2SC5791 – Design of a cladding : Control of external acoustic pollution

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Department: DOMINANTE - MATHÉMATIQUES, DATA SCIENCES
Language of instruction: FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 40
On-site hours (HPE): 27,00

Description
We are positioning ourselves on the industrial stakes which impose the economic constraints and the technological constraints necessary for the improvement of the existing products of the market, to design innovative coatings to absorb the noise of the planes, trains, cars. The aim is to develop these innovative products in an optimal way by controlling the energy of the waves by the geometry of the wall while taking into account the economic constraints. For example, COLAS and École Polytechnique have developed an anti-noise wall called "Fractal Wall" TM, which was designed empirically with complex geometry to dissipate different wavelengths. However, this wall even if it is four times more efficient than conventional walls for low frequencies, is almost not sold ... The explanation is that its construction, being by demolding, may break the wall, this which results in a high cost of manufacture. This IS proposes to find by wave control methods optimal forms that are as absorbent as possible (in decibels) that satisfy the constraints imposed by the manufacturer, for example, the least expensive manufacturing cost with the greatest reduction. important decibels. First numerical results in this context show the existence of optimal "not too complex" forms capable of improving the performance of the "Fractal wall" by a factor of 6.

Quarter number
ST5

Prerequisites (in terms of CS courses)
The courses of ST5 and in particular the course "Theory and algorithmics for wave control" (one of two proposed tracks)

Syllabus
Teamwork simulated an "industrial company", definition of issues, bibliographic research, physical understanding and practical interest,

mathematical modeling of the problem, development of the corresponding mathematical theory if necessary (the problem well or badly posed, regularity of the solution , derivation of acoustic energy with respect to the geometry of the wall, influence of choice of chosen porous material on the absorption of energy, ...), development / implementation of the numerical method, numerical analysis of the results , the analysis of their relevance, possible improvement, obtaining an effective shape for a large band of frequencies.

Class components (lecture, labs, etc.)
Teamwork, project, dialogue with various specialists in the field.

Grading
Report, final and intermediate deliverables, defense.

Resources
Connection to a cluster at the distance

Students will perform modeling, simulation, visualization and rendering of the chosen phenomenon. They will study the simulation chain with a goal of performance and precision under economic constraints (manufacturing cost) and environmental (gain in decibel or potential).

Deliverables: report, software, transparencies and defense

Learning outcomes covered on the course
Understand the contribution of geometry in the design and development of new products
To understand the theoretical and numerical techniques of acoustic wave control
Implement numerical methods to simulate acoustic wave propagation phenomena of large dimensions (external problems and problems for a wide band of frequencies)
Validate the theoretical and numerical techniques of acoustic wave control
Confront students with the realization of a complex product using numerical simulation techniques

Description of the skills acquired at the end of the course
C4.1 Thinking customer. Identify / analyze the needs, issues and constraints of other stakeholders, including societal and socio-economic: study of industrial, psychoacoustic and environmental interest for the determination of the constraints of the control problem.

C6.1 Identify and use the software necessary for his work on a daily basis (including collaborative work tools). Adapt your "digital behavior" to the context: use and development of a numerical code based on existing parts.

C7.1 Convince on the merits. Be clear about the objectives and the expected results. Be rigorous about the assumptions and the approach. Structure your ideas and your argumentation. Highlight the created value. To convince while working on the relation to the other: by working in team the strategic choice is crucial to have good results of the project, to do it it is necessary to be able to convince the others; teamwork itself; the final defense before a multi-disciplinary jury.