

# AIDAA Educational Series and Academy

## List of Webinars

May 2021 – Apr2022

### Webinar 01

Title: Aircraft Impact Dynamics

Duration: 4 hours/1 CFU

Dates: 25 and 28 May 2021

Speakers:

Michele Guida – Università di Napoli Federico II  
Wim Doeland – EASA  
Chiara Bisagni – TU Delft  
Michiel Shuurman – TU Delft  
Gerardo Olivares – NIAR  
Bonaventura Vitolo – GEVEN Spa

Overview

The webinar provides an overview of recent developments in a specialized area research on aircraft impact dynamics.

The original contributions from the authors define the state of the art in the chosen thematic area by focusing attention on cases of industrial interests addressed to development programmes.

They give an overview of the definition of the field of applicability and of how the research has produced innovations and improvements. Improvements concern certainly materials and structures, but they also include the ways of energy absorbing involving a greater part of the structure during the impact.

This short webinar is addressed to PH'D students, experienced researchers, regulatory agencies and industry specialists. It discusses the latest aerospace crashworthiness regulations, certification by analysis methods for aircraft, bird strike, metallic & composite structures, impact dynamics up to computational and experimental technique. Finally two cases study about the aircraft seat structures and an aircraft accident will be discussed.

### Webinar 02

Title: An overview on space debris protection best practices

Duration: 4 hours/1 CFU

Dates: June 2021

Speaker: Lorenzo Olivieri - Università di Padova

Overview

Space debris represent a real threat to the Earth orbit access and utilization. In the development and management of a space mission, it is important to focus on the evaluation of impact risk, the protection of spacecraft from debris impact, and the modelling of impact-induced fragmentation.

This webinar will focus on the current status and the most promising advancements in this field, introducing the best practices suggested by the scientific community and focusing on specific case studies. Attendees will learn about recent advances in catastrophic fragmentation modelling due to hypervelocity impact, impact risk assessment, spacecraft protection.

Learning objectives:

- Space debris and impact risk assessment
- Hypervelocity impacts modelling
- Introduction to protection and mitigation strategies

#### Webinar 03

Title: Composite materials: Modeling, Processing, and Characterization

Duration: 12 hours/3 CFU

Dates: June 2021

Speakers:

Navid Zobeiry, University of Washington

Marco Petrolo, Politecnico di Torino – Membro del Collegio di Dottorato in Ingegneria Meccanica

Overview and Learning Objectives

- Structural models for composites – 2 hours
- Multiscale models and failure analysis – 2 hours
- Processing methods and simulation – 2 hours
- Evolution of properties during processing and characterization methods – 2 hours
- Fabrication process of Boeing 777x and 787 – 2 hours
- Safety factor, building block and substantiation of composite aircrafts – 2 hours

#### Webinar 04

Title: Sound transmission control through optimized composite sandwich lattice panels

Duration: 10 hours/2.5 CFU

Dates: September-October 2021

Speakers: Calogero Orlando e Stefano Valvano - Università Enna Kore

Overview and Learning Objectives

- Sound transmission through solid – 2 hours
- Structural models for composite sandwich panels – 2 hours
- Properties evaluation of lattice materials – 1 hour
- Viscoelastic materials for passive damping – 1 hour
- Population Decline Swarm Optimization PDSO method – 2 hours
- Sound transmission optimization of aeronautical panels – 2 hours

#### Webinar 05

Title: Planetary Probes Entry and Descent Science

Duration: 4 hours/1 CFU

Dates: September-October 2021

Speaker: Alessio Aboudan - CISAS "G. Colombo", Università di Padova

Overview

Deliver robotic platforms and, in the next future, human missions on a planetary body with an atmosphere is a great technological challenge. On-board data acquired during Entry Descent and Landing (EDL) mission phases are normally used to verify the engineering system performances. Nevertheless, such data carry out a lot of information of great scientific value. This webinar introduces the post-flight analysis of EDL mission data with particular focus on the reconstruction of atmospheric profiles building up on the experience with past missions such as Huygens and ExoMars-2016 and presenting real-world case studies.

Learning objectives:

- Understand of EDL challenges and current technologies.
- Understand aeroshell and parachute aerodynamic, dynamical modelling and entry and descent phases simulation issues.

- Implement methods and algorithms for the reconstruction of both the vehicle trajectory and the atmospheric structure from inertial data.
- Application of Bayesian techniques for data assimilation and multi-sensor fusion.

#### Webinar 06

Title: Innovative propulsion system in service of Small satellites

Duration: 4 hours/1 CFU

Dates: September-October 2021

Speakers: Daniele Pavarin, - Università di Padova – Membro del Collegio di Dottorato in Scienze, Tecnologie e Misure Spaziali; Francesco Barato and Elena Toson, T4i, TECHNOLOGY FOR PROPULSION AND INNOVATION S.P.A.

#### Overview

Small satellites are the new dominant platforms in the new space economy. Thanks to the very high capabilities of the electronic systems, small satellite, especially if working within the frame of a constellation, are capable of providing innovative services with a cost not achievable from big satellites. However, to fully exploit their huge potential such a platform has specific need both in term of access to orbit and movement in space.

Regarding orbit access, most of the platforms fly as piggy bag on big launcher. This mean that they cannot choose the right orbit and they have to fly within a schedule which is not based on their need. Around the world several companies are developing micro launchers to provide a dedicated access to space to small platforms. Micro launchers require the development of innovative propulsion systems capable to combine high performances with reasonable costs.

Once in orbit micro satellites need to reach the right altitude, the right phasing within the orbit and to maintain its position. To do it they do require an onboard propulsion system. These thrusters need to be designed to respect the reduced size of such a platform and to allow low recurring costs. Moreover, innovative missions, such as for example very low earth orbit (VLEO) require dedicated thruster to accomplish the specific mission, in VLEO for example a thruster capable of performing continuous drag compensation is required. These new scenarios open new challenges and opportunities for new innovative technology capable of reaching the right compromise between costs and performances.

Object of this webinar is to provide an overview of the ongoing market scenario related to small platforms than to provide an overview of the most innovative micro launchers developed or currently under development, and finally to provide an overview of the most promising propulsion systems suitable for small satellites developed or currently under development.

#### Learning objectives:

- Understanding of propulsion technologies for microsattellites
- Overview of innovative propulsion systems for micro launchers
- Application of innovative thrusters for VLEO orbital control

#### Webinar 07

Title: Full Flight Simulator: testing and research platform

Duration: 6 hours/1.5 CFU

Dates: December 2021

Speakers: Andrea Alaimo e Antonio Esposito - Università Enna Kore

#### Overview

The webinar deals with an introduction to the world of flight simulators employed as research platforms and not exclusively as training tools. The main simulator levels, recognized by the EASA, European Union Aviation Safety Agency, will be firstly described focusing on FFS (Full Flight Simulator). Then, the main research contexts, taking advantage from the use of flight simulator, will be presented with some referenced research activities. This will be followed by the description of research topics concerning the human factor and comfort in the simulated environments of cockpit and cabin. Firstly, the objective and

subjective techniques used to evaluate the aeronautical human factor will be described. The main subjective tests for both real-time and post-task are given, evaluating the main advantages and drawbacks. Then, objective measurement based on existing technologies will be introduced, with particular reference to sensors exploitable inside the aircraft. Also for these techniques, the main advantages and drawbacks will be shown. A brief overview of the mathematical correlation tools that can relate the two types of measurement data will be presented with reference to some experimental study cases. In the second part of the course, the research topic of aviation comfort will be introduced. The human body's biodynamic modeling techniques will be described with an overview of the models employed in the aeronautical framework, followed by experimental results. The analytical and numerical modeling will be shown with examples of evaluation on the human body's comfort indexes with aeronautical manufacturers' restrictions.

Learning objectives:

- Simulator: classification and standards – 1 hour
- Experimental research activities with flight simulator – 1 hour
- Human Factors in cockpit and cabin environment – 2 hours
- Human Body Comfort for pilot and passenger – 2 hours

Webinar 08

Title: Introduction to the design of LEO nanosatellite orbits for local coverage

Duration: 4 hours/1 CFU

Dates: November 2021

Speaker: Carlo Bettanini - Università di Padova – Membro del Collegio di Dottorato in Scienze, Tecnologie e Misure Spaziali

Overview

This webinar delivers an introduction to the design of orbits for Low Earth Orbit (LEO) nanosatellites and nanosatellite's constellations aimed at maximizing local transmission or coverage capacity with limited number of satellites. It will describe main drivers in determining orbital evolution in Low Earth Orbit considering the perturbed two body problem of Keplerian orbital dynamic and deriving the expression for repeated ground track and revisit time considering different coverage or visibility conditions with multiple ground station. The webinar will present application of orbit analysis investigations aimed at maximizing visibility of single satellites from multiple ground stations and optimized local coverage pattern using special architectures for regional constellation design (Walker and flower constellations) aimed at continuous optical and SAR monitoring of large infrastructures.

Learning objectives:

- Classical and perturbed two body orbital flight dynamics
- Repeated ground track orbits and revisit time calculation
- Regional constellation design

Webinar 09

Title: Challenges and opportunities for the aerospace frontier research offered by the ERC and the MSCA programme

Duration: 4 hours/1 CFU

Dates: February 2022

Speaker: Alfonso Pagani – Politecnico di Torino – Membro del Collegio di Dottorato in Ingegneria Meccanica

Overview

The main instruments for the development and attraction of talent to the European Union (EU) are the European Research Council (ERC) and the Marie Skłodowska-Curie Actions (MSCA). Over the last decade, the ERC and the MSCA found wide and diverse areas of research of relevance to aerospace and gave many researchers the opportunity to develop their projects with highly competitive conditions.

This short webinar is addressed to early-career and experienced researchers and is intended to promote successful proposals for the ERC and MSCA.

Learning objectives:

- Overview on the main characteristics and opportunities offered by the ERC and MSCA funding schemes
- Proposal writing
- CV
- Stage-2 interview

Webinar 10

Title: Tethers in Space: deorbiting and power generation

Duration: 4 hours/1 CFU

Dates: April 2021

Speaker: Giacomo Colombatti - CISAS "G.Colombo", Università di Padova

Overview

The Space Tether consists of a complex structure where there are 3 main parts: 1) a main satellite; 2) a secondary satellite; 3) a cable (of variable lengths) that is used to join the two spacecraft together. This cable allows the transfer of energy and momentum between the two spacecrafts, this transfer can be present in both directions and in some cases can switch direction.

The Space tethers can be classified in two different areas: Passive tethers, which are used simply for mechanical connection and mainly transfer momentum from one part to the other; and Electrodynamic tethers, conductive wires or tapes or more complex structures), in which an electric current can flow and pass from one end to the other.

The simplest application involves the use of the tether system as a de-orbit system, a drag Force is induced on the tether due to its relative motion with respect to the rotating plasma and the.

An opposite application is the injection of electric current from one satellite and have an effect which is opposite to the de-orbiting, this effect can be used to increase the SMA of the system or produce movements in the orbital plane.

The Electrodynamic tether is a system that can act as an orbital control for small and relatively big structures (depending on the tether length and on the produced current).

Even of the dynamics of the tethers (passive or electrodynamic) are complex and not at all completely understood, the current knowledge in materials and technology are bridging the gap between theory and extensive application in current Space missions.

Learning objectives:

- Dynamics of tethers
- Bare and electrodynamic differences
- Space mission possibilities

## Members of the AIDAA Educational Series and Academy Technical Committee

- Andrea Alaimo, Università Enna Kore
- Sara Bagassi, Università di Bologna
- Carlo Bettanini, Università di Padova
- Erasmo Carrera, Politecnico di Torino
- Pierluigi Di Lizia, Politecnico di Milano
- Michele Guida, Università di Napoli Federico II
- Marco Petrolo, Politecnico di Torino
- Giuseppe Petrone, Università di Napoli Federico II
- Sergio De Rosa, Università di Napoli Federico II