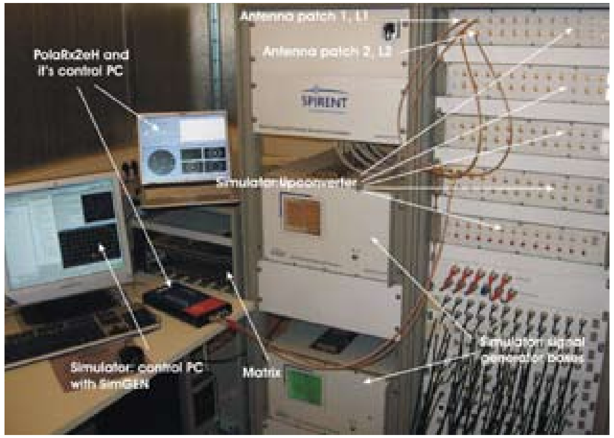
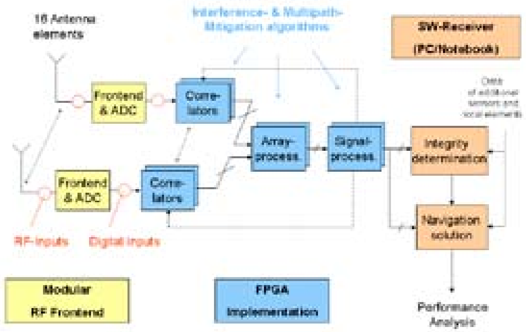
GNSS and Interference Laboratory:

The receiver test laboratory of the institute consists of an advanced multi-output GPS + Galileo signal generator, a programmable signal generator for interference generation and further measurement equipment. Additionally, a high data rate recorder will be available for recording of real interference signals in 2008.



GNSS and Interference Laboratory



Architecture of receiver demonstrator

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 5,300 people are employed in DLR´s 28 institutes and facilities at eight locations in Germany: Koeln-Porz (headquarters), Berlin-Adlershof, Bonn-Oberkassel, Braunschweig, Goettingen, Lampoldshausen, Oberpfaffenhofen, and Stuttgart. DLR also operates offices in Brussels, Paris, and Washington, D.C.

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

DLR
Institute of Communications
and Navigation

Postfach 1116
82230 Wessling-Oberpfaffenhofen

Dr.-Ing. Achim Hornbostel
Tel: 08153/28 2318
Email: achim.hornbostel@dlr.de

Information

SoL

Safety of Life

DLR

Developments for Safety of Life Applications

Modernization of GPS and the upcoming European Galileo System will enable Safety of Life applications (SoL) as for example aviation or maritime applications which are only based on GNSS world-wide. These applications depend not only on accurate positioning but strongly on the reliability of the position, thus integrity of the user position. A main technology driver regarding SoL applications is aviation: In the U.S.A. WAAS (Wide Area Augmentation System) is certified for the approach category APV (Approach with Vertical Guidance). In addition, certification of systems for CAT I landings is foreseeable .
The Institute of Communications and Navigation of the German Aerospace Center (DLR) as one of the leading research centers in Europe in the field of aviation and satellite navigation is especially dedicated to the development of methods and technology to enable SoL applications. The Institute of Communications and Navigation has several test facilities and experimental systems in order to support development of new methods and technology and has performed numerous measurement campains in order to gather unique knowledge on the satellite navigation channel with regard to multipath and interference in the satellite navigation frequency bands.

Safety of Life Applications

Integrity

The key performance parameter in Safety of Life applications is the integrity i.e. the trust one can have in the function of the system. In our activities we investigate the robustness of the navigation solution, develop techniques to monitor threats, investigate and develop techniques to detect, mitigate or exclude a faulty element of the system that drives to an unacceptable fault. The GNSS integrity activity is subdivided into 4 sub-activities: Combined GPS + Galileo RAIM, Satellite Based Augmentation Systems (SBAS) and Galileo Integrity Channel (GIC), Ground Based Augmentation Systems (GBAS) and Aircraft Based Augmentation Systems (ABAS).

Interference Mitigation

The precision provided by current generation GNSS receivers together with the use of sophisticated processing methods, such as differential and kinematic techniques, to remove certain errors (e.g. ionospheric error), leaves multipath reception and radio frequency interference as the dominant remaining error sources affecting GNSS performance. A receiver that is not prepared to detect and mitigate undesired in-band signals will either loose lock of valuable satellites or will let the navigation solution be degraded without notification of the user. In order to effectively mitigate interference and multipath signals in a GNSS receiver the Institute of Communications and Navigation is developing and testing robust spatial filtering techniques (digital beamforming algorithms) and advanced array processing techniques (e.g. high resolution estimation methods), especially for safety critical applications. The algorithms are implemented and tested in a software GNSS receiver and in experimental systems.

Receiver Demonstrator Development

For development and testing of new algorithms and in order to demonstrate new applications the Institute builds up a SoL receiver demonstrator.

- An array patch antenna enables the user to detect the direction of arrival (DOA) of the received signal and to do adaptive forming of the antenna pattern. The signal of each antenna element is filtered and amplified, down converted to IF and digitized. The front-end is designed to work within the L1, E5, E6 frequency bands and is currently under development.
- Digital Signal Processing: Currently tracking and acquisition of GPS, GIOVE and Galileo signals and array processing algorithms are implemented in a SW-receiver for offline processing of simulated or recorded IF or baseband data. In order to provide real time processing, time consuming processing tasks will be implemented in a FPGA.
- Navigation Data Processing: Processing of pseudo ranges and other raw observations with relative low data rates for the navigation solution and integrity determination will stay on a PC. The advantage of this approach is that high level programming languages as C or MATLAB can be used.

This design offers a high flexibility of the demonstrator. The functionality of the receiver can be adapted to specific requirements by modifying the SW and firmware and a number of different algorithms and techniques can be implemented without new hardware development.