
MASTER IN “MECHANICS OF MATERIALS AND STRUCTURES”

<http://mastermms.udg.edu/>

COURSE 2021/2022

SEMINARS OF INVITED PROFESSORS

DR. MARCO PAGGI



*Full Professor of Structural Mechanics
at IMT School for Advanced Studies Lucca, Italy*
<http://www.imtlucca.it/marco.paggi>



Lesson 1 (2 hours)

Introduction to the course. Reliability and durability issues in composite materials and structures. Examples relevant for aerospace applications and photovoltaics. How to model and simulate multi-field problems: theory, finite element procedures and algorithmic aspects.

Lesson 2 (2 hours)

Bridging and nonlinear phenomena at a crack tip: the cohesive zone model. The weak form of the problem and the interface finite elements. Applications in statics and dynamics. Further applications to coupled problems (thermo-mechanics and diffusive phenomena at interfaces).

Lesson 3 (2 hours)

Phase field approach to brittle fracture in the continuum: theory and finite element implementation. Formulation for solid shell finite elements. Further generalizations for macro-mechanics of composites (anisotropic phase field; multi-phase field formulations for heterogeneous materials; computational homogenization).

Lesson 4 (2 hours)

Coupling the phase field approach to fracture and the cohesive zone model. Simulation of complex crack patterns in laminates: translaminar vs. interlaminar failure modes.

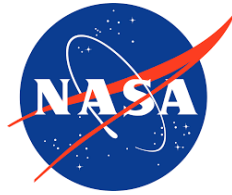
Lesson 5 (2 hours)

Micro-mechanics of composites exploiting the phase field approach to fracture coupled with the cohesive zone model: reliability of fiber-reinforced composites.

DR. CARLOS G. DÁVILA



Team Lead for the development of structural analysis and computational methods.
NASA Langley Research Center 757-864-9130
Hampton, VA



Session 1: Failure Investigations of Metallic and Composite Structures (2 hours)

- Introduction: NASA Langley – Who Are We?
- Failures of Metallic Structures
 - Window to disaster: the de Havilland Comet (1954)
 - Aloha Airlines 737 and Multi-site Damage (1988)
 - Apache Helicopter Blade Retention System (1994)
- Composite Failure Cases
 - X-33 RLV LH2 tank failure (1999)
 - AA Airbus A300 Crash (2001)

Session 2: Good Engineering or Bad Engineering? (2 hours)

- Two Very Different Projects: Douglas DC-3 (1935) – Mark 14 Torpedo (1931)
- A Tale of Two Accidents: Challenger (1983) - Columbia (2003)
- Two Systematic Errors: Cognitive Bias and Organizational Silence
- Fundamentals of Root Cause Analysis and Fault Tree Analysis
- Learning from Failure

Session 3: Analysis for Composites Design and Certification (2 hours)

- The Building Block Approach
- Issues of Scale
- Strength or Toughness?
- Progressive Damage Analysis
- Skin/stiffener Separation in Postbuckled Structures

Session 4: Cohesive Methods for Structural Analysis (2 hours)

- Boeing 787 Wing Root Cracks
- Analysis of Crack Propagation
- Cohesive laws
- R-curves

- Stability of Crack Propagation

Session 5: Fatigue Analysis with Cohesive Models (2 hours)

- S-N or Paris law?
- Miner's rule
- Goodman Diagram
- CF20: A New Cohesive Fatigue Model
- Effect of R-curves on Fatigue Crack Propagation
- Skin/Stiffener Separation in Fatigue

CALENDAR – TIMETABLE

Classes Dr. Marco Paggi					
Classes Dr. Carlos G. Dávila					
CET	Monday 14 March 2022	Tuesday 15 March 2022	Wednesday 16 March 2021	Thursday 17 March 2022	Friday 18 March 2022
8:00					
9:00					
10:00					
11:00	Lecture 1 - M. Paggi	Lecture 2 - M. Paggi	Lecture 3 - M. Paggi	Lecture 4 - M. Paggi	Lecture 5 - M. Paggi
12:00	On-line	On-line	On-line	On-line	On-line
13:00					
14:00					
15:00	Lecture 1 - C. Dávila	Lecture 2 - C. Dávila	Lecture 3 - C. Dávila	Lecture 4 - C. Dávila	Lecture 5 - C. Dávila
16:00	On-line	On-line	On-line	On-line	On-line
17:00					
18:00					
19:00					
20:00					

ON-LINE CONNECTION

If you are interested to attend them, please, fill the following Google forms:

- **Dr. Marco Paggi:**
<https://forms.gle/Us1hA24wC6CybYcf9>
- **Dr. Carlos G. Dávila:**
<https://forms.gle/ykxVUd2XFyzLqM5H9>