VIPER-ACOUTECT SUMMER SCHOOL

3-5 JUNE 2019
LEUVEN-BELGIUM

Joined Summer school on Innovative Acoustic Materials and Product Development with a focus on Vibro-Acoustic Metamaterials

This summer school is organized in the framework of the EU MSCA projects VIPER and ACOUTECT. It gives a introduction to the main physical principles of sound absorption and sound transmission loss and discusses the working principles of classical visco- and poro-elastic media and more recent metamaterials. Also an introduction to duct acoustics and innovative solutions for duct noise are presented.

Consortia members:

These projects have received funding from the European Union's Horizon 2020 research and innovation program under Marie Sklodowska Curie grant agreements No 675441 & No 721536.

Program

03/06/2019 PM

13h30-15h00: Introduction to physical acoustics
"Sound is all around us. We use sound to communicate, to listen to music, etc., but sound can also be a nuisance. For example, noise pollution from a nearby airport and from construction work. To effectively reduce the impact of noise, the underlying physics have to be known. In this lecture the physical principles behind sound waves are explained and detailed. We will treat, amongst others, the Helmholtz and wave equation, sound power levels, sound intensity, transmission loss and sound absorption"
Sjoerd van Ophem

15h-15h30: Coffee break

15h30-16h45: Visco-elastic material solutions for vibration damping
"Viscoelastic materials, as their name suggests, combine two different types of material behavior. They are viscous, in that they slowly deform due to an external force, and they are elastic in that they will return to their original configuration. Due to the hysteresis loop that is formed in this loading/unloading cycle, they are able to dissipate energy as heat. This capability for energy dissipation makes these materials very well suited to reduce e.g. vibrations. In this lecture, we will go deeper into the physics and we discuss ways to model these materials, with special attention to the characterization approaches to learn the material parameters that feed these models."
Stijn Jonckheere

16h45-18h00: Poroelastic materials for sound absorption
"Poroelastic materials, like foams and fibrous structures, consist of two constituents, the solid material and the fluid filling the voids. Poroelastic materials for acoustic applications are very porous (porosity > 95%) and allow energy to be dissipated by structural, viscous and thermal means which is why they are often applied as cost-efficient, lightweight sound absorbers. In this lecture the physics describing these materials, their mathematical models and their applications will be discussed."
Elke Deckers

04/06/2019 AM

9h30-11h00: Metamaterials: Theory and tools *(supported by the Flanders Make SBO IMALIGHT project)*
"In the search for innovative lightweight solutions with favourable vibro-acoustic performance, vibro-acoustic locally resonant metamaterials have recently emerged. By embedding local resonances in a flexible host structure on a sub-wavelength scale, locally resonant metamaterials exhibit frequency ranges without free structural wave propagation, referred to as stop bands. These stop bands enable targeted and tunable frequency ranges of strong vibration attenuation, reduced sound radiation and reduced sound transmission. This first lecture gives an introduction to the theory behind vibro-acoustic locally resonant metamaterials, provides an overview of their vibro-acoustic modelling and discusses their driving design parameters."
Lucas Van Belle

15h-15h30: Coffee break

11h30 – 13h00: Metamaterials: Design process *(supported by the Flanders Make SBO IMALIGHT project)*
"Since the resonant vibro-acoustic metamaterial concept is eligible for a variety of designs and production processes, their design becomes a challenging task. This second lecture deep dives into this design process of metamaterials: the design process is explained and a design tool is presented which allows selection of the most promising designs based on expected NVH performance."
Matias Clasing Villanueva

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Program

04/06/2019 PM

13h00 -14h00: Lunch break

14h00 – 15h00: Metamaterial applications - part 1 *(supported by the Flanders Make SBO IMALIGHT project)*

"As a first application case, a lightweight metamaterial concept is applied in a commercial vehicle to tackle a low frequency structure borne road noise problem. This metamaterial solution, realized through additive manufacturing, is applied on the rear shock towers of the vehicle, with the goal of attenuating the vibrational energy entering into the vehicle body through the suspension assembly, which is excited by the interaction of the tire with the road while driving. This results in similar NVH performance in the interior compartment around 190 Hz and a reduction of the mass by 48% with respect to the current NVH solution. Both numerical and experimental results on a smooth and a rough road profile validate the performance of the metamaterial concept proposed."

Luca Sangiuliano

15h-15h30: Coffee break

15h30 – 17h00: Metamaterial applications - part 2 *(supported by the Flanders Make SBO IMALIGHT project)*

"This last lecture on metamaterials puts the focus on the variety of manufacturing process which can be used to derive metamaterial solutions. As a first application, metal metamaterials are used to attenuate vibrations in a compressor piping. As a second application, a fully integrated twinsheet thermoformed metamaterial panel is produced to increase sound transmission into an acoustic cavity dominated by modal behaviour. Finally, a cheap laser cutting process is applied to derive a metamaterial to attenuate the mass-spring-mass effect in double panels, a classic NVH problem."

Noé Geraldo Rocha de Melo Filho

05/06/2019 AM

9h00 -11h00: Introduction to duct acoustics

"Heating, ventilation and air conditioning systems are crucial to maintain a healthy indoor climate in buildings, cars and airplanes, but are also an important source of noise nuisance. In this lecture, we will briefly introduce the physical principles behind the noise generation in ducted flows, study how noise propagates through a duct system, and explain how simple models can provide valuable insights in the flow-acoustic behavior of complex duct systems."

Hervé Denayer

11h-11h30: Coffee break

11h30 – 13h00: Innovative noise control in flow duct systems

"*Flow duct systems not only contain important noise sources, such as fans, compressors and valves, but the ducts themselves also act as an efficient transmission path. Performant noise control measures are therefore often needed to satisfy the legal requirements and customer expectations. This lecture will discuss widely used conventional noise control solutions , such as mufflers and liners, as well as recently proposed innovative approaches (modal filters, micro-perforated panels, …)."*

Hervé Denayer

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Participation

Participants from both academia and industry are welcome.

Registration fee: €50.
This includes coffee breaks, lunch on Tuesday and the course material.

Deadline for Registration:
23/05/2019

To register, please send an e-mail to augusto.carvalho@kuleuven.be

Venue

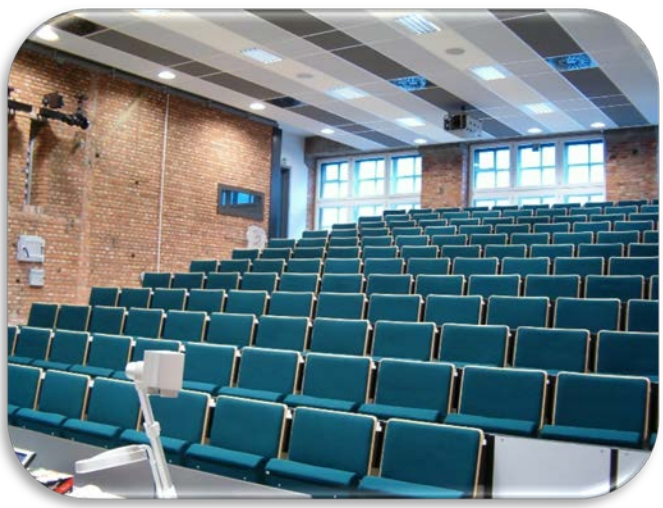
Auditorium van de Tweede Hoofdwet

Thermotechnisch Instituut
Kasteelpark Arenberg 41

3001 Heverlee
Belgium

How to get there:
https://www.mech.kuleuven.be/en/tme/thermotechnisch-instituut/routebeschrijving

Machinezaal



Auditorium van de Tweede Hoofdwet

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