Aeroacoustic source localization using bayesian approaches

Key words: source localization, aeroacoustics, bayesian statistics, signal processing

Department: Aerodynamics, Energetics and Propulsion Department

JOB DESCRIPTION:

Global economic and demographic expansion is leading to an increase in noise pollution associated with land and air transportation as well as new energy developments (wind power). Noise pollution regulations are becoming increasingly strict and the reduction of aerodynamic noise sources, known as aeroacoustics, is therefore a major challenge. The characterization of aeroacoustic sources in the pre-project phase by means of wind tunnel tests is a key step to help understand noise generation mechanisms and to be able to develop effective noise reduction strategies.

For this purpose, various source localization techniques have been developed. The most well known is called Beamforming and was developed by Billinglsey and Kinns [1] in 1974. This technique is based on the assumption that the sound field radiated by the sources under study follows a certain source model (usually monopole). It is then possible to localize the acoustic sources from farfield microphone measurements by interpreting the propagation delays measured between each microphone of the antenna and by knowing the source-antenna distance. However, the use of inverse methods is required for the evaluation of the sound level of the studied sources. Different methods based on deconvolution algorithms have been developed for that purpose: CLEAN [2], DAMAS [3].

More recently, source localization techniques based on bayesian statistics have also been developed [4]. These techniques offer an original solution to the inverse problem of acoustic source localization. Work has been done in recent years to evaluate the potential of these methods on simple test cases ([5], [6]). This approach seems particularly promising for the localization of aeroacoustic sources in wind tunnels and has already shown its potential in other fields of aeroacoustics, such as the characterization of porous materials [7] or the impedance reduction of liners under grazing flow [8].

MISSION:

The objective of this post-doctoral fellowship is to evaluate the potential of bayesian approaches for the localization of aeroacoustic sources. Bayesian methods allow to take into account some prior knowledge about what we are looking for, which introduces a form of regularization of the inverse problem. The idea will be to extend the methods available in the literature [9] for example to problems of correlated sources encountered on rotating objects.

The methodology developed will be compared to source localization codes available in the laboratory (beamforming, CLEAN-SC, CIRA, Deep Learning [10]...) or accessible online (http://acoular.org/). The performances of the different algorithms will be evaluated on synthetic source fields (monopoles, dipoles...) and data of increasing complexity, for example: loudspeakers or propellers in anechoic room, measurements in aeroacoustic wind tunnels, numerical LES simulations.

REQUIRED PROFILE:

We are looking for candidates with a PhD in acoustics or applied mathematics. Knowledge in signal processing is a plus to approach this theme. Candidates will also be required to program in Matlab and/or Python.

DURATION: 12 months renewable for a maximum of 3 years –

COMPENSATION:

Directorate General of Armaments (DGA)

LOCATION: : ISAE-SUPAERO, 10 avenue Edouard Belin – BP 54032, 31055 Toulouse Cedex 4, France

RESPONSIBLE OF THE SUBJECT:

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