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THE FRENCH AEROSPACE LAB

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POST-DOCTORATE PROPOSAL

Title : Computation of jet noise with One Way approach

Reference: **PDOC-DMPE-2024-07**
(to be recalled in all correspondence)

Start of contract:	**Application deadline: 31 dec 2024**

Duration: 18 months - Gross salary: about 38 k€ (medical insurance included)

Keywords

Jet noise, flow instability, wave propagation, operator factorization, One Way equations

Profile and skills required

Applied mathematics, numerical analysis, fluid mechanics, flow instability, aeroacoustics, noise radiation, Fortran parallel programming

Presentation of the post-doctoral project, context and objective

Numerical computation of long-range wave propagation is often expensive since the equations are basically elliptic and they must be solved in the whole space domain. Therefore, considerable efforts have been devoted for several decades to the transformation of the propagation equations into a parabolic system, which can be integrated by space marching. In particular, the One Way equations are obtained by algebraic factorization of the wave operator. They are used for example to describe the propagation of acoustic, seismic or electromagnetic waves. Recently, a modified approach combining operator decomposition in the wave direction and numerical discretization in the transverse direction has been proposed by Towne & Colonius (2015). One of the key advantages of this approach is that it does no longer require tedious algebraic factorization and it can therefore be applied to more complex systems of equations, such as the linearized Euler or Navier-Stokes equations to describe the propagation of waves in inhomogeneous flows.

Two doctoral works have already been carried out at ONERA Toulouse to improve the numerical One Way approach and a Fortran code has been developed. The purpose of the post-doctoral training will be to continue to improve the code capability and to apply it to a practical problem such as the low-frequency sound radiation of jets due to the instability of the jet shear layer. First, the growth of fluctuations inside the jet shear layer will be computed by One Way method and compared with the results of parabolized stability equations (PSE). Then the sound radiation will be deduced and compared with LES and experimental data, first for a circular single-stream jet, then for a coaxial double-stream jet. The test cases will be defined in coordination with Airbus Aircraft and with Pprime Institute, which will also provide experimental data, in the frame of a collaborative research program funded by the French Civil Aviation Authority.

External collaborations : Airbus Aircraft (Toulouse), Pprime Institute (Poitiers)

Host laboratory at ONERA

Department: Multi-Physics for Energy

Location (ONERA centre): Toulouse, France

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