

## **STUDENTS' ANNUAL ACTIVITY REPORT CYCLE 34 YEAR 2**

- Name and Surname: **Ehsan DANESHKHAH**
- Dottorato in **INGEGNERIA MECCANICA**
- Department **DIMEAS**
- Coordinator **Prof. Luca GOGLIO**
- Tutor: **Prof. Erasmo Carrera**
- Macroarea:

### **Nonlinear Analysis of Structures using Unified Formulations**

- Short description of research activity (maximum 20 lines)

In this research, Advanced Finite Element methods will be used to describe the mechanical nonlinear behavior of complex structures and materials. Both geometrical and physical nonlinearities will be considered in order to obtain the accurate and precise results by CUF-1D or CUF-2D nonlinear models.

The first part of this study is focused on the geometrical nonlinearities such as the large deflection and post-buckling behavior of structures for isotropic rectangular plates and composite plates with different laminations. By taking into account the three-dimensional Green–Lagrange strain components, the explicit forms of the secant and tangent stiffness matrices of unified plate elements are presented in terms of the fundamental nuclei and nonlinear parameters. The Newton–Raphson linearization scheme combined with a path-following method based on the arc-length constraint is utilized to solve the geometrically nonlinear problem. Available nonlinear CUF-2D plate model is used considering different nonlinear theories based on Green–Lagrange strain components. In this regard, the post-buckling curves and related stress distributions for each case are presented and discussed.

The second part of this PhD thesis will be focused on the implementation of Physical Nonlinearities in the CUF-1D or CUF-2D models in order to be used in the complex materials with different plastic or hyperelastic behaviors. Using the Unified Formulations, the constitutive relations of soft tissues or complex structures using continuum approaches will be investigated.

- Training activities carried out during the year (courses, seminars, etc.); for each activity specify the nature, duration, and location

• Course Name	Skill Type	Duration (hrs)	Location
Modelli agli elementi finiti avanzati per problemi meccanici e multiscampo	Hard	30	PoliTo
Writing Scientific Papers in English	Soft	15	PoliTo
Project management	Soft	5	PoliTo
Public speaking	Soft	5	PoliTo
Communication	Soft	5	PoliTo
Aeroelastic tailoring - modelling, design, manufacturability and experiments (didattica di eccellenza)	Hard	15	PoliTo
Materials by design - How structure meets function (didattica di eccellenza)	Hard	12	PoliTo
MUL <sup>2</sup> Spring School on Virtual Manufacturing and Testing of Composites	SpringSchool		PoliTo
Automotive transmissions (manual, non-manual and hybrid)	Hard	20	PoliTo

- Possible participation in further research activities during the year (research projects and agreements)
- Possible participation in internal activities to support teaching during the year (specify on which courses, named as "subject expert")
- Stays at other research institutions during the year
- Collaborations with companies during the year
- List of accepted papers

"Evaluation of geometrically nonlinear terms in the large-deflection and post-buckling analysis of isotropic rectangular plates", International Journal Of Non-Linear Mechanics.

Date,



Signature of Tutor



Signature of the Phd student

The Coordinator