

## The Deimos-2 Mission Concept

- The Deimos-2 end-to-end system has been designed to provide a **cost-effective** and **highly responsive** service to cope with the increasing need of fast access to very-high resolution imagery
- It **expands Elecnor Deimos Imaging portfolio**, complementing DEIMOS-1 with VHR multispectral imagery (**75 cm Pan-sharpened**)
- The combined use of DEIMOS-1 (22 m) and Deimos-2 (75 cm) will provide a wide range of capabilities for the generation of products in all optical Earth Observation market segments

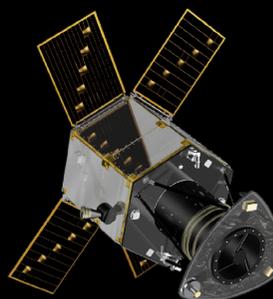


- With Deimos-2, Elecnor Deimos expands its capabilities into satellite integration with the creation of a new subsidiary: **Elecnor Deimos Satellite Systems**
- Its **brand new facilities**, built in Puertollano (Spain) in 2012, include more than 4,000 m<sup>2</sup> office space, a 430-m<sup>2</sup> **clean room** and a complete **control centre** with a 10-m X-band antenna

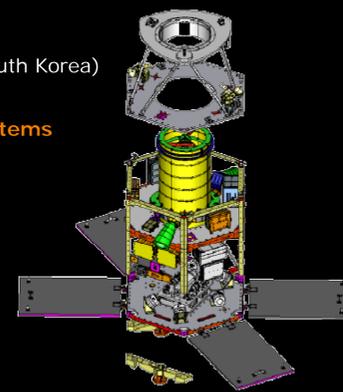


## The Satellite

- The satellite is being developed together with **Satrec Initiative** (South Korea)
- Based on SpaceEye-1 concept (heritage from DubaiSat-1 and -2)
- It will be **integrated and tested in Elecnor Deimos Satellite Systems** premises in Spain in Q2 2013
- Launch foreseen for early 2014**

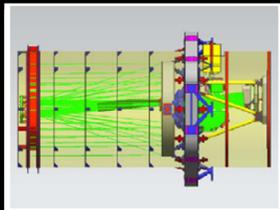
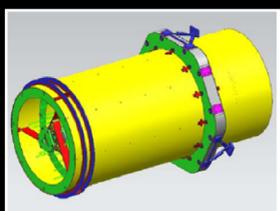


- Mass: 300 kg
- Size: Ø 1.5 m x 2.0 m
- Agile platform ( $\pm 45^\circ$  across-track)
- High-performance AOCs for pointing accuracy & stability
- Dual redundancy in all critical systems
- Xenon gas thrusters (HEPS) for orbit control
- X-band antenna for 160 Mbps data transmission
- S-band antenna for telemetry & telecommand



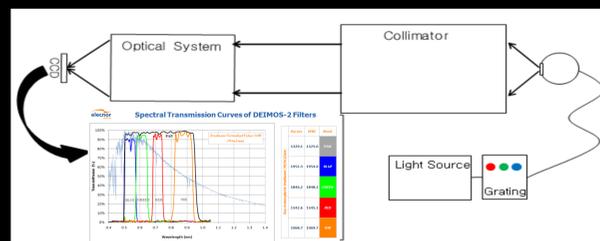
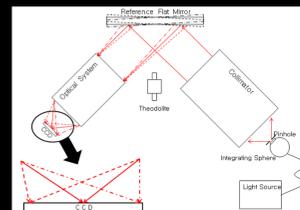
## The Payload

- EOS-D pushbroom camera with multi-linear TDI sensor
- 40-cm Korsch telescope (5.75 m focal length, 1.2° FoV)
- Ground spatial resolution of 1m Pan, 4m MS
- 75-cm GSD pan-sharpened products**
- Swath > 12 km** (24 km in wide-area mode)
- Pan** (450-900 nm) + **4 bands** (R,G,B, NIR)
- Radiometric resolution **10 bits**
- Images are stored on a high-capacity solid-state recorder
- During transmission of the stored image data via X-band, **data are compressed, encrypted and encoded in real time**



## Pre-launch Geometric Cal

- The geometric calibration of D-2 payload is to **qualify** the system and to obtain a **rigorous sensor model** parameterization
- The main parameters include:
  - Effective Focal Length (EFL)
  - FOV and IFOV
  - Pixel Line of Sight (LOS)
  - Band-to-band registration of CCD arrays
  - Distortion map of CCD arrays
  - Knowledge of the camera optical axis



## Pre-launch Spectral Cal

- The purpose of this measurement is to characterize the spectral transmissivity profile of each band and the response of the CCD arrays

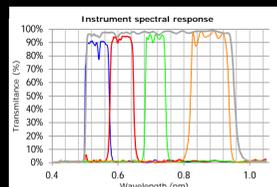
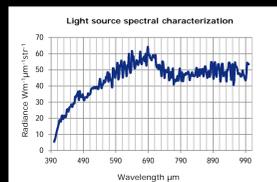
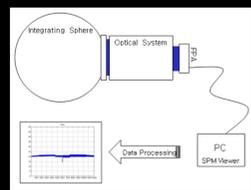
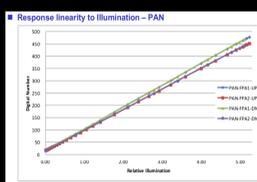
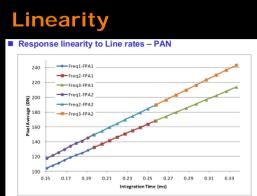
## Pre-launch Radiometric Cal

- The aim of this calibration is to **characterize the optical sensor** in order to obtain absolute physical measurements:
  - Response Linearity
  - Dark Signal and Non-uniformity
  - Pixel Response and Non-uniformity
  - Signal-to-Noise Ratio (SNR)
  - Pixel Saturation
  - Absolute calibration

- Dark Signal (DS)** behavior is characterized pre-launch
- Blind pixels will provide DS information for each line



- By manufacturing, each detector has different response to equal illumination conditions: **Pixel Response Non Uniformity (PRNU)**
- To equalize the detectors, their response to a uniform light source shall be characterized



- PRNU
- DS

## Absolute Calibration

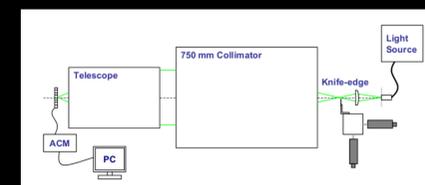
- Camera parametrization:
  - TDI mode
  - Gain
  - Line rate

## SNR measurement

- Illumination output levels are adjusted to simulate the spectral radiance of a given reference ground target
- Requirement is SNR  $\geq 90$

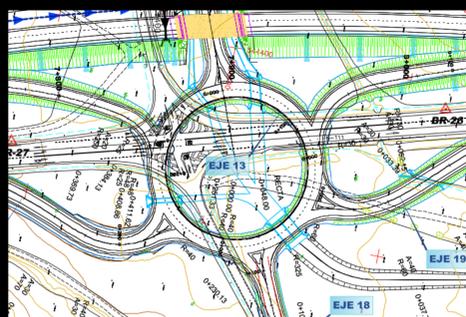
## MTF measurement

- Knife-edge method
- Requirements are:
  - PAN MTF @ Nyquist  $\geq 9\%$  full FOV
  - MS MTF @ Nyquist  $\geq 18\%$  full FOV



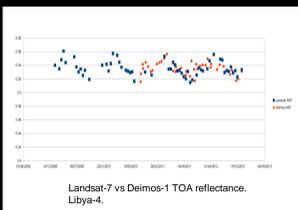
## Post-launch Geometric Cal/Val

- Launch vibrations and other effects can affect the payload
- Centimeter location accuracy targets such as modern highways and railways in Spain will be used



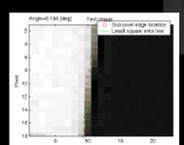
## Post-launch Radiometric Cal/Val

- Closely follow **CEOS** Cal/Val recommendations and **sites**
- PRNU measurements using uniform and high reflectivity Land Non Equipped Sites (**LNES**)
- Dark signal measurements using night images over the ocean
- Libya-4 LNES (pseudo-invariant) for sensor trending
- Vicarious measurements for **absolute** Cal/Val using CEOS Land Equipped Sites (**LES**) and
- CIBA** (low atmosphere research center)
- Managed by the University of Valladolid (Spain)
- Planned to enhance instrumentation to comply with CEOS LES sites



## Post-launch MTF Estimation

- Will be performed using the **slanted edge methodology**
- Same as Deimos-1 but using artificial targets instead of field transitions



## calval4EO

- Part of the **gs4EO** suite
- Fully developed in-house
- Systematic extraction of calibration data
- Systematic generation of calibration reports
- Interactive
- Calibration database

