Patria Finavitec's engagement in the ENVISAT-project

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Patria had a considerable role in building the ozone-monitoring instrument GOMOS for the Envisat satellite. Patria's Space Electronics section (former Finnyards Ltd Electronics) developed and manufactured a central part of the instrument, namely it's science data electronics (SDE) unit. In addition, four demanding test systems (EGSE's) that have been used during the integration of the GOMOS instrument and the spacecraft were also developed and built by Patria.

The design and development of the Envisat satellite and its instruments has lasted for more than ten years. GOMOS and ozone research have also been among the main investments of Finland in space during the last decade. The Finnish Meteorological Institute (FMI) was one of the proposers of the GOMOS instrument. Patria Finavitec has been involved in the development of the GOMOS instrument almost from the beginning. We participated already in the Phase A study in 1989 - 1990 as an industrial partner to the FMI. This study was conducted for the French Space Agency, CNES. The definition and preliminary design of the instrument started in 1991 as a phase B and it was led by Matra Marconi Space (MMS, now Astrium SAS). Since then we were a subcontractor to the MMS. At that phase, also the development of the electrical ground support equipment (EGSE) started. The EGSE systems were delivered to MMS in 1995 and the flight model of the SDE in 1997.

Taisto Tuominen (M.Sc, age 43) has been working in Finavitec's space projects since 1989. He was the project manager of the GOMOS SDE-project during it's design and development phase. Since that, he has been working in project management and development tasks. Currently he works as the R&D manager of the Patria's space electronics group.

GOMOS Instrument Concept

The GOMOS instrument uses a stellar occultation method to measure the gas composition of the upper atmosphere. GOMOS observes stars, one by one, as they set behind the earth's atmosphere, and measures changes in the star light spectrum. From the absorption at different wavelengths and altitudes, the concentration of various gases and aerosols in the atmosphere will be retrieved. This is possible because each gas has a specific absorption profile. Four spectral bands are of interest: ultraviolet, visible and two infrared bands are measured.

The GOMOS instrument is composed of a steering mirror and a telescope that are used to point the instrument towards a selected star. In the detection module there are gratings and other optical components that are used to create the above mentioned spectrums of the light of selected star. In addition, there are two star tracker modules (one main unit and one spare) to keep the pointing locked to the start. Two photometers are used to record variations in the brightness of the star, caused mainly by turbulence and other movements of the atmosphere. Each of the above mentioned modules has a CCD-sensor where the spectrum or image of the star is created.

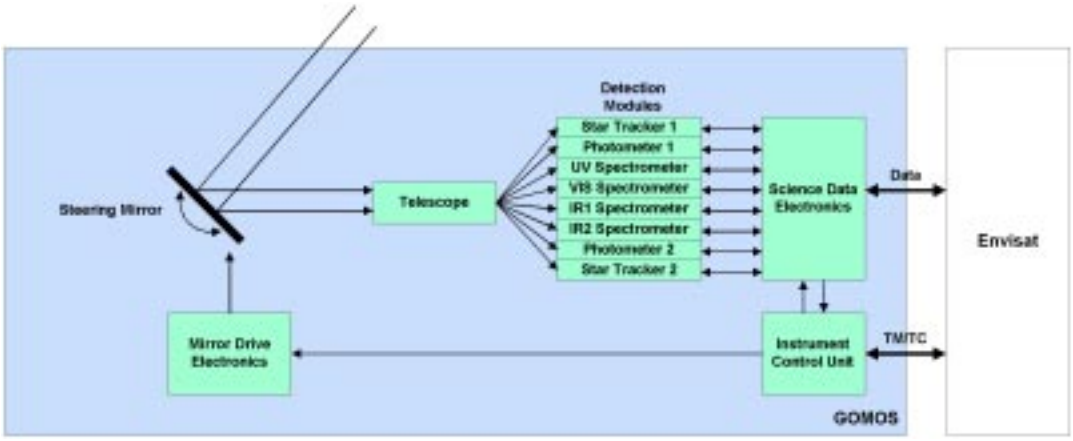


Figure 1: Block diagram of the GOMOS instrument.

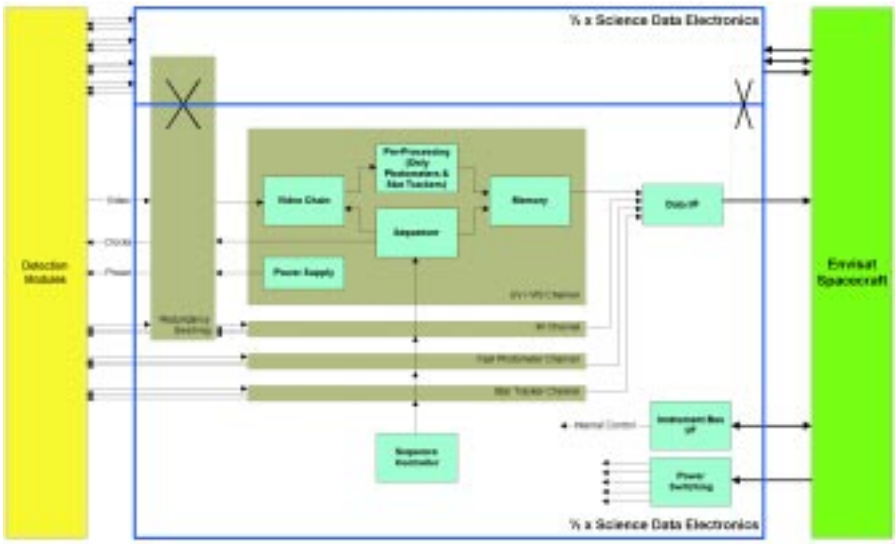
GOMOS SDE

The Science Data Electronics unit of the GOMOS controls all operations of the CCD's and processes the data that they provide. The tasks of the SDE are to

- Control and sequence the read-out operation from the CCD's
- Receive, amplify and digitise the CCD output signal
- Perform pre-processing of the Star Tracker and Photometer data
- Provide power to the detector modules

There are 8 CCD's to be controlled and handled. Several operating modes for calibration and instrument health checking purposes were required. A special attention was paid for the quality of the video signal handling since it has a direct impact on the overall performance of the instrument. As a result, a very high quality video chain performance was achieved. An other demanding point was the sequencing of the CCD's since a lot of programmability in selecting the lines and rows to be read out was required. In addition, a redundancy scheme, which enables to secure the data of at least the UV-VIS channels in case of failure of one of the video chains, was required. The SDE is divided in two, partly redundant sections. A simplified block diagram of it is shown in figure 2 below.

Figure 2: Simplified block diagram of the GOMOS SDE unit.



GOMOS EGSE's

The integration of the instrument was done by MMS in certain phases and partly in parallel. For that purpose they needed several test systems to support the test campaign. There are several interfaces and operations that need to be simulated by the test system during the integration.

Figure 3:
GOMOS SDE Flight Model

Two sets of test systems for sub-assemblies were needed. One system was meant for a subassembly composed of the detection modules and the SDE. This was used to verify the performance and operation of the detection chains. A second test system was used to test the operation of the instrument control unit (ICU) and the mirror drive electronics (MDE) connected together.

Finally, also a test system for the fully integrated instrument was needed. In practise, this system simulated all interfaces of the instrument to the spacecraft. Two systems were delivered; one for the instrument tests and another for the spacecraft integration phase.

All EGSE's were based on similar basic structure: a real time front end that made the interface to the equipment under test and one or more workstations for user interfaces and other control, data handling and reporting purposes. In these systems, there was a considerable part of software to be developed and tested as well.

Figure 4:
One of the GOMOS EGSE systems.

Conclusion

GOMOS was an important milestone for Patria on its way to a space company. Before GOMOS our space activities had been rather small power supplies for several scientific instruments in Swedish Freja and ESA´s SOHO spacecraft. All those were related to domestic research programmes. After GOMOS we have been able perform as an industrial subcontractor to the main European prime contractors in ESA programmes like XMM, Rosetta, Mars Express and in EOS/AURA for NASA.

Patria in Brief

The Finnish Patria Group operates internationally as a technology group. The Group´s core businesses include products and services within aviation and space, as well as the defence and telecommunications industries. Among the most important products and services are military and special vehicles, weapon systems, aircraft and helicopter maintenance, aerospace structures and telecommunications systems as well as airport snow removal equipment.

The corporate net sales in 2000 totalled EUR 208.5 million. The Group employed an average of 2 200 people, and the export share was 47% of net sales. Patria´s space actitivies employ about 70 - 90 people.

For more information, see www.patria.fi