

**PhD: “Miniaturized Sensors for Mars and other planetary bodies”**

**Position: PhD Thesis Electronic Engineering with FPI fellowship**

**Micro and Nano Technologies Group at:**

- **Technical University of Catalonia (UPC)**
- **in collaboration with the Astrobiology Center (CAB, INTA-CSIC).**

**Laboratory: UPC-Campus Nord. Barcelona. Spain.**

**Keywords: Sensors, control, planetary exploration, miniaturization.**

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## 1. CONTEXT OF THE PhD

### a. Candidate

He/She must have validated a master or engineer degree in order to be able to enroll in a PhD position by approximately September 2019. He/She must have a good knowledge in analog and digital electronics. Candidates willing to combine experimentality with theory/modeling are welcome.

### b. Supervision

The thesis will be made at the facilities of the MNT group in UPC Campus Nord, Jordi Girona 1-3. 08034 Barcelona, Spain. The thesis advisors are

Name	Institution	Role
Manuel Domínguez-Pumar	UPC <a href="mailto:manuel.dominguez@upc.edu">manuel.dominguez@upc.edu</a>	Co-supervisor
Vicente Jiménez Serres	UPC <a href="mailto:vicente.jimenez@upc.edu">vicente.jimenez@upc.edu</a>	Co-supervisor

## 2. TECHNICAL CONTEXT AND MOTIVATION

The MNT group has participated in the design, fabrication and calibration of the wind sensors in three NASA missions to Mars:

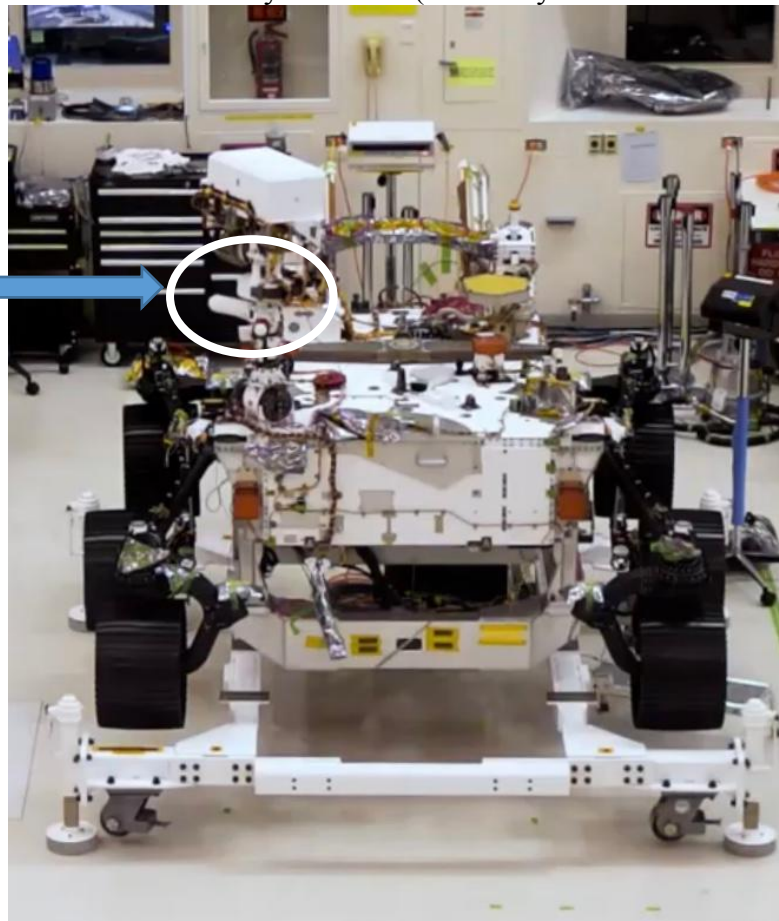
- Rover Environmental Monitoring Station (REMS): instrument for Mars Science Laboratory (Curiosity rover): launched in 2011 [1-3].
- TWINS instrument for InSight: launched in 2018.
- Mars Environmental Dynamics Analyzer (MEDA) instrument to be launched in July 2020 within the Mars2020 mission.

The thesis is associated with a project recently granted by the Spanish Ministry for Science, RTI2018-098728-B-C33, with the title:

*“Instrumentation for characterizing the Martian environment in NASA missions: Wind Sensor for MEDA (conclusion of phases D and E)”*

The objective of the project is to carry out Phases D and E of the MEDA instrument (Mars Environmental Dynamics Analyzer) for Mars2020. Additionally, work will be developed for new miniaturized sensors working under smart controls, intended for future missions.

The MEDA instrument is currently in ATLO (Assembly Test and Launch Operations):



MEDA wind sensor:  
Two cylinders protruding in  
the mast

Figure: Picture of the Mars2020 rover in ATLO at JPL (Jet Propulsion Laboratory).

### 3. OBJECTIVES OF THE THESIS

The main objectives of the proposed thesis are related with the previous project:

- Development of **miniaturized sensors for planetary exploration** in future missions:
  - o The MNT group has been developing a miniaturized wind sensor [4-6]. The thesis will continue this work, in particular the design of control electronics, calibration and design of system control algorithms

for the optimization of the sensor response (sensitivity and response time).

- Other miniaturized sensors such as heat flow sensors will also be developed using Components Of The Shelf (COTS) + smart controls.
- Participation in the **optimization of the calibration of the MEDA wind sensor** using the calibration model. This task is done in collaboration with the Astrobiology Center in Madrid (INTA-CSIC) and the Microelectronic Institute in Seville (IMSE).
- Application of **data extraction optimization to wind recovery in the different sensors**. Improvement of the inverse algorithm in order to provide resilience to the sensor.

#### 4. FINANCIAL CONDITIONS

An FPI fellowship has been granted to the project. The fellowship funds the PhD for **4 years**. The **net quantities** for the PhD candidate are: **1000-1100 euros/month**.

The call for this fellowship is scheduled for **September 2019**.

The detailed information for last year call is:

[http://www.ciencia.gob.es/stfls/MICINN/Ayudas/PE\\_2017\\_2020/PE\\_Promocion\\_Talento\\_Emp\\_leabilidad/Subprograma\\_Estatal\\_Formacion\\_IDI/FICHEROS/Contratos\\_Predoctorales\\_Formacion\\_Doctores\\_2018/Convocatoria\\_predoctorales\\_2018\\_def\\_firmada\\_SEUIDI.pdf](http://www.ciencia.gob.es/stfls/MICINN/Ayudas/PE_2017_2020/PE_Promocion_Talento_Emp_leabilidad/Subprograma_Estatal_Formacion_IDI/FICHEROS/Contratos_Predoctorales_Formacion_Doctores_2018/Convocatoria_predoctorales_2018_def_firmada_SEUIDI.pdf)

The call for the fellowship that has been granted to this project is expected to be very similar. Applicants must apply specifying the project they are interested in. In our case: project RTI2018-098728-B-C33.

If interested contact us asap

#### References

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- [3] Maria-Teresa Atienza, Lukasz Kowalski, Sergi Gorreta, Vicente Jiménez, Manuel Domínguez-Pumar, "Thermal dynamics modeling of a 3D wind sensor based on hot thin film anemometry", Sensors and Actuators A: Physical, Vol. 272, pp. 178-186, 2018,
- [4] L. Kowalski et al., "Spherical Wind Sensor for the Atmosphere of Mars," in IEEE Sensors Journal, vol. 16, no. 7, pp. 1887-1897, 2016.
- [5] Maria-Teresa Atienza, Lukasz Kowalski, Sergi Gorreta, Vicente Jiménez, Luis M. Castañer, Manuel Domínguez-Pumar, "Sliding mode analysis applied to improve the dynamical response of a spherical 3D wind sensor for Mars atmosphere", Sensors and Actuators A: Physical, Vol. 267, pp. 342-350, 2017, 2017,
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