ABYSOUND project

Post-doctoral position offer

Coupling a finite-spectral element method with a parabolic equation method for numerical simulation of wave propagation in underwater acoustics

Duration : 18 months Starting date between 01/09/2017 and 01/11/2017
Location : Laboratoire de Mécanique et d'Acoustique (LMA), Marseille, France
Net salary : 2080 €/month (full health coverage included for free).

The ABYSOUND project objective is to establish the feasibility of the development of an underwater system which will be able to estimate noise generation by sea-floor mining in deep waters and to evaluate its impact on marine life. To this end, several partners, headed by DCNS, have gathered to propose a project to meet this need for characterization imposed by new regulations. One of the tasks of this project concerns the modeling of acoustic wave propagation generated by sound sources associated to these underwater activities. Given the complexity of the source, the topography of the environment and its proximity to the sediment, which must be considered as elastic, numerical codes conventionally used in underwater acoustics are not well-adapted. Only numerical methods of the finite element type are able to handle such a complexity without any approximation.
In recent years, several works conducted at Laboratoire de Mécanique et d'Acoustique in Marseille has shown the usefulness of a spectral-finite element method in the context of wave propagation modeling in underwater acoustics [1,2,3]. In particular, it combines the flexibility of finite element methods with the accuracy of spectral methods. It is also very well-adapted to high performance computing. Nevertheless, it is still difficult, even for 2D configurations, to carry out numerical simulations for long ranges because of the large number of wavelengths the distances represent. It is then necessary to find a compromise.
The solution considered in this project and which is the subject of this post-doctoral internship will consist in combining a spectral-finite element method with a parabolic equation method. The spectral finite element method will be implemented in regions where the complexity requires it i.e. mainly close to the source. Then, the results generated by the spectral-element method will be used as a starting field for a parabolic equation method in order to simulate the propagation of acoustic waves in the ocean at long ranges for evaluating how acoustic energy injected in the ocean by underwater human activities is distributed. Energy maps which may be generated from the results of these numerical simulations will be essential for evaluating the potential impact on marine mammals of this source of noise. The work of the candidate will consist in implementing the coupling of these two numerical codes.

As a consequence, this combination will make it possible to obtain numerical solutions closer to physical reality in the context of wave propagation in marine environments in complex configurations. It is also worth mentioning that the development of such a numerical tool will also benefit to a wide range of applications in underwater acoustics.

Candidate profile :

Skills :

1. Knowledge of wave propagation in underwater acoustics and its numerical modeling (finite elements and finite differences etc...).
2. Compulsory knowledge of computer language (Fortran, C, C++, Python...).

The research program proposed here will involve a lot of scientific computing and programming to modify / enhance existing computer codes.

Skills that would be a plus : Knowledge of meshing software (Gmsh, GiD, CUBIT, TetGen or similar) and/or High-Performance Computing (HPC), Message-Passing Interface (MPI), OpenMP.

Contacts :

This postdoc will take place at Laboratoire de Mécanique et d'Acoustique de Marseille, France (http://www.lma.cnrs-mrs.fr) , in the « Waves and Imaging » team.
Web site:
http://www.lma.cnrs-mrs.fr/spip/spip.php?page=team&id_mot=16&lang=fr

Contact : Paul CRISTINI, mail : cristini@lma.cnrs-mrs.fr, tel : 04 84 52 42 51

Application :

Please send:
a detailed CV and full list of publications,
a letter of application with a statement of research interests
a list (with email addresses) of people who can write recommendation letters

to Paul Cristini (cristini@lma.cnrs-mrs.fr).

REFERENCES:

[1] P. Cristini and D. Komatitsch. Some illustrative examples of the use of a spectral-element method in ocean acoustics. Journal of the Acoustical Society of America, 131(3) :EL229–EL235, 2012.
[2] X. Zie, R. Matzen, P. Cristini, D. Komatitsch, and R. Martin. A new PML formulation for coupled fuid-solid problems : Application to numerical simulations in ocean acoustics with solid ocean bottoms. Journal of the Acoustical Society of America, 140 :165, 2016.
[3] A. Bottero, P. Cristini., D. Komatitsch, and M. Asch. An axisymmetric time-domain spectral-element method for full-wave simulations : Application to ocean acoustics. Journal of the Acoustical Society of America, 140 :3520, 2016.