Course offered for the PhD program
in Civil, Chemical and Environmental Engineering
Curriculum in Structural and Geotechnical Engineering, Mechanics and Materials
a.a. 2019/2020 (XXXV ciclo)

(course is open for participation of students from other PhD cycles or programs)

1. Title

Advanced computational methods in nonlinear mechanics

2. Course Description

Objective of the course is to provide the participants with refined computational methods in nonlinear mechanics. Focus will be given to iterative solutions, continuation methods, discretization techniques and reduced order models. Different sources of nonlinear behavior will be examined, with special attention to large deformations and rotations of structures, buckling problems and material nonlinearity.

3. Course Organization

Continuation methods for nonlinear problems (3 hours)

- Problem statement
- The Newton-Raphson method
- The Riks arc-length method
- Some implementation details
- An implementation in Matlab
- Some applications in solid and fluid mechanics

Large deformation analysis (3 hours)

- Solid-shell model: finite elements and isogeometric formulation
- Kirchhoff-Love shell model: isogeometric formulation and patch coupling
- Treatment of 3D finite rotations in finite element analysis of beams
- An efficient and robust iterative solution for general large deformation problems: mixed formulation and mixed integration points

A reduced order model for buckling problems based on Koiter's theory (2 hours)

- The multimodal Koiter method
- Imperfection sensitivity
- Post-buckling optimization of thin-walled composite structures

Inelastic analysis (2 hours)

- An introduction to computational plasticity: strain-driven formulation, backward Euler method and closest point projection
- Mixed finite elements and element state determination
    - Plane stress\strain problems
    - 3D frames: stress resultant model and fiber model
- A numerical strategy for Limit and Shakedown analysis

4. Teacher

Domenico Magisano, Ph.D.
Post-doctoral researcher at DIMES, University of Calabria

4. Duration and credits

10 hours (2 credits)

6. Activation mode and teaching period

The course will be delivered in e-learning mode using Microsoft Teams.

Mon 6 July 2020 9.30-12:30
Tue 7 July 2020 9.30-12:30
Wed 8 July 2020 10.30-12:30
Thu 9 July 2020 10.30-12:30

7. Deadline for registration

Fri 3 July 2020

8. Final exam

The exam will consist of a short report on one or more topics of the course.