Non Destructive Testing

ECTS

3

Mots clés

Description du contenu de l'enseignement

Objectifs

Nondestructive testing (NDT) is of major industrial interest for insuring safety and reliability of complex structures (nuclear plants, aircrafts, pipe-lines…). Among the various NDT methods used, techniques relying on the use of elastic waves at ultrasonic frequencies are the only ones which allow inspecting the whole volume of thick components; therefore, they are routinely used. The main NDT ultrasonic techniques make use of either bulk or guided waves. This mature technology is however still subject of intensive Researches and Developments (R&D) over a broad range from academic works to practical applications, to meet the growing needs from industry. French R&D in this field is at the highest level thanks to the strong needs emanating from its nuclear and aircraft industries which possess their own R&D teams working in close relation with academic laboratories, and the transfer of fundamental results to practical use is very efficient. There is a necessity for training engineers and researchers in this science to meet the numerous needs expressed.

Contenu

A first lecture presents the industrial significance of NDT and specifically of ultrasonic NDT, investigates its history to explain the present situation of R&D to meet industrial needs by providing advanced tools (simulation, phased-array techniques). The other lectures are organized in three main parts.

The first part aims at treating elastic wave propagation in homogeneous isotropic or anisotropic media, by studying the physical bases, equating wave propagation, and deriving wave solutions (bulk waves and guides waves) –including asymptotic ones (ray)– which are classically developed for describing them. A particular emphasis will be put on the fact that, contrary to sound waves, elastic waves have different velocities related to different polarizations.

The second part enters into detailed solutions dealing with complex phenomena arising when forming ultrasonic beams and when such beams interact with defects.

The third part describes how this knowledge is implemented for designing ultrasonic testing methods: techniques exploiting time-of-flight of acquired signals after interaction with a defect, advanced imaging techniques based upon the used of phased-arrays. Nonlinear techniques which industrial implementation is under study are also broached. Lastly, practice with the software platform CIVA developed at CEA illustrates, through a few simple simulations made by students, the influence of the main parameters related to the component to be tested, to the transducer used or to the defect considered, on typical results of an examination.

Compétences à acquérir

Compétences

- Derive equations for elastic wave propagation in homogeneous isotropic or anisotropic media
- Solve problems dealing with the interaction between ultrasonic beams and defects.

- Design ultrasonic testing methods
- Practice with the software platform CIVA developed at CEA

Modalités d'organisation et de suivi

Coordinateur
Lhémery, Alain, ingénieur de recherche, CEA-LIST

Équipe pédagogique
Bonnet-Ben Dhia, Anne-Sophie, directrice de recherche au CNRS, ENSTA ParisTech

Rébillat, Marc, maître de conférences, ENSAM

Langue
Anglais

Volume horaire
CM : 20h, TD : 10h

Pré-requis obligatoires
Basic knowledge in continuum mechanics

Période et lieu(x) enseignements

Période
B (novembre-février)

Lieu
ENSTA ParisTech

Mode de contrôle des connaissances
Written or oral exam