



UNIVERSITÀ DI PISA  
**DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE**  
**Dottorato di Ricerca in Ingegneria dell'Informazione**

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Doctoral Course

**“Spacecraft environmental testing: methodologies and technologies”**

G. Casarosa, M. Appolloni

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**Short Abstract:** The conception and development of a Spacecraft is a complex and rather long process requiring the effort of many people and often also a big financial investment. The latter being true especially for scientific Spacecraft, which are one-of-a-kind units with typically challenging technological developments needed to accomplish the goals they have been built for.

Spacecraft need to survive two critical phases: the launch and the journey and operation in harsh environment. In both cases, servicing the Spacecraft is not possible, therefore confidence in its survival is required before launch and thus testing.

This course focuses on Spacecraft testing, covering all the different methods, with emphasis on the two main test categories: mechanical testing and thermal testing. An overview of the sensors used is also given, including an outlook to the future, covering methodologies and technologies that might soon become day to day tools during environmental testing.

**Course Contents in brief:**

- Module 1: Why we test? Overview of needs and environmental test activities
- Module 2: Mechanical Testing – Vibration testing, different types and goals
- Module 3: Thermal Testing – Close look to thermal testing and thermal facilities
- Module 4: Sensors used for testing and needs for the future (e.g. Virtual Twin)

**Total # of hours of lecture: 16**

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## CV of the Teacher

G. Casarosa is the Head of the Engineering Service Section, Test Centre division, of the European Space Agency, ESTEC site. G.Casarosa got his master Degree in Electronic Engineering in 2001 at University of Pisa. Shortly after, in 2002, he joined the Engineering Services Section as Young Graduate first and consulting engineer afterwards, before getting an MBA at Webster University, Leiden campus, and working as Business Unit Manager for ATG Europe . In 2015 G. Casarosa returned to the Engineering Services Section as Electromechanical Engineer, before becoming Head of Section in 2018. Since then, he has been leading a multidisciplinary team of competent engineers and technicians, in support of the Test Centre and of its customers. During his career at ESA, G. Casarosa has contributed to the development of top notch measurement systems used to test ESA spacecraft, has initiated collaborations with research institutions across Europe, supervised students during their final thesis and finally has co-authored more than 40 scientific publications presented at conferences, symposia and on journals. He has been awarded in 2008 with the Otto Hamberg Best Paper Award at the 24<sup>th</sup> Aerospace Testing Seminar and he is member of the Technical and Programme Committee of the “European Conference on Spacecraft Structures Materials and Environmental Testing”, and of the Advisory Planning board of the “Aerospace Testing Seminar (US)”.

Matteo Appolloni holds a Master’s degree in mechanical engineering from the University of Florence, Italy. He works in the Test Centre Division for the European Space Agency in the area of mechanical design and simulations since 2003. One of his main focuses for the past two decades has been to engineer innovative ways to perform thermal and mechanical testing, like with contactless thermoelastic deformation and contactless thermal mapping during thermal-vacuum testing. He has developed innovative systems in support to many Spacecraft Programs, from Scientific Missions to Earth Observation and Human Exploration, often in collaboration with international partners like NASA and JAXA. Since 2005 he has been pioneering Virtual Shaker Testing approaches and Digital Twins in general, both in the mechanical and thermal-vacuum fields, and he has over 60 publications on these subjects. He has received twice the ATS Otto Hamberg Best Paper Award from the Aerospace Corporation in US, the first one in 2008 on “Validation of a Strategy for Deformation Monitoring of the Herschel Spacecraft Under Ambient Conditions by Photogrammetry”, and the second one in 2018 on “Transient multi-dof vibration testing: analytical and experimental data”. He is regularly chairing sessions in international conferences and invited to give keynotes and lectures in his domain fields.

## Room and Schedule

Room: *Aula Riunioni del Dipartimento di Ingegneria dell’Informazione, Via G. Caruso 16, Pisa – Ground Floor*

Schedule:

Day 1: 10/6/2024 - 4 hours PM (13:00-17:00)

Day 2: 11/6/2024 - 4 hours AM (9:00-13:00)

Day 3: 12/6/2024 - 4 hours AM (9:00-13:00)

Day 4: 13/6/2024 - 4 hours AM (9:00-13:00)

Day 5: 14/6/2024 - AM exam