

**Tuesday May 5th, 14:00-15:00**

## **Navigation Technologies for Space Transportation Systems: new developments and trends**



**Speaker:** Sergio Ramirez, SENER

**Short Bio:** Sergio is an aerospace engineer with a master's degree in Aerospace Engineering, with specialty in Space Vehicles, by the Technical University of Madrid. He has almost 10 years of experience in the area of navigation data fusion and sensors, systems engineering and project management. He works at Sener Aerospace and Defense as a Product Line Leader for Hybrid Navigation Units, which include the development and production of navigation systems for space transportation (like the NAVIGA unit for the VEGA-C and VEGA-E) and autonomous flight termination systems for launchers.

**Abstract:** Navigation technologies for space transportation systems are evolving rapidly to meet the demands of higher autonomy, lower costs and improved robustness and performance. This lecture presents a comprehensive overview of the current state of the art in spaceborne navigation, followed by an in-depth focus on the development, achievements, and roadmap in this domain.

The first part of the talk surveys major technological trends shaping modern launcher navigation. An initial overview of the evolution from traditional high-end inertial navigation systems to current multisensor architectures. Progress in inertial navigation systems, from radiation tolerant high grade IMUs to increasingly performant MEMS units, and in GNSS processing, with dynamic signal tracking, and on board authentication, is reviewed together with hybridization strategies that enable robust and cost-effective performance through the most demanding flight phases. Emerging technologies such as quantum inertial sensors and AI assisted filtering are also addressed. The role of advanced estimation algorithms, and integrity monitoring is discussed as a cornerstone for shortening development cycles and reducing costs.

The second part of the presentation focuses on Sener's work in developing space transportation navigation systems. Results from several projects covering from ascent, orbital, and re-entry operations are presented where it was looked at the use of high-dynamic GNSS processing, loosely and tightly coupled GNSS/INS fusion, robust integrity management, multisensor integration and safety-critical avionics architectures. This work has been developed by Sener in several developments of navigations units, NAVIGA and NAVIGA-EVO.

By bridging the global technological landscape with concrete industrial developments, the presentation offers a clear view of where launcher navigation stands today, and how systems like NAVIGA and NAVIGA EVO will shape the next decade of resilient, competitive, and autonomous space transportation.