TEIDESAT.

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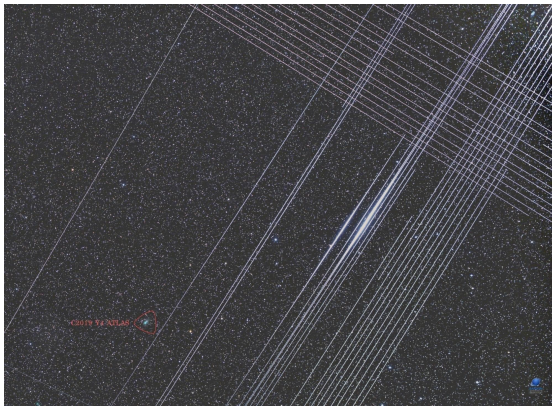
TEIDESAT is an initiative that was born in the University of La Laguna (Tenerife, Canary Islands), in December 2017, and that now involves up to 25 students, mainly from the University of La Laguna (ULL) and the University of Las Palmas de Gran Canaria (ULPGC), but that has extended widely, with students from universities in Madrid, Valencia, Barcelona and Milan. All members of the team share a common vision: to design, build, fly and operate the first nanosatellite, Teidesat-I, made from university-level students from the Canary Islands. Such a complex and engaging endeavour requires a multidisciplinary approach, including science, engineering, design, management and economics. Our team is conformed by students covering all these areas, and from all university levels, from undergraduate students all the way to MSc and Phd levels.

The main goal of the TEIDESAT team is to learn to develop, in a practical way, the skills and abilities necessary for the creation of a 1U CubeSat, and to form future professionals in the aerospace field. With that goal in mind, and after a thorough research, we decided the mission objective of Teidesat-I: to demonstrate the capability to establish optical communication through LED technology between a CubeSat on Low Earth Orbit (LEO) and Earth, using robotic telescopes located in the observatorios of the Canary Islands (Observatorios de Canarias).

1.- Context of the research

The TeideSat project consists of four fundamental pillars:



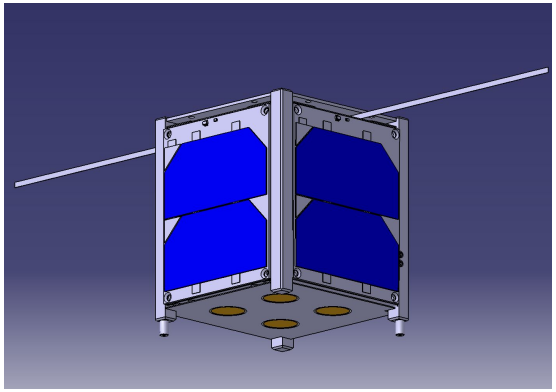
Scientific Objective

To Analyze the impact of optical communications on astrophysical observations.

Source:
Zamora, Rodriguez-Alarcón, Koll. A new pipeline for Space Surveillance and Tracking activities at the IAC80 telescope

Academic Objective

To learn about areas of knowledge related to space outside the academic discipline of each member, with the aim of becoming a much more complete and versatile professional.



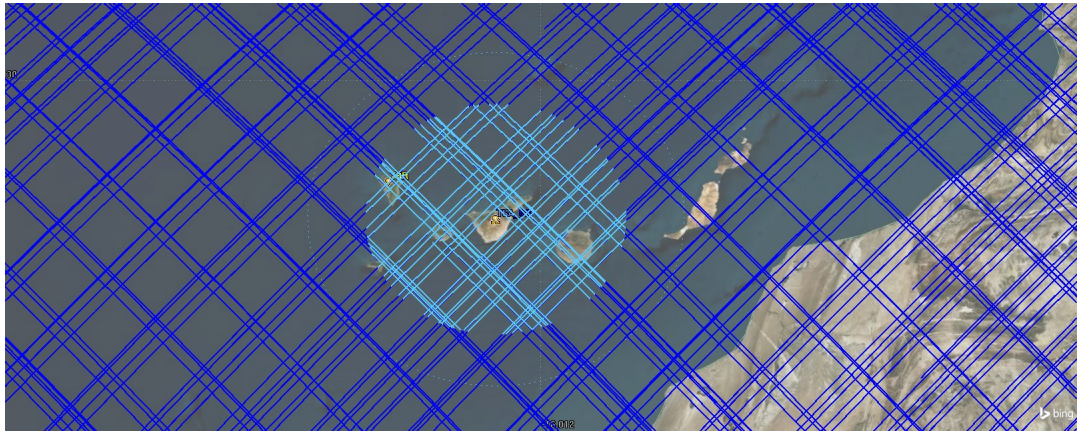
Technological Objective

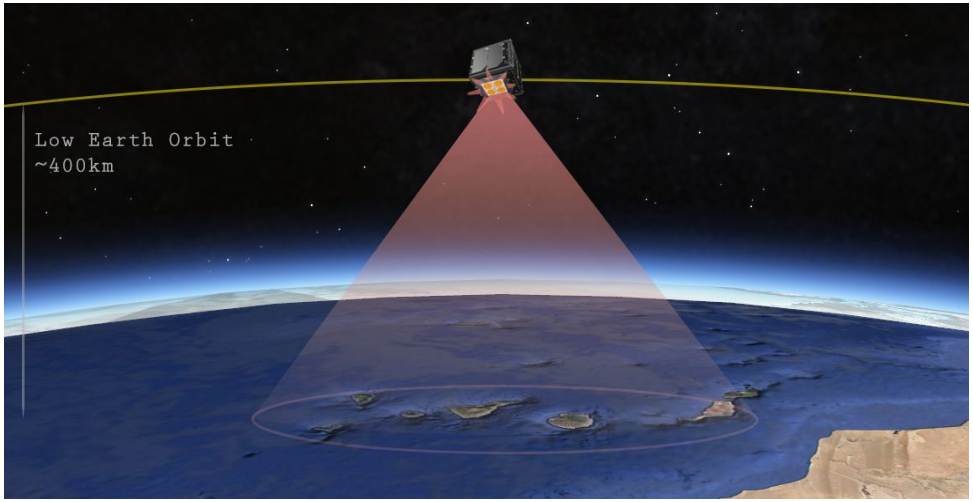
To design and build a perfectly functional nanosatellite that complies with ESA quality standards to establish an optical data downlink between the nanosatellite and the surface of Earth.

Dissemination Objective

The TeideSat team believes in the importance of scientific-technical dissemination among people of all ages, but with special emphasis in the young. It devotes part of its time to this end trying to increase their interest in this topic.

2.- Description of the project

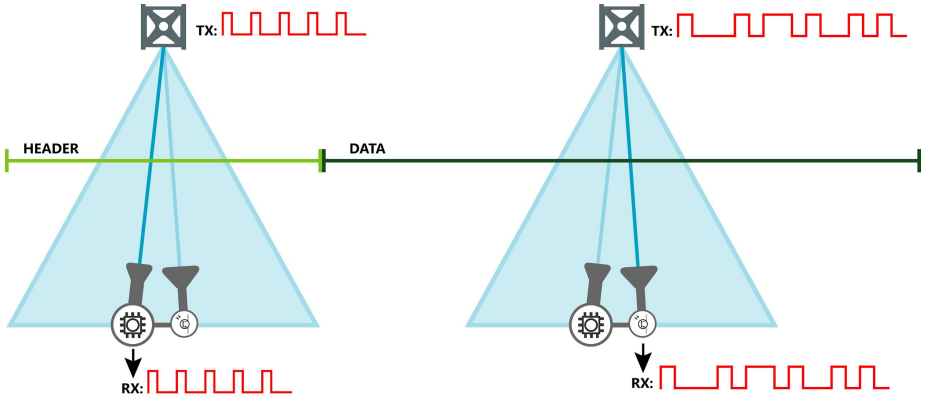


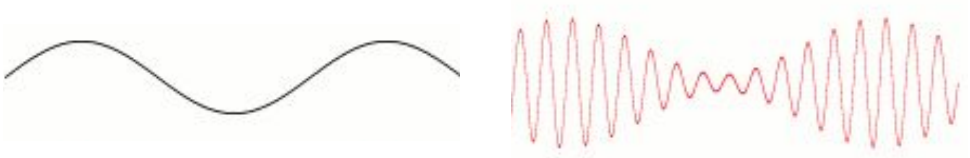


Light pulse sequence:

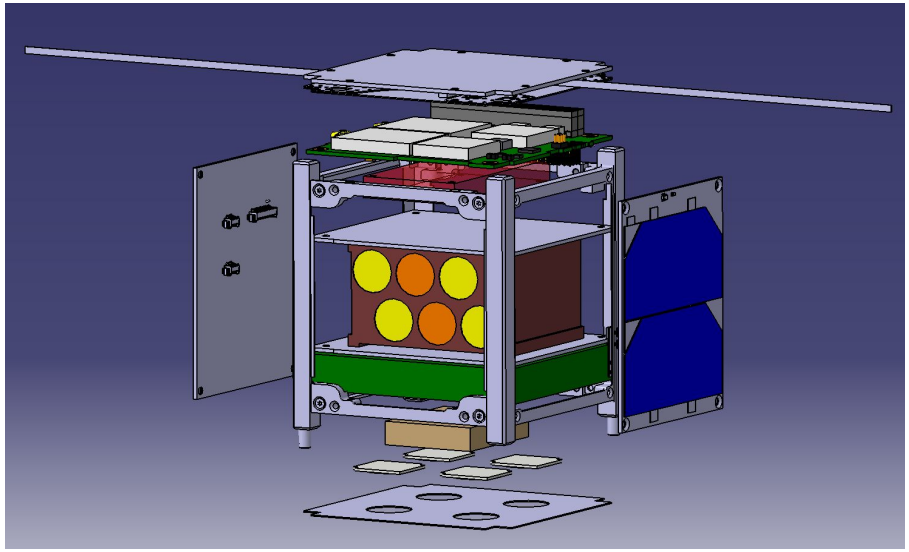
Header
Satellite identifier (Low frequencies)
Wide Field Telescope + CCD (autotracking)

Data:
Downlink Transmission (High Frequencies)
Narrow field telescope + photodiode





3.- Results (Satellite)



Satellite development

Payload & Subsystems Design

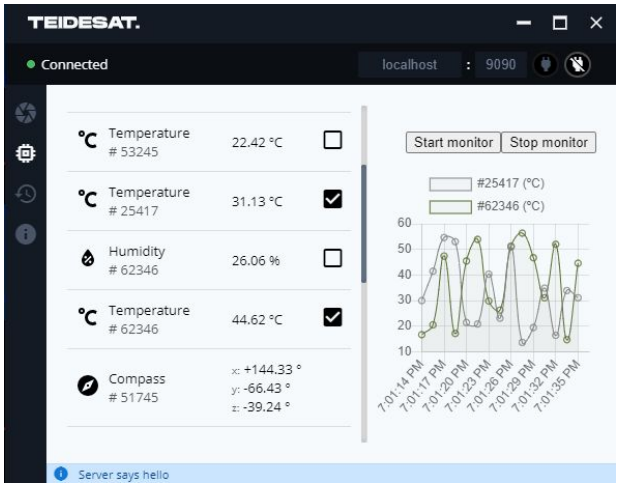
- Payload *PLY*
- Attitude & Orbit Control subsystem *AOCS*
- Electrical Power Subsystem *EPS*
- On-Board Data Handling *OBDH* On-Board Software architecture *OBSW*
- Communication *COM*
- Thermal control
- Structure

- ➔ Payload
  - ◆ (4x LEDs COB)
- ➔ AOCS
  - ◆ (GPS)
- ➔ EPS (4x Battery LiFePO4 / 2x Battery Li-Ion)
- ➔ OBDH & OBSW
  - ◆ Q7S OBC from Xiphos running Linux 4.4+
- ➔ COM
  - ◆ (UHF-VHF Dipole Antenna)

Payload		
POWER	370 W (ON)	0 W (STANDBY)
FREQUENCY	60 MHz (MAX)	10 MHz (MIN)
WINDOW TIME	110 s (MAX)	20 s (AVERAGE)

3.- Results (Ground Station)

"FOMALHAUT"



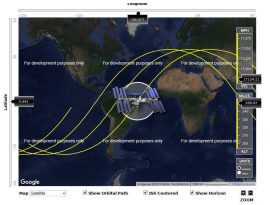
The **software** is designed as a general purpose cross-platform application for TeideSat. The interface will connect to the local server by default or any other remote server. Its currently implemented features range from:

- Camera analysis
- Satellite tracking
- Sensor monitoring (sensors are not available for all platforms)
- Logging view (mostly for remote server)
- Logging to file (server)

Radio Ground Station (VHF/UHF)

- Construction our VHF and UHF antennas at the URE (Union of Radio Amateurs of Spain)
- VHF contact with another country bouncing the signal on satellites

Optical Ground Station



- Design and construction of the preliminary telescope for testing
- Preliminary observations of the ISS
- Star calibrations
- Calibration with Pre-Payload

4.- Impact and prospects for the future

TEIDESAT-I (Satellite)

- Finish the critical design
- Manufacture and test
- Launch and operate

Source: ESA, Vega

Radio Ground Station (VHF/UHF)

- Automate radio ground station (VHF / UHF)
- Complete the tests for uploading and downloading data to satellites currently in orbit

Source: HamStudio UT8UU
http://ut8uu.blogspot.com/2018/09/satnogs-antenna-rotator-part-1-overview.html

Optical Ground Station

- Design and integration of the robotic telescope capable of TEIDESAT-I nanosatellite downlink optical communications.
- Track calibration with bright satellites
- Calibration of the light pulse receiving instrument

Source: Journal of Astronomical Telescopes, Instruments and Systems.Rapid telescope pointing calibration: A quaternion-based solution using low-cost hardware (Kathleen M. Riesing, Hyosang Yoon, Kerri L. Cahoy)