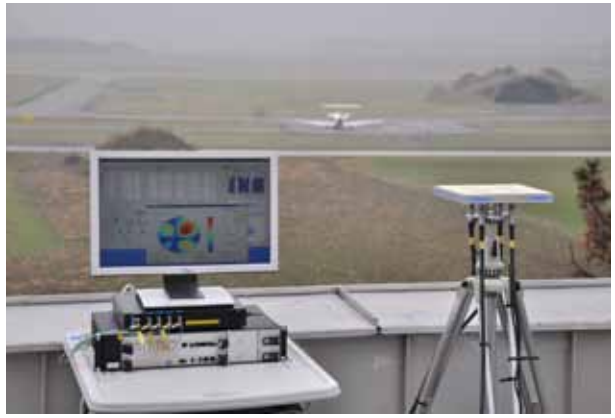
Demonstrator

The SoL receiver demonstrator comprises a 2x2 active antenna array, RF front ends for GPS/Galileo L1/E1/E5a signal reception and baseband digital signal processing. The signals are down converted, digitized and processed in real-time mode. For further investigations on signal processing and beamforming, the signals are also recorded for off-line processing. The device will be able to demonstrate the direction-of-arrival estimation, adaptive beamforming, detection of spoofer signals and multipath/interference suppression as well as the resulting improvements for ranging, positioning and integrity determination.

The GALANT receiver has been successfully tested in the Galileo Test Environment (GATE) in Berchtesgaden. Adaptive beamforming, interference suppression, and spoofer detection shave been shown in real time with a mobile terminal.



Test of DLR's SoL receiver demonstrator

Technical data of receiver demonstrator

- Real-time operation
- Two by two E1/E5 antenna array
- Digital beamforming (after correlation)
- DOA estimation for satellite, spoofer, multipath and jammer
- Online calibration
- GPS/Galileo L1/E1 PVT, GPS/Galileo L5/E5 tracking
- Up to 16 multi-antenna tracking modules
- 20 correlators per multi-antenna tracking module
- FDAF (Frequency Domain Adaptive Filtering)

DLR at a glance

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. In addition to its own research, as Germany's space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation's largest project management agency.

DLR has approximately 7700 employees at 16 locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Goettingen, Hamburg, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stade, Stuttgart, Trauen, and Weilheim. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

DLR **Deutsches Zentrum für Luft- und Raumfahrt** e.V.
in der Helmholtz-Gemeinschaft

Institute of Communications and Navigation

Postfach 1116
82230 Wessling-Oberpfaffenhofen

Dr.-Ing. Achim Dreher
Telephone: +49 (0)8153 28-2314
Email: achim.dreher@dlr.de

www.DLR.de

Information

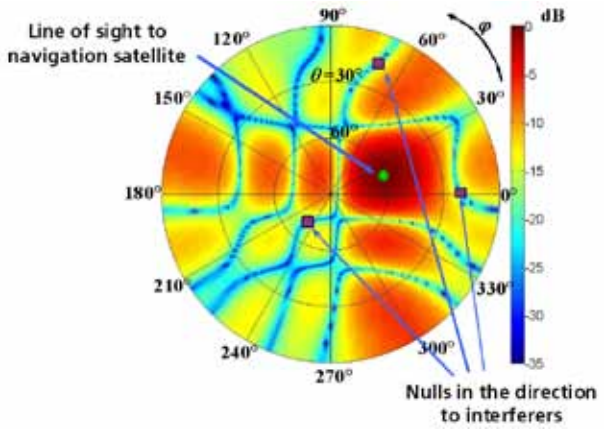
GALANT

Galileo Antenna

DLR

Project Overview

Interference and multipath signals can cause serious performance degradations of satellite navigation receivers that cannot be tolerated for safety-of-life (SoL) applications. Also, deceptive signals from spoofers and repeaters are an increasing threat for the dependable navigation. To overcome these problems, multi-antenna receivers with new beamforming and signal-processing algorithms will be employed. They enable a more accurate, reliable and robust navigation solution by detecting and suppressing interference, multipath and spoofer signals and improving the reception of the useful line-of-sight satellite signals. For the development and testing of these algorithms and in order to demonstrate new applications, the Institute of Communications and Navigation builds up a GNSS receiver demonstrator with improved capabilities for interference, multipath and spoofer mitigation by utilization of array processing techniques. The aim is to develop a complete safety-of-life receiver system including array antenna, RF front end, digital signal processing, navigation solution, and integrity assessment.



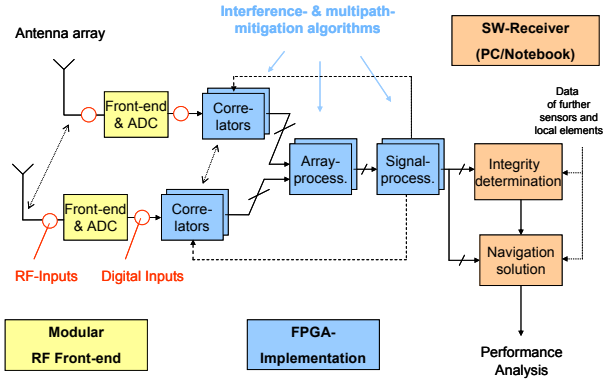
Antenna pattern resulting from adaptive beamforming

Architecture

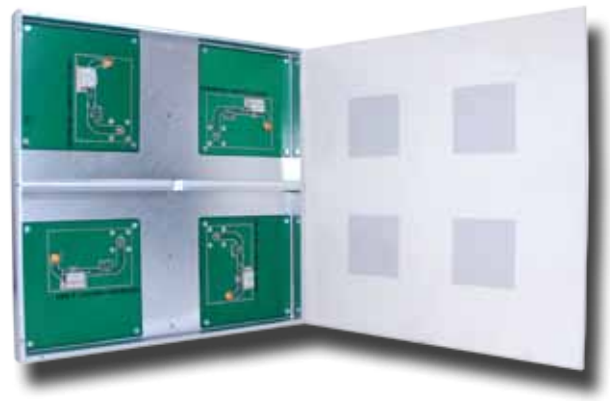
To detect the directions of arrival (DOA) of more than 12 navigation satellites and form each antenna pattern independently, the employment of digital beamforming (DBF) is very well suited. Therefore, the signal of each antenna element passes through a complete RF front end, IF circuits and AD converters before the antenna pattern is generated by processing the data from all elements.

The front end is designed to operate in the L1/E1 and E5a frequency bands. It is equipped with a multifrequency active antenna element in microstrip technology with right-hand circular polarization (RHCP) and two isolated ports. The antenna exhibits a high suppression of the cross-polar component and a very broad beam characteristic to obtain good scanning capabilities down to the horizon.

The further development will include size reduction of antenna array, elements and front end. This is required for the seamless integration of the antenna into the surface of aircraft and vehicles and for the extension of its functionality.



Architecture of receiver demonstrator



Active antenna array

GALANT receiver with reduced size