

## Training Opportunity for Portuguese Trainees

Reference	Specialist Area	Duty Station
PT-2012-TEC-ECN(2)	Guidance Navigation and Control Systems	ESTEC

### Overview of the Division missions:

The Control Systems Division is responsible for project support and technology development of space applications covering the fields of

- Control systems and Sensors, including
  - Attitude Control system design, modelling, analysis, testing and verification, covering both operational and FDIR aspects
  - Control law algorithm analysis, design, implementation (S/W and H/W) and testing
  - Attitude Sensors design development testing and verification
- Navigation, Guidance and control, including
  - Rendezvous system design, analysis and verification
  - Entry, Descent and Landing guidance and control system design, analysis and verification
  - Planetary navigation and ascent vehicle system design, analysis and verification
  - Formation flying control systems
  - Advanced control and estimation techniques
- Dynamics and Mathematical Analysis including
  - Trajectory analysis (ascent, re-entry, low thrust) and optimisation
  - Spacecraft dynamics modelling and analysis

The division hosts Avionics Laboratory and computing facilities that allow hands on work in the above fields.

### Overview of the field of activity proposed:

#### **Description:**

The training will be focused on the assessment of a closed loop INS/GNSS Hybrid Navigation system (SW in the Loop / Processor in the Loop / HW in the Loop) for space transportation vehicles. This is applicable to launchers and re-entry vehicles.

#### **Background:**

The HiNAV studies have shown the navigation performance we could get with an INS/GNSS hybrid navigation system for launchers and re-entry vehicles. But the overall GNC performance has not been addressed in these studies.

Such an assessment requires indeed to have high-fidelity Guidance & Control blocks in the loop, which was out of the scope of HiNAV.

End-to-end simulators are now available within TEC-ECN (VEGA, IXV), which can be used for such purpose.

#### **Objectives :**

- integrate the VEGA and IXV Guidance & Control, Dynamics, Kinematics and Environment blocks and HiNAV within a SIL
- perform the end-to-end GNC performance assessment with the SIL to characterize the performance with and without INS/GPS for VEGA and IXV
- perform the autocoding of the SIL and integrate both SW and environment blocks into the PIL
- setup a HIL with real GNSS signals (Spirent) based on the PIL and HiNAV breadboard
- perform the HIL performance assessment and compare the performance with the SIL results for VEGA and IXV
- prepare a paper for a conference describing the results, and the added value of INS/GNSS navigation for both VEGA and IXV

**Required Education:**

University degree or equivalent qualification in aerospace, control engineering or mathematical methods for aerospace applications. Command of MATLAB and experience with real time test benches. A good knowledge of English is required.