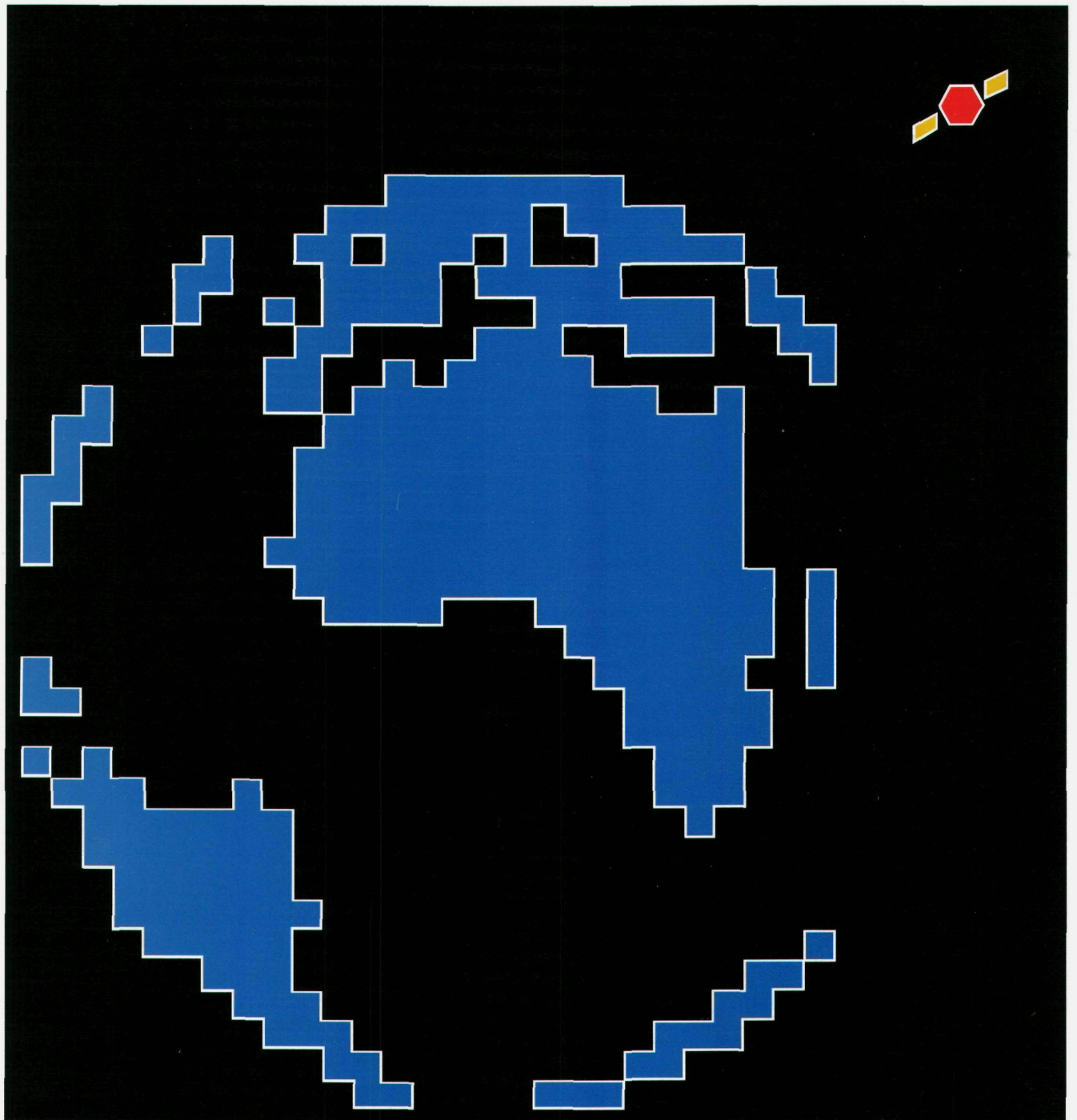


Space instrumentation



Space instrumentation

Talking about space technology is talking about frontiers. Space technology itself is a frontier, as can be said of the challenges it imposes on design, materials, technology, accuracy, quality, reliability and management.

The TNO Institute of Applied Physics (TPD) contributed to pushing out a number of these frontiers since it started as a supplier of flight hardware more than 25 years ago.

TPD's wide experience of optics and detection techniques has been its basis in space instrumentation. The design and construction of sophisticated scientific instruments and sensors based on optical principles is the backbone of its space activities. Wavelength coverage is from X-ray to far infrared.

By carrying out projects in space optics TPD has acquired a wide experience in precision engineering, and in designing and constructing highly accurate mechanisms for effecting translations in the micrometer range and rotations in the sub-arcsec range.

TPD is active in three major fields:

- attitude sensors
- scientific instruments
- instruments for earth observation and remote sensing.

Instrumentation for micro-gravity is a new field of activity.

Collaboration

Projects in space instrumentation which involve electronics, are usually carried out jointly with TPD's Instrumentation Division. This Division is renowned for its pioneering designs in hardware and software. TPD collaborates closely with Delft University of Technology and has access to all facilities of that University. This includes the optical workshops and the Centre for Submicron Technology. Being a part of the TNO Organization, TPD regularly draws

upon the multi-disciplinary expertise available with sister institutes. The institute sub-contracts activities when experience is not available in-house.

Clients

As for space instrumentation, major clients of TPD are the European Space Agency ESA, the Netherlands Agency for Aerospace Programs (NIVR), the Netherlands Space Research Organization (SRON) and aerospace companies at home and abroad.

Facilities

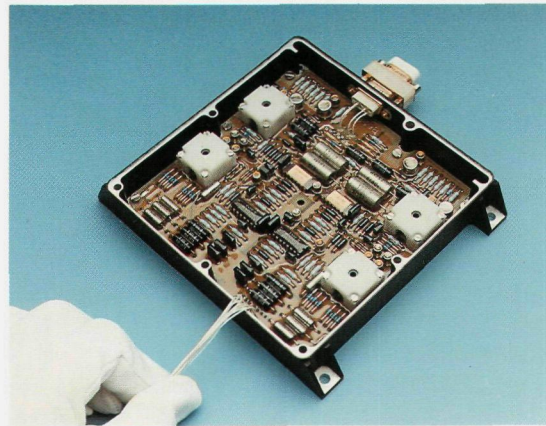
- Computer programs for optical design
- CAD/CAE systems for mechanical and electronic design and analysis
- Precision machining and assembling workshops
- Optical laboratories
- Clean room facilities
- Test rigs; solar and stellar simulators
- Facility for testing and characterizing CCD arrays
- Facilities for thermal testing in vacuum.

Attitude sensors

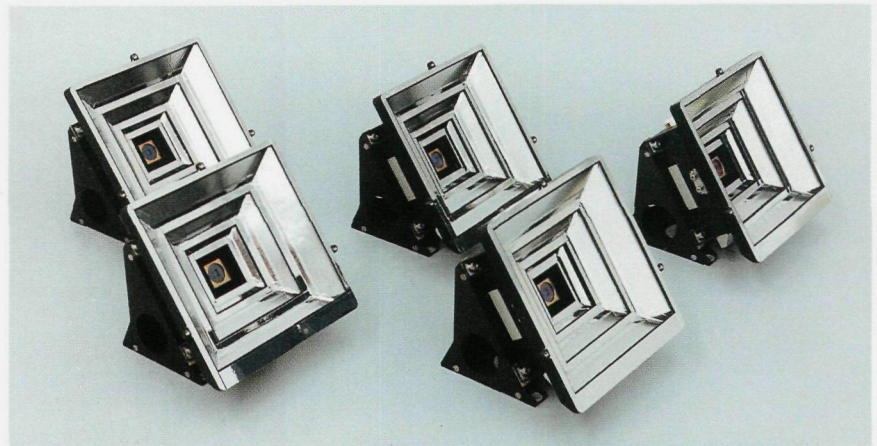
TPD offers a wide range of sensors for use in attitude control systems:

- Sun Acquisition Sensor
- Coarse Sun Sensor and Attitude Anomaly Detector

Testing a sun sensor in TPD's clean room.



Sensor electronics.



Quadrant Sun Sensors.

- Quadrant Sun Sensor
- Digital Sun Sensor
- High Accuracy Sun Sensor
- Starmapper
- CCD Startracker.

Usually, the sensors are custom-made. As for the Sun Acquisition Sensor, TPD occupies a leading position in the European space market. Most European satellites for telecommunication and earth observation have been equipped with this sensor, and so have a number of European scientific satellites. The success of the GIOTTO mission and its close encounter with Halley's comet can be partially attributed to the excellent performance of the on-board TPD Starmapper.

Scientific instruments

TPD started in space instrumentation with the design and construction of the highly successful UV stellar spectrometer for the European TD-1A satellite. Other achievements are flight hardware for the X-ray satellite ANS, scientific instruments for IRAS and the Hubble Space Telescope.

Some recent examples:

- modulating grid and refocusing mechanism for HIPPARCOS
- cryogenic IR spectrometer for ESA's Infrared Space Observatory ISO.

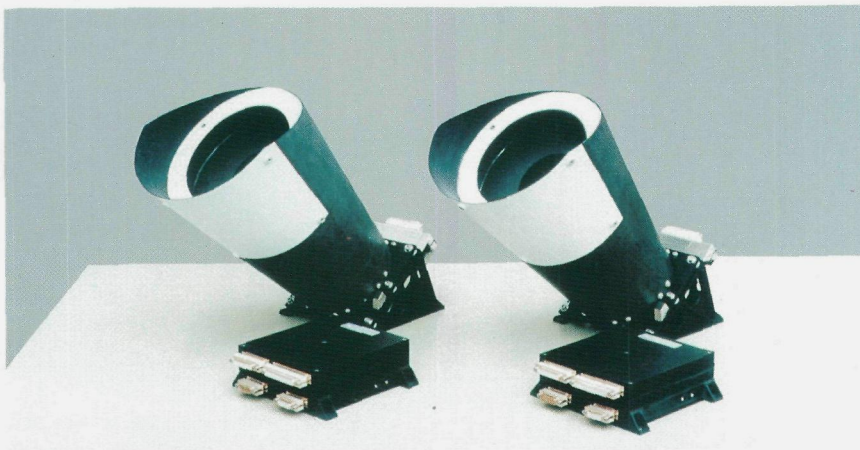
TPD is also closely involved in the scientific instrumentation for the future Space Station.

Earth observation and remote sensing

The institute has recently delivered an advanced instrument for remote sensing of the Earth from an aeroplane. TPD is also working on a number of studies on instrumentation for the Polar Platform and the new generation of Meteosat satellites.

A new and rapidly developing field in Earth observation, in which TPD is playing an important role, is the study and global monitoring of the earth's atmosphere using space-based instruments.

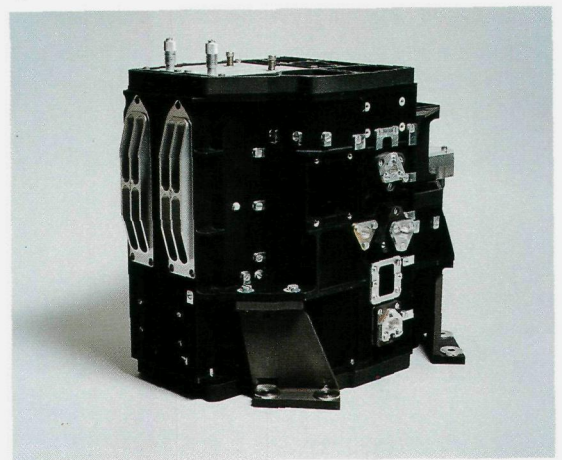
Starmapper GIOTTO satellite.



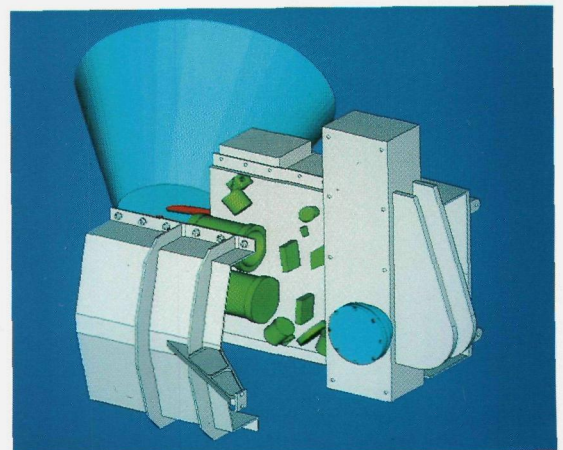
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Cryogenic infrared spectrometer for ISO satellite.



Global Ozone Monitoring Experiment (GOME) design.



The TNO Institute of Applied Physics (TPD) is one of the R&D institutes of TNO, the Netherlands Organization for Applied Scientific Research. With 5100 employees and an annual turnover of more than Dfl 650 million TNO is the largest independent R&D organization in the Netherlands and one of the largest in Europe.

TPD's mission is to utilize results of the physical sciences, mathematics, electronics, informatics, mechanics and material science in the development of new and advanced systems for clients. In this, the Institute collaborates closely with the Delft and Eindhoven Universities of Technology. The institute also acts as a technical consultant.

TPD's five fields of work are:

Acoustics

Noise control in and around buildings, industries and machines, in traffic and on board ships.

Heat and flow dynamics

Development and application of numerical models for flow, heat and mass transport, pulsating flow in pipe systems and flow machinery, development of measuring instruments for thermal parameters.

Materials

Properties and technology of glass, ceramics (whiteware, technical ceramics, structural ceramics and refractories), X-ray diffraction analysis of crystalline materials.

Optics

Optical systems, spectrometers (from infrared to X-ray), optical detection systems, sensors and instruments for space science, laser applications, optical sensors and integrated optics.

Instrumentation

Development of sensors, electronic design and system engineering, data collection and information networks, image processing and image interpretation, computer applications in signal processing and simulation.

Evaluation Centre for Instrumentation and Security Techniques (EIB)

Evaluation of measuring and control systems, the security of data-communication systems, and the fraud resistance of documents and securities.

At Delft, the Faculties of Applied Physics and of Electrical Engineering are the principal partners in collaboration; at Eindhoven, the Faculty of Chemical Engineering. The Biomedical Instrumentation department is housed on the premises of the Amsterdam Academic Medical Centre and collaborates with the medical scientists of that Centre.

TPD participates in the Delft Centre for Image Processing CBD. The Faculty of Chemical Engineering of Eindhoven University and TPD have founded and jointly manage the Centre for Technical Ceramics.

If required for the satisfactory completion of a project, TPD collaborates with other (applied) scientific laboratories and institutions in the Netherlands and abroad.

The Institute has 300 employees, including 180 scientific staff. Every year, TPD deals with some 2600 projects for clients in the Netherlands and abroad, considerable part of which is of a high-technology nature.

Major clients are home and foreign industries, the government, national and foreign R&D institutions and service industries. Part of the activities is financed by funding organizations, and participation in European programmes is increasing steadily.