Professional Software in Acoustics

ECTS: 6 ECTS

COORDINATOR: Manuel A. Sobreira Seoane (msobre@gts.uvigo.es)

UNIVERSITY WHERE THE COORDINATOR IS: Universidade de Vigo

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? Yes

LECTURER 1: Guillermo García Lomba (guille@dma.uvigo.es)

UNIVERSITY WHERE THE LECTURER 1 IS: Universidade de Vigo

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? Yes

LECTURER 2: Andrés Prieto Aneiros (andres.prieto@udc.es)

UNIVERSITY WHERE THE LECTURER 2 IS: UDC

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? Yes

CONTENTS:

Topic 1: Numerical methods in acoustics applied to one-dimensional problems

1.1 Introduction to the Numpy and Scipy libraries in Python.

1.2. Approximation of the Helmholtz equation: finite differences, finite elements and spectral element methods

1.3. Error behavior in wave propagation problems: phase shift, elongation, dispersion error and numerical pollution

1.4. Propagation of Plane Waves in a Multilayer Media: Transfer Matrix Method

Topic 2: Finite element method (FEM) in acoustics.

2.1. Introduction to the NGSolve library in Python.

2.2. Vibrations in structures: compressible fluid – elastic solid coupled problem

2.3. Acoustic dissipation: compressible fluid – porous material coupled problem

2.4. Vibration transmission: compressible fluids in the presence of wall impedances, porous veils, and thin plates

2.5. Finite element approximation of an unbounded problem: absorbent conditions and Perfectly Matched Layers (PML)

Topic 3: FEM/BEM applications to acoustic problem solving.

3.1 OpenBEM modeling of 2D and 3D cavities and rooms.

3.2 Modeling radiation problems.

3.3 Design of acoustic barriers using BEM.

3.4 Modeling acoustic problems with COMSOL Multiphysics.

METHODOLOGY:

The focus of the subject is fundamentally practical. A brief theoretical summary will be presented at the beginning. The numerical methods and models are described before moving on to the explanation of the different software alternatives for modeling acoustic problems.

Given the practical nature of the subject, students will dedicate most of their time, under the supervision of the teacher, individually to familiarize themselves with the computer packages presented as well as to solve the exercises and problems that will arise throughout the course.

With the methodology described above, the part of the CG1, CG4, CE4, CE5, CS1, and CS2 competencies that are contemplated in this subject is worked on.

LANGUAGE: Spanish.

IS FACE-TO-FACE ATTENDANCE REQUIRED TO ATTEND CLASSES? The subject is developed entirely by videoconference. The recording of the classes allows you to follow the sessions later. Face-to-face attendance is not strictly necessary, but it is highly recommended due to the discussions, doubts and clarifications that may arise during the interactive session.

BIBLIOGRAPHY

- D.T. Blackstock. Fundamentals of Physical Acoustics. John Wiley & Sons. New York, 2000.

- G.C. Cohen. Higher-order numerical methods for transient wave equations. Springer-Verlag. Berlin, 2002

- COMSOL Acoustics module. User's Guide and Model Library.

- F. Ihlenburg. Finite Element Analysis of Acoustic Scattering. Springer-Verlag. Berlin, 1998.

- The Boundary Element Method for Sound Field Calculations. PhD Peter Moller Juhl. Disponible en http://www.openbem.dk/

- Schöberl, Joachim. Netgen/NGSsolve. Software disponible en https://ngsolve.org, 2017.

SKILLS

Basic and general:

CG1: To have knowledge that provide a basis or opportunity for originality in developing and / or applying ideas, often within a research context, knowing how to translate industrial needs in terms of R&D in the field of mathematics Industrial.

CG4: To have the ability to communicate the findings to specialist and non-specialist audiences in a clear and unambiguous way

Specific:

CE4: To be able to select a set of numerical techniques, languages and tools, appropriate to solve a mathematical model.

CE5: To be able to validate and interpret the results, comparing them with visualizations, experimental measurements and functional requirements of the physical engineering system.

Numerical specialization:

CS1: To know, be able to select or use how to handle most suitable professional software tools (bot commercial and free) for the simulation of processes in the industrial and business sector.

CS2: To adapt, modify and implement software tools for numerical simulation

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WILL YOU BE USING A VIRTUAL PLATFORM? Yes: Moovi (moovi.uvigo.gal), Microsoft TEAMS and Virtual Campus of Vigo University.

WILL YOU BE USING ANY SPECIFIC SOFTWARE? .COMSOL Multiphysics (acoustic module), Matlab, Python (Numpy, Scipy and NGSolve libraries), and proprietary software.

CRITERIA FOR THE 1ST ASSESSMENT OPPORTUNITY

The student will be evaluated from the exercises and problems throughout the course and a practical final examination. The tests / activities described above fully evaluate the part of the competences CG1, CG4, CE4, CE5, CS1, and CS2 worked on this subject.

CRITERIA FOR THE 2ND ASSESSMENT OPPORTUNITY

The student will be evaluated from the exercises and problems throughout the course and a practical final examination. The tests / activities described above fully evaluate the part of the competences CG1, CG4, CE4, CE5, CS1, and CS2 worked on this subject.
