Postdoc position at ISAE-SUPAERO

Acoustic wave propagation and source detection by deep learning

Advisors: Michaël Bauerheim, Hélène Parisot-Dupuis
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Location: ISAE-Supaéro (Toulouse, France)
Expected starting data: from 1st of October 2019
Duration: from minimum 1 year, to maximum 3 years, **fully funded**
Keywords: acoustics, source detection, deep learning, artificial intelligence

Context and objectives:

Artificial Intelligence (AI) recently emerges in many engineering fields as a new approach to handle complex systems and elaborate physical models. Based on the training of large neural networks, Deep Learning 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 AI for 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 deep learning 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. In particular, two axes will be developed: (*i*) the use of deep neural networks to approximate numerically the propagation of acoustic waves (see Fig. 1) in complex media (obstacles, inhomogeneous sound speed, etc.), and (*ii*) the application of deep learning to tackle the inverse problem, i.e., to detect the initial acoustic sources from the back-propagation of acoustic waves. While standard techniques already exist for these two problems, artificial intelligence allows the development of new approaches, potentially not limited by classical constraints such as the CFL number in high-order compressible simulations, or the presence of noise measurements for the detection of acoustic sources. In the second part of the project dedicated to the detection of acoustic sources, experiments will be carried out in the anechoic chamber at ISAE-Supaéro.

This postdoc will complement an existing PhD already on-going at ISAE-Supaéro dedicated to AI methods for acoustic wave propagation (Fig. 1). This postdoc is part of the DGA project POLA[3]. In addition to the scientific and technical background, it therefore requires good soft skills, in particular in collaborative working; participating in group meetings etc.

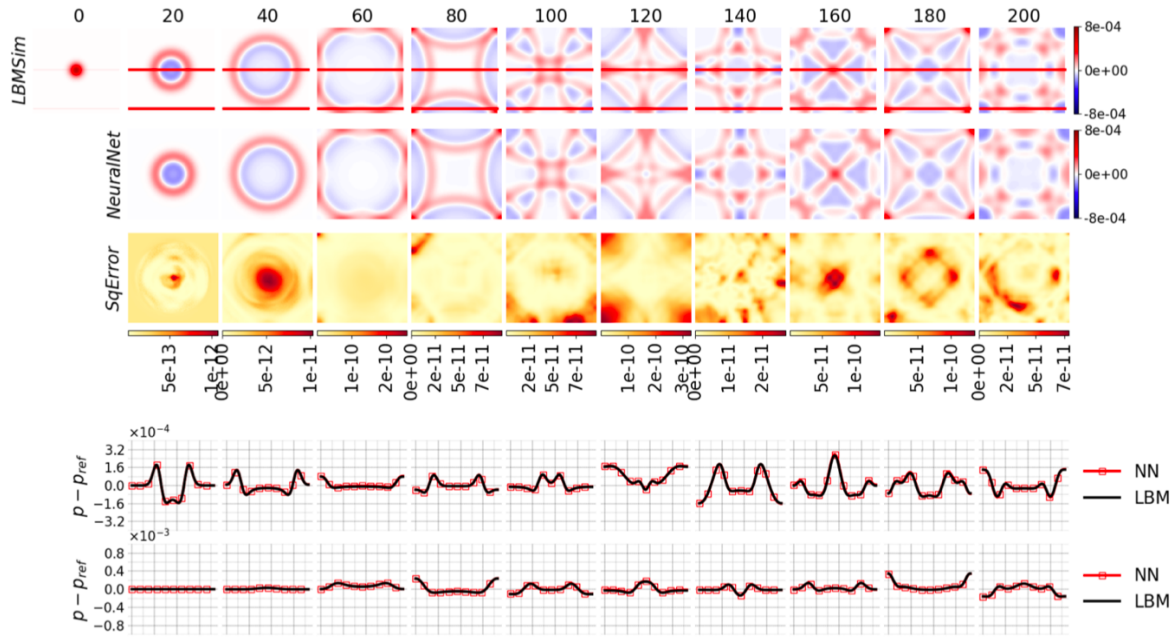

Fig. 1 Comparison between the classical propagation of an acoustic gaussian pulse by a Lattice Boltzmann Method (LBM, top) and the same case obtained by artificial intelligence (NN, middle), revealing a very good agreement (3 bottom rows).

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, etc.) are required. Analytical modelling skills and a knowledge on either CFD or experiment dedicated to aeroacoustics would be also 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.

Salary (indication):

2200 euros/month