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## 2SC5792 – Design of a cladding : Indoor noise pollution control

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**Instructors:** Frédéric Magoules

**Department:** DOMINANTE - MATHÉMATIQUES, DATA SCIENCES

**Language of instruction:** FRANCAIS

**Campus:** CAMPUS DE PARIS - SACLAY

**Workload (HEE):** 40

**On-site hours (HPE):** 27,00

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### Description

We focus on the industrial issues that impose the economic constraints and the technological constraints necessary to improve existing products on the market, in order to design interior coatings to absorb the noise inside the buildings and also acoustic liners in jet engines. In this context we are interested in three key applications: (i) the design of coatings in anechoic chambers (until now acoustic anechoic chambers have been empirically designed based on geometries using different scales), (ii) ) the design of perforated absorbent panels (absorbent materials are fibers that have very good acoustic absorbency properties, and are usually covered with wooden panels for aesthetic reasons, which unfortunately hampers their effectiveness) and finally (iii) ) absorbent insulations perforated in jet engines. In the last application it is important to optimize the diameter and positioning of the holes in the material. The objectives are to better control the waves by analyzing the optimal shape of the surface of these coatings in order to improve the sound absorption in decibels by taking into account the stakes and industrial constraints.

### 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
- Apprehend the theoretical and numerical techniques of acoustic wave control
- Implement numerical methods to simulate acoustic wave propagation phenomena of large dimensions (internal 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 by 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 the 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.