Part IV: Similitudes in vibroacoustic response

14:00 - 15:00 Sergio De Rosa (University of Naples Federico II, I)
Background and State-of-the-Art in the Similitudes in the Engineering Fields

15.15 - 16.15 Francesco Franco (University of Naples Federico II)
Theoretical, Numerical and Experimental Applications of Similitudes to the Problems of Lightweight Vehicles

16.30 - 17.30 Giuseppe Petrone and Alessandro Casaburo (University of Naples Federico II)
Adoption of Machine Learning

Wednesday, November 25

Part V: Smart Structures for vibro-acoustic control

9.00 - 10.00 Paolo Gardonio (University of Udine, I)
Vibro-acoustic response of thin structures excited by deterministic and stochastic acoustic fields

10.15 - 11.15 Paolo Gardonio
Smart structures for vibro-acoustic control, Part 1: physical principles

11.30 - 12.30 Emanuele Turco (University of Udine, I)
Smart structures for vibro-acoustic control, Part 2: practical design and implementation

Part VI: Aeroelastic Tailoring methodology and applications of composites in aircraft structures

14.00 - 15.00 Alex Pereira do Prado (Embraer, Sao Paulo, Brazil)
Aeroelastic Tailoring Methodology

15.15 - 16.15 Henrique Estevão Araújo Almada dos Santos (Embraer)
Applications of Aeroelastic Tailoring in the Study of Buckling of Typical Wing Panels

16.30 - 17.30 Pedro Higino Cabral (Embraer)
The Use of Lightweight Composites as substitutes to Die Forgings in Typical Aircraft Structures

ADMISSION

The webinar will be hosted on the Microsoft Teams platform.

The registration fee is 100.00 Euro + VAT*, where applicable (bank charges are not included).

CISM will financially support students participating in the Advanced Webinar by providing registration fee exemption to PhD and early stage researchers and to members of PRIN DEVISU project.

Online registration is available at https://www.cism.it/en/activities/courses/E2012

A message of confirmation will be sent to accepted participants.

The application deadline is November 16, 2020.

For further information, please visit CISM website.

* Italian VAT is 22%.

For further information please contact:
CISM
Palazzo del Torso
Piazza Garibaldi 18
33100 Udine (Italy)
tel. +39 0432 248511 (6 lines)
fax +39 0432 248550
e-mail: cism@cism.it
https://www.cism.it/

ACADEMIC YEAR 2020

Centre International des Sciences Mécaniques
International Centre for Mechanical Sciences

INNOVATIVE STRUCTURES FOR LIGHTWEIGHT VEHICLES

Advanced Webinar

CISM-UNIUD Advanced Webinar
Coordinated by

Erasmo Carrera
The Polytechnic University of Turin, Italy

Paolo Gardonio
University of Udine, Italy

Alfonso Pagani
The Polytechnic University of Turin, Italy

PRIN DEVISU project

November 23 - 25 2020

INNOVATIVE STRUCTURES FOR LIGHTWEIGHT VEHICLES

This Advanced Webiner on Innovative Structures for Lightweight Vehicles brings together expert lecturers in the fields of structural modelling, composite materials, nano-materials, smart structures for vibration control. The course combines academic scientific excellence with industrially-relevant applications and is organized by the partners of the on-going intersectorial MIUR PRIN project DEVISU: DEvelopment and applications of a VIrtual hybrid platform for multiscale analysis of advanced StructUres of aircraft. The course is organised in six Sessions.

The first Session considers the development of the Carrera Unified Formulation (CUF) as a tool to develop 2nd generation of theories of structures, including beams, plates and shells. In the first part, enhanced 1D and 2D formulations are presented with reference to the condensed CUF notation and using the so-called equivalent-single-layer, zig-zag and layer-wise theories. In the second part, asymptotic and axiomatic approaches are compared, which lead to the Best Theory Diagram using genetic-type algorithms rotating blades and rotor-dynamic analysis, applications to bio-structures and fluid dynamics of Poiseuille flow with Stokes fluid flux.

The second Session is focussed on design and optimization of new, disruptive structural solutions for aerospace systems. Initially the focus is on the extension of CUF to geometrical nonlinear problems. Then, the stiffness tailoring of variable stiffness laminates is examined, considering curvilinear stiffeners too. Finally aerodynamic and aeroelastic preliminary design tools and theoretical frameworks are introduced, which are customized for innovative non-planar wing systems.

The third Session aims at introducing new trends in multi-scale and coupled computational mechanics. The main aspects are first discussed for a recently developed three-dimensional computational framework for multiscale and multi-physics analysis of structures made of polycrystalline materials. Then, the solution of discontinuous mechanical problems by Peridynamics, which is a non-local continuum theory based on integral equations, are presented. Finally, variable kinematics (eventually multi-dimensional) models for the analysis of multi-component structures and local-nonlocal material subdomains are revised using CUF.

The fourth Session concerns a presentation of a range of activities focused on similitudes in vibroacoustics. The main rules for building complete or distorted/incomplete models will be presented and discussed with theoretical, numerical and experimental investigations. Specific attention will be paid also to the structural and the aero/acoustic responses. The approach will be presented by using all the available information coming from analytical developments, numerical investigations and experimental tests.
Also emphasis will be given to the adoption of Machine Learning to support the analysis and the definition of the scaling laws for mechanical systems.

The fifth Session provides a comprehensive overview of the principal features of smart thin structures equipped with feed-forward and feedback systems for the control of the flexural response and sound transmission due respectively to tonal and to stochastic broadband disturbances. The Session is structured in 3 Parts. Part 1, presents an overview of the excitation, flexural response and sound radiation of thin structures exposed either to deterministic (e.g. plane acoustic waves) and stochastic (e.g. acoustic diffuse field and turbulent boundary layer) excitations. The second part introduces and discussed the physical effects of a single channel and multi-channel feed-forward and feedback control systems. Finally the third part presents an overview of practical smart structures.

The sixth Session is dedicated to: i) a general presentation of an Aeroelastic Tailoring Methodology, ii) its application to develop adequate margins in buckling of wing panels, iii) the use of lightweight composites as substitutes to die forgings in aircraft structures like landing gears.
The first part discusses the Aeroelastic Tailoring methodology, which is used to design wing structures to meet strength, buckling and flutter requirements simultaneously. The second part presents an application of the Aeroelastic Tailoring in typical composite wing panels to study the effect of pure compression loads and develop adequate margins in buckling. Finally, the third part discusses the design of composite complex shaped components as replacement of parts made with metal forgings is introduced.

The Course is organised within the technical programme of the International Centre for Mechanical Sciences (CISM) and is held on-line via TEAMS internet platform. The course provides training for graduate students (MSc) and both Early Stage (PhD) and Experienced (Post Doc) Researchers and creates a platform for networking and knowledge exchange.

The Ministero dell'Istruzione, dell'Università e della Ricerca (Italy) is gratefully acknowledged for supporting the organisation of this training course through the the DEVISU project which was funded by the research funding programme PRIN 2017.

PROGRAMME

Monday, November 23

8.40 - 09.00 **Welcome**

Part I: Developments and applications of second generation theory of structures based on Carrera unified formulation

9.00 - 10.00 Erasmo Carrera (Polytechnic University of Turin, I)
Unified formulation of theories of structures with emphasis on laminated composites

10.15 - 11.15 Erasmo Carrera
Application to thermo-piezo-elasticity and other problems

11.30 - 12.30 Marco Petrolo (Polytechnic University of Turin, I)
Best structural theories and accuracy evaluations via machine learning

Part II: Nonlinearities in the design and optimization of deployable structures, variable stiffness composites and innovative wing systems

14.00 - 15.00 Alfonso Pagani (Polytechnic University of Turin, I)
Geometrical nonlinear analysis of thin structures with application to deployable booms

15.15 - 16.15 Riccardo Vescovini (Polytechnic University of Milan, I)
Stiffness tailoring of aerospace panels using curvilinear fibers and stringers

16.30 - 17.30 Luciano Demasi (San Diego State University, USA)
Aerodynamics and aeroelasticity of innovative wing systems

Tuesday, November 24

Part III: New trends in multi-scale and coupled computational mechanics

9.00 - 10.00 Ivano Benedetti (University of Palermo, I)
A 3D multiscale multi-physics computational framework for degradation and failure in polycrystalline materials and structures

10.15 - 11.15 Mirco Zaccariotto (University of Padua, I)
Discontinuous mechanical problems studied with a peridynamics-based approach: simulation of fracture and damage propagation

11.30 - 12.30 Alfonso Pagani
Coupled models for multi-component structures and local-nonlocal material subdomains