiated pressure using a simple acoustic radiation model on some control microphones.

The last step of the project (separation of sources) will consist in post-processing the results of the inversion step with statistical techniques in order to extract sources that are as statistically independent as possible. It will make use of some recently proposed criteria in the context of acoustics [4][5].

The candidate should have some skills on experiments and numerical simulation (Finite Element methods) and should be at ease with scientific computer programming (Matlab, Python, for example). The candidate should be able to write scientific articles in a good English.

[1] C. Pézerat, Q. Leclère, N. Totaro, M. Pachebat, Identification of source velocities on 3D structures in non-anechoic environments: Theoretical background and experimental validation of the inverse patch transfer functions method, Journal of Sound and Vibration, Volume 329, Issue 18, 30 August 2010, Pages 3691-3708

[2] N. Totaro, D. Vigoureux, Q. Leclère, J. Lagneaux, J.L. Guyader, Sound fields separation and reconstruction of irregularly shaped sources, Journal of Sound and Vibration, Volume 336, 3 February 2015, Pages 62-81

[3] S. Forget, N. Totaro, J.L. Guyader, M. Schaeffer, Source fields reconstruction with 3D mapping by means of the virtual acoustic volume concept, Journal of Sound and Vibration, Volume 381, 27 October 2016, Pages 48-64

[4] Bin Dong, Jérôme Antoni, Erliang Zhang, Blind separation of sound sources from the principle of least spatial entropy, Journal of Sound and Vibration, Volume 333, Issue 9, 28 April 2014, Pages 2643-2668

[5] Bin Dong, Jérôme Antoni, Antonio Pereira, Walter Kellermann, Blind separation of incoherent and spatially disjoint sound sources, Journal of Sound and Vibration, Volume 383, 24 November 2016, Pages 414-445

Location:

Laboratoire Vibrations Acoustique
Campus LyonTech la Doua - INSA de Lyon
Bâtiment St. Exupéry
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Salary: around 2360€/month free of charge

Start: September or October, 2017.