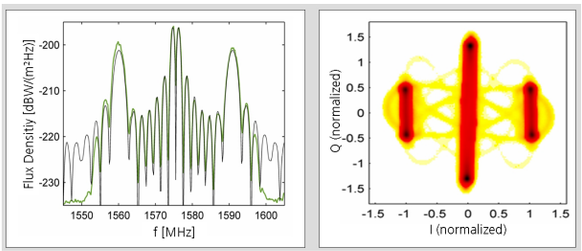
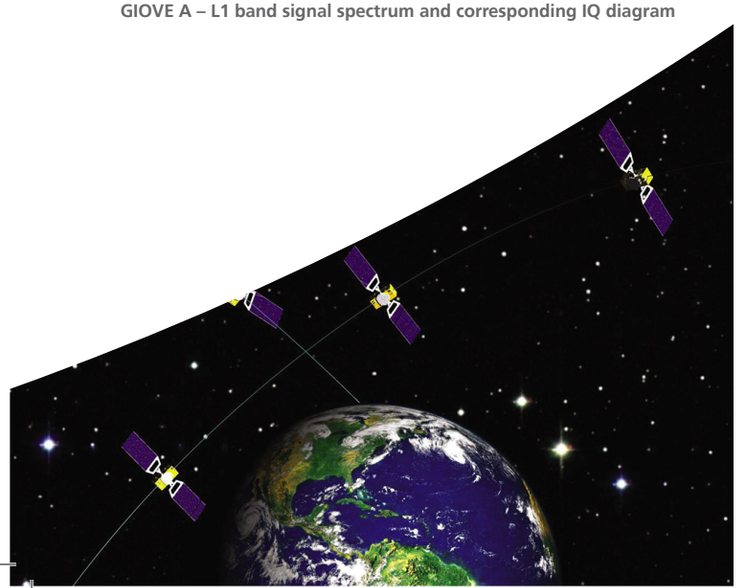
Signal Analysis

The used vector signal analyzer allows real time monitoring of the received spectra and, therefore, provides a fast-lookup functionalty. For detailed analysis the received data is recorded and further processed offline using a signal-in-space analysis facility. Based on the performed analysis different results and representations like spectra, time-domain plots, correlation functions, and IQ-diagrams can derived. These representations are used for evaluating the signal quality in different aspects.

Consequently, it is possible to check compliance of the signals-in-space to all important system requirements and to detect for example spectral asymmetries and gain imbalances of the satellite signal. These results will be used for the development of the new European Navigation System Galileo to gain maximum performance and will act as input to further research on the future offline evolution of the Galileo system.



GIOVE A – L1 band signal spectrum and corresponding IQ diagram



DLR at a glance

DLR is Germany´s national research center for aeronautics and space. Its extensive research and development work in Aeronautics, Space, Transportation and Energy is integrated into national and international cooperative ventures. As Germany´s space agency, DLR has been given responsibility for the forward planning and the implementation of the German space program by the German federal government as well as for the international representation of German interests. Furthermore, Germany's largest project-management agency is also part of DLR.

Approximately 5,600 people are employed in DLR´s 28 institutes and facilities at thirteen locations in Germany: Koeln-Porz (headquarters), Berlin-Adlershof, Bonn-Oberkassel, Braunschweig, Bremen, Göttingen, Hamburg, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stuttgart, Trauen and Weilheim. DLR also operates offices in Brussels, Paris, and Washington, D.C.

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Information

Galileo Signal Verification and Validation

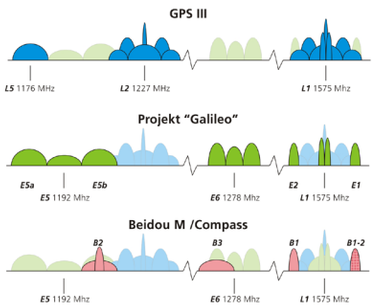
DLR

Galileo Signal Verification and Validation

In the morning of 28 December 2005, the first Galileo In-Orbit Validation Element – GIOVE-A – was launched. The main perspective of this mission is the validation of key technologies and the characterization of the radiation environment at an altitude of 23,200 km. Furthermore, this satellite secures the frequency filing in the Galileo bands L1, E5 and E6.

At the same time the Institute of Communications and Navigation of the German Aerospace Center (DLR) established an independent monitoring station for the analysis of GNSS signals. A deep space antenna at the DLR site Weilheim with adapted measurement equipment raises GNSS signals above the noise floor. The use of this unique instrument allows a detailed analysis and verification of the transmitted signals from Galileo test satellites.

Galileo first test satellite – GIOVE A

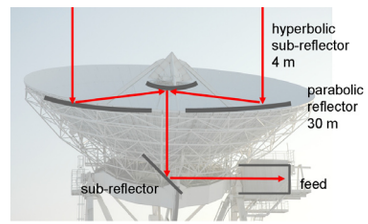


GNSS signals overview

The 30 Meter Antenna

In the early seventies DLR built up a 30 meter dish for the HELIOS-A/B satellite missions at the DLR site Weilheim. HELIOS was the first US/German interplanetary mission launched in 1974. Later the antenna was used to support other scientific deep space missions like e.g. Giotto, AMPTE and Equator-S as well as for various scientific experiments.
This impressive antenna is based on a shaped Cassegrain design. It is characterized by its high antenna gain (around 50dB) and a very small beam width (0.5° in the L-band).
A prerequisite for using this antenna for GNSS signal analysis is the adaption of the existing equipment to the used frequency bands in the navigation field.

The 30 meter antenna at Weilheim

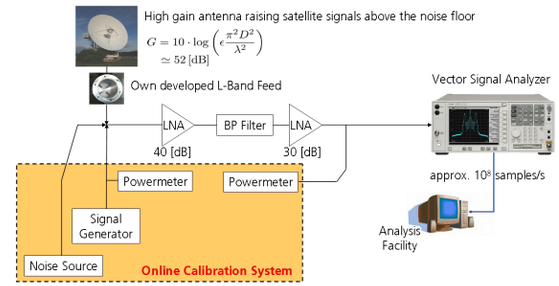


The shaped Cassegrain design

The Measurement Setup

The signals received by the 30 meter dish and a new developed circular polarized L-band feed are amplified by two low noise amplifiers (LNA) with a total gain of around 70dB to reach a high input power level for the vector signal analyzer. A set of band pass filters reduces the bandwidth to the used GNSS bands and minimizes possible interference.

For the measurements on the second Galileo test satellite GIOVE B a newly developed online calibration system is added to this setup to maximize the measurement accuracy. This calibration system consists of powermeters and a noise source which is needed for precise antenna calibration using radio stars like Cassiopeia A or geostationary satellites. With the help of a power stabilized signal generator defined pilot signals will be injected in the signal chain in order to characterize the actual frequency response of the system and perform constant calibration of all measurements.



Measurement setup overview