**Research Topic for the ParisTech/CSC PhD Program**

*Field:* Mathematics and their applications  
*Subfield:* Applied Mathematics  
*Title:* Acoustic propagation in a fluid in flow  
*ParisTech School:* ENSTA Paris  
*Advisor(s) Name:* MERCIER Jean-Francois  
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*Research group/Lab:* POEMS  
*(Lab/Advisor website):* https://uma.ensta-paris.fr/

**Short description of possible research topics for a PhD:**
The PhD is in the field of Aeroacoustics, which aims at describing the coupling between acoustic waves and a fluid in flow, notably in the presence of a structured wall or a structured rigid film. The main application is the sound reduction of the noise emitted by airplanes. The sound flow interaction takes different forms involving different physical mechanisms (refraction, diffraction, Doppler effect ...) which have to be properly addressed theoretically and precisely reproduced in numerical computations. Additional complexities arise when the background flow contains a thin layer with a strong gradient. This arises typically for a fluid flowing close to a rigid wall and becomes more complex when the wall is structured (roughnesses, surface treatment as honeycombs, ...) which is often the case in practical aeroacoustic applications. In this case, the numerical treatment has to account for two very different scales (that of the structured wall and that of the incident wavelength or of the flow variations), which becomes numerically time consuming or even may be numerically too costly. The aim of the PhD is twofolds: to use homogenization techniques to replace the microstructure (or the boundary layer of the flow) by effective boundary or transmission conditions and to develop numerical methods which account for these effective conditions.

**Required background of the student:**
The PhD requires a solid background in theoretical mechanics. Skill in mathematics and numerics are desirable: the student will have to develop theoretical calculations (asymptotic expansions, Green formula integration) and numerics (Matlab typically or Finite Elements method).

**A list of 5(max.) representative publications of the group:**