Wave approaches to vibration control

Speaker Lecturer: Emilian Rustighi

April 13, 14, 15, 20, 21, 22, 27, 28, 29; hour: 10:00 – 12:00
Venue: Seminar room, Department of Industrial Engineering
Via Sommarive 9, Povo - Trento

Mechanical vibrations affect in a positive or negative way the efficiency, the strength and the ergonomic of many engineered structures. Vibration is caused by dynamic loads arising during operation, e.g. in all transportation vehicles, motors/generators and buildings. It is also an invaluable diagnostic tool for monitoring the long-term health of structures. This module aims to provide an in-depth physical understanding of and an ability to implement the wave approach for modelling vibration. The course concerns the physics and modelling of wave propagation in structures and solids. The theories and formulations covered by the course are applicable within structural and mechanical engineering. Firstly, an introduction is given to the basic properties of body waves in an elastic continuum. The formulation of theories for wave propagation in one-dimensional structures, including bars and beams is considered. The concepts of dissipation, dispersion, reflection and transmission in one-dimensional waveguided will be discussed. Wave propagation in plates and in shell (pipe) is also presented. Experimental techniques are covered and some recent practical applications will be given.

Syllabus:
1. Introduction to wave interpretation and dispersion curves
2. Elastic wave motion in strings, rods and beams
3. Waves in rods and beams – energy flow and damping
4. Waves in beams – forcing, reflection and transmission
5. Waves in plates
6. Vibration control
7. Experimental techniques (measurements of the dispersion curves and realization of anechoic ends)
8. Practical applications (Mapping the underworld, leak detection, anechoic end, ice removal)

Prerequisites: The participant must have a solid background in continuum mechanics and partial differential equations. Experience with numerical methods and programming is strongly recommended. The participants are expected to read the texts in the literature list before the course. The literature will be available upon registration.

Evaluation: The final evaluation consists in the completion of a project assignment.