Postdoc position at ISAE-SUPAERO

Acoustic source localization using deep learning

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Location : ISAE-SUPAERO, 10 avenue Edouard Belin – BP 54032, 31055 Toulouse Cedex 4, France
Duration : for 1 year from the 1st of October 2021
Salary (indication) : 2200 €/month
Keywords : acoustics, source localization, deep learning, artificial intelligence

Context and objectives :

Artificial intelligence (AI) is now used in many engineering fields as a new approach to handle complex problems and elaborate physical models. Based on the training of large neural networks, deep learning (DL) is one of those methods which has shown outstanding results. In fluid mechanics, breakthrough in numerical methods can be expected by using such a technique to develop complex physical models, or accelerating current numerical solvers. Yet, the small amount of studies dedicated to fluid mechanics suggests that progress is still required to make these methods mature and reliable.

The Department of Aerodynamics, Energetic and Propulsion (DAEP) at ISAE-SUPAERO is currently applying DL techniques to several problems encountered in fluid mechanics, involving data from experiments or numerical simulations. This postdoc position will complement the current team to apply AI to tackle acoustic problems. Precedent work was done on the use of deep neural networks to approximate numerically acoustic wave propagation in complex media, and on the application of deep learning to tackle the inverse problem of acoustic source localization.

For the latter, standard techniques exist known as acoustic imaging methods and based on microphone array measurements associated to localization algorithms. The most common is the beamforming technique that performs a spatial filtering operation that makes it possible to map the distribution of the sources at a certain distance from the array. This method presents some limitations: spatial aliasing, noise sensitivity, source model… Some of them can be limited by applying deconvolution algorithms such as CLEAN or DAMAS to the microphones cross-spectral matrix. Previous work shows the potential of using DL to deconvolute beamforming maps respect to standard deconvolution algorithms (see Figure 1). A way to overcome the limitations encountered with the beamforming technique will be to apply DL directly to time signals recorded by the microphones. This is the path proposed in this postdoc

position. The potential of this method will be assessed first numerically by using synthetic source fields, and then by applying the technique to experimental data obtained in anechoic room.

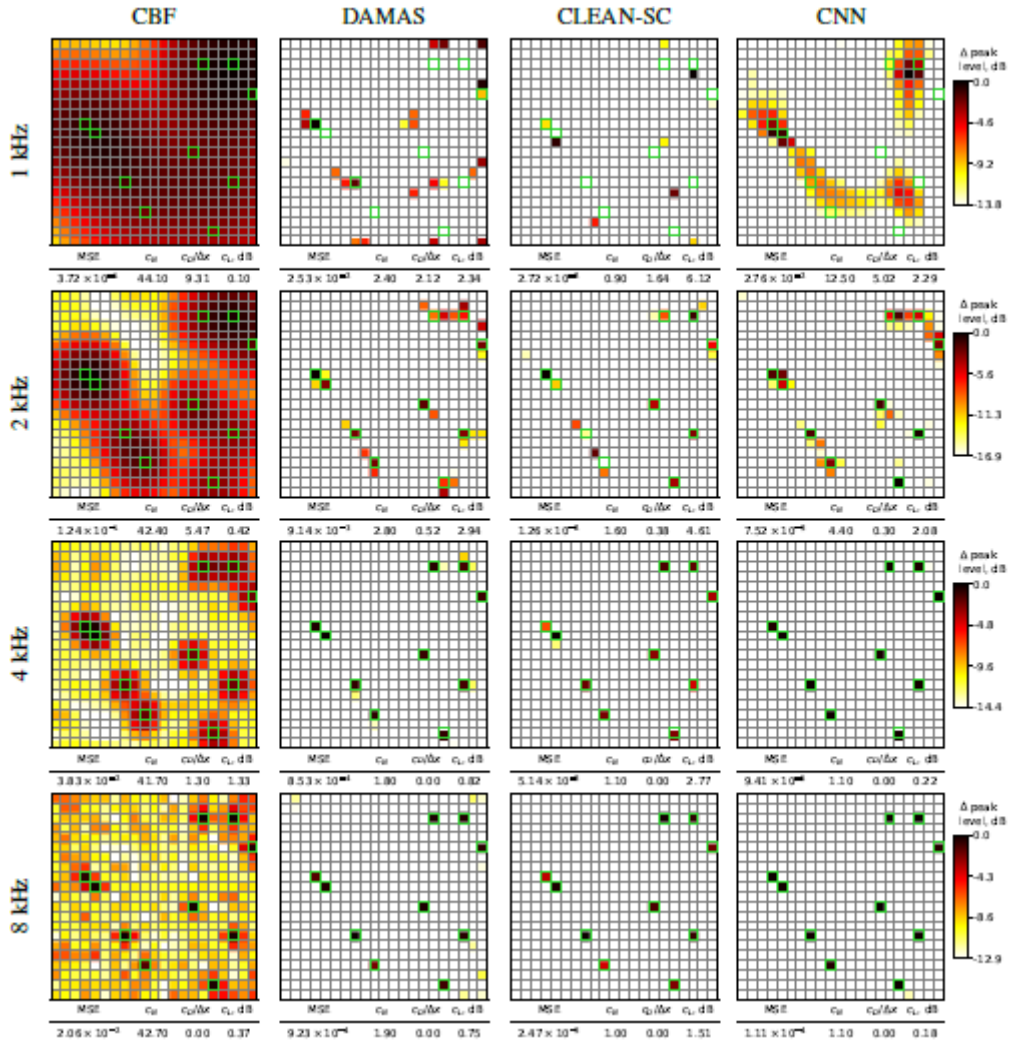

Figure 1 : Comparison of acoustic maps obtained by conventionnal beamforming (CBF), deconvolution methods (CLEAN, DAMAS) and convolutional neural network (CNN) for 10 sources positionned randomly from 1 kHz to 8 kHz (W. Gonçalves Pinto, M. Bauerheim, H. Parisot-Dupuis, *Deconvoluting acoustic beamforming maps with a deep neural network*, Internoise 2021.).

Requirements :

The postdoc candidate has a PhD with a strong background in acoustics or fluid mechanics and/or artificial intelligence. Coding skills (Python, C++, pyTorch…) are required. Analytical modelling skills and a knowledge on either CFD or experiments dedicated to acoustics or fluid mechanics would also be appreciated. Oral and writing skill in English is mandatory. Please send a cover letter, a CV, a list of relevant publications as well as recommendation letters.