Acoustic propagation in inhomogeneous moving media

ECTS

3

Mots clés

Description du contenu de l'enseignement

Objectifs

Some noise sources can propagate over large distances, and interact in a complex manner with the propagation medium and with the frontiers of the domain. The objectives of this course are to:

- describe the physical phenomena involved in acoustic propagation: ground reflection and topography interaction, refraction effects, diffraction by obstacles, scattering by turbulent fluctuations and other inhomogeneities, etc.;
- propose models to account for these phenomena;
- apply relevant numerical methods to solve an acoustic propagation problem in a specific situation.

This course mostly focuses on the acoustic propagation in the atmospheric boundary layer, but other propagation media such as the ocean or the human body are also mentioned. Numerous application examples are presented, both for audible, infrasonic and ultrasonic sound sources.

Contenu

- Acoustic waves in a homogeneous unbounded medium
- Introduction to the atmospheric boundary layer
- Reflection of acoustic waves by a finite impedance ground
- Modeling of acoustical waves in an inhomogeneous moving medium and refraction effects
- Geometrical acoustics and creeping wave theory
- Effects of irregular terrain and noise barriers
- Scattering effects due to turbulence
- Numerical models of sound propagation: ray-tracing, parabolic equation and finite difference time domain solution of the linearized Euler equations

Compétences à acquérir

Compétences

Describe the physical phenomena involved in acoustic propagation: ground reflection and topography interaction, refraction effects, diffraction by obstacles, scattering by turbulent fluctuations and other inhomogeneities, etc.

Propose models to account for these phenomena

Apply relevant numerical methods to solve an acoustic propagation problem in a specific situation.

Compétences compélementaires

Team work in a project framework

Witing of a research report and preparing a presentation in English

Using and developing numerical codes.

Modalités d'organisation et de suivi

Coordinateur
Cotté, Benjamin, Maître de conférence, ENSTA ParisTech

Équipe pédagogique
Cotté, Benjamin, Maître de conférence, ENSTA ParisTech

Gainville, Olaf, Ingénieur de recherche, CEA/DAM/DIF

Langue
Anglais

Volume horaire
CM : 10.5h, TP : 9h, TD : 10.5h

Bibliographie, lectures recommandées

V. Ostashev: Acoustics in Moving Inhomogeneous Media (1997)

A.D. Pierce : Acoustics : An introduction to its physical principles and applications (2nd edition, 1991)

E.M. Salomons : Compatutional Atmopsheric Acoustics (2001)

Pré-requis obligatoires
Basic knowledge in linear acoustics and fluid mechanics

Période et lieu(x) enseignements

Période
A (septembre-novembre)

Lieu
ENSTA ParisTech

Mode de contrôle des connaissances
1 midterm exam (1/3 of the grade), and 1 project with defense and report (2/3 of the grade)