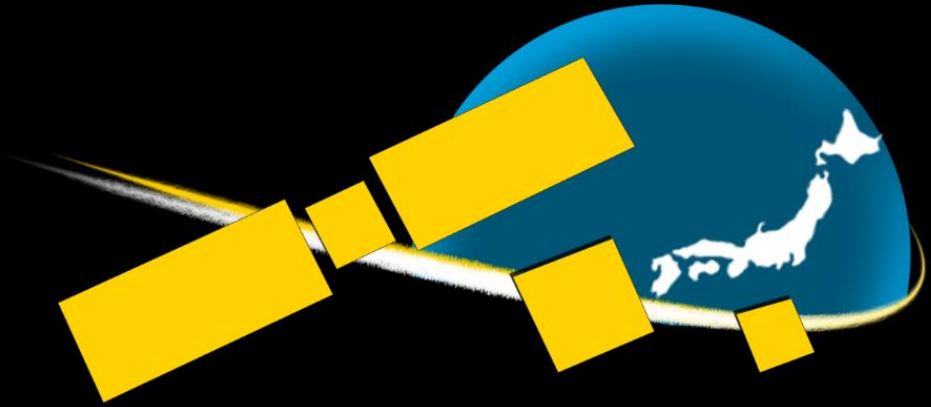


Another expert's lecture  
provided for the students  
of



# SEIC

## Special Guest Lecture by Prof. Andres Marcos (Universidad Carlos III de Madrid (UC3M))

Andrés Marcos is the director of the space lab ST3LLAR (<https://st3llar.uc3m.es/>), which is part of the academic-industry aerospace chair between the Universidad Carlos III de Madrid (UC3M) and SENER (one of the main Spanish engineering companies).

**Date: Friday  
(23 June 2023)**

**Time: 13:00-14:30**

**Language: English**

**This event will  
be in-person (対面)  
– see map on the next  
page.**

## **Title:**

“Application of advanced robust control methods to the ESA/NASA LISA mission”

## **Abstract:**

Future space scientific and observation missions require increasingly methodological and robust control designs in order to fulfil, in the presence of uncertainties and external disturbances, the stringent actuator/sensor constraints and performance objectives these missions demand. In addition, these missions also require an increasingly complex series of operational modes, each using different suites of sensors, actuators, and control designs.

The need for robust controller designs and simplified modes is paradigmatically present in the Laser Interferometer Space Antenna (LISA) mission. This is a joint ESA/NASA mission aimed at detecting and measuring gravitational waves in space. This will be achieved by detecting pico-meter displacements between free-flying test masses (TMs) contained within three identical spacecraft (SC) heliocentrically orbiting in a triangular formation with a separation of 2.5 million kilometres.

# Title:

“Application of advanced robust control methods to the ESA/NASA LISA mission”

# Abstract:

LISA’s scientific objectives require to establish a laser link between the three spacecraft. But in order to achieve this, several operational modes are necessary, among which the following three are highlighted: the accelerometer mode (where the test masses are released), the acquisition mode (where all laser links between SCs are acquired), and the science mode (where some of the TMs coordinates need to be controlled in drag free to fulfil stringent science spectral noise requirements). Each of these modes use a specific set of controllers, actuators and sensors and care must be taken to minimize the mode switching transients to avoid loss of laser link or the test masses getting in contact with their cages within the spacecraft. In addition, LISA’s control system must also provide amelioration capabilities from events such as micro-meteoroid impacts (MMIs). These events pose a serious threat to the scientific observations of the LISA mission, since they might also cause the loss of the laser links between S/C – and thus requiring their re-acquisition, a process that can take up to several hours resulting in a loss of scientific observation time.

This talk presents the methodological control design process used for several of the LISA modes as well as the development of an additional mode to handle the MMIs. Solutions to the latter have also been proposed by other teams based on advanced (nonlinear or anti-windup) control methods, but the proposed mode is shown to be simple, but very effective. With respect to the LISA modes’ control designs, the robust H-infinity methods are used (the standard and the structured algorithms) and it is shown that they are capable of addressing all the objectives while respecting all constraints.

**4th floor of  
General & Research  
Building #1  
(総合研究1号棟)4階**

**“Seminar room”**

**NOTE: THERE IS NO NEED TO REGISTER FOR THIS EVENT. JUST ATTEND. BUT COME AT LEAST 5 MINUTES EARLY – DO NOT INTERRUPT THE LECTURE BY COMING INTO THE ROOM LATE.**



## Bio of our guest speaker

### Speaker:

#### Andrés Marcos

Beatriz Galindo Senior Distinguished Investigator UC3M-SENER Aerospace Chair  
Director UC3M-SENER space lab ST3LLAR Universidad Carlos III de Madrid (UC3M),  
Spain Websites: <https://aero.uc3m.es/> <https://st3llar.uc3m.es/>



Dr. Andrés Marcos received his Aerospace Engineering MSc. (2001) and Ph.D. (2004) degrees from the University of Minnesota (USA) supervised by prof. Gary Balas. He has over 20-years work experience on the development and application of robust control to aerospace systems, about half in academic posts and half in industry. During his career he has been principal investigator for over 22 projects / 17M€ related to re-entry vehicles, launchers, satellites, aircraft, and UAVs. The results of his research and development activities have been published in over 140 peer-reviewed publications, and together with his team he has flight tested robust control controllers and fault detection and isolation filters in: aircraft (DLR's ATTAS and JAXA's MuPAL-alpha), autonomous Vertical Take-Off and Landing vehicles (DLR's EAGLE), and small solid-fuel test rockets (NDUT).

Currently, he is a "Beatriz Galindo Distinguished Senior Investigator" at the aerospace engineering department of the Universidad Carlos III de Madrid. This is a personal award conferred by the Spanish Government to attract talent back to Spain. As such, Dr. Marcos has taken over the directorship of the academia-industry UC3M-SENER space lab ST3LLAR and its aerospace chair. He is also the founder and director of a small consultancy firm focused on reducing the gap between theory and practice, Technology for Aerospace Control Ltd (TASC for short).

# Note to doctoral students

Your attendance at this seminar can count towards credits that you need for “Interdisciplinary Seminar of Engineering” (doctoral candidates). See the following websites for details:

Interdisciplinary Seminar of Engineering

<https://www.tobata.kyutech.ac.jp/gr-school/gra-menu/>

Space Engineering Seminar

<https://www.tobata.kyutech.ac.jp/gr-school/gra-menu/space-engineering-seminar/>

For seminars held in-person, you should get a stamp or signature on a Performance report form by Prof. Fuse as a proof of attendance.

For online seminars, instead of getting a stamp 印鑑 as a proof of attendance, submit a one paragraph (75-150 words) summary (typed in English, with student ID number and date, and then signed) using Microsoft Word. Send the file to Prof. Fuse within one week of the lecture. His email address is: <fuse.tetsuhito856(at)mail.kyutech.jp>.

If you have any questions concerning the contents of this page, please contact the Graduate School Section: [koh-daigakuin@jimu.kyutech.ac.jp](mailto:koh-daigakuin@jimu.kyutech.ac.jp)

# **End**

**promotional document for talk by  
Andres Marcos on  
23 June 2023**