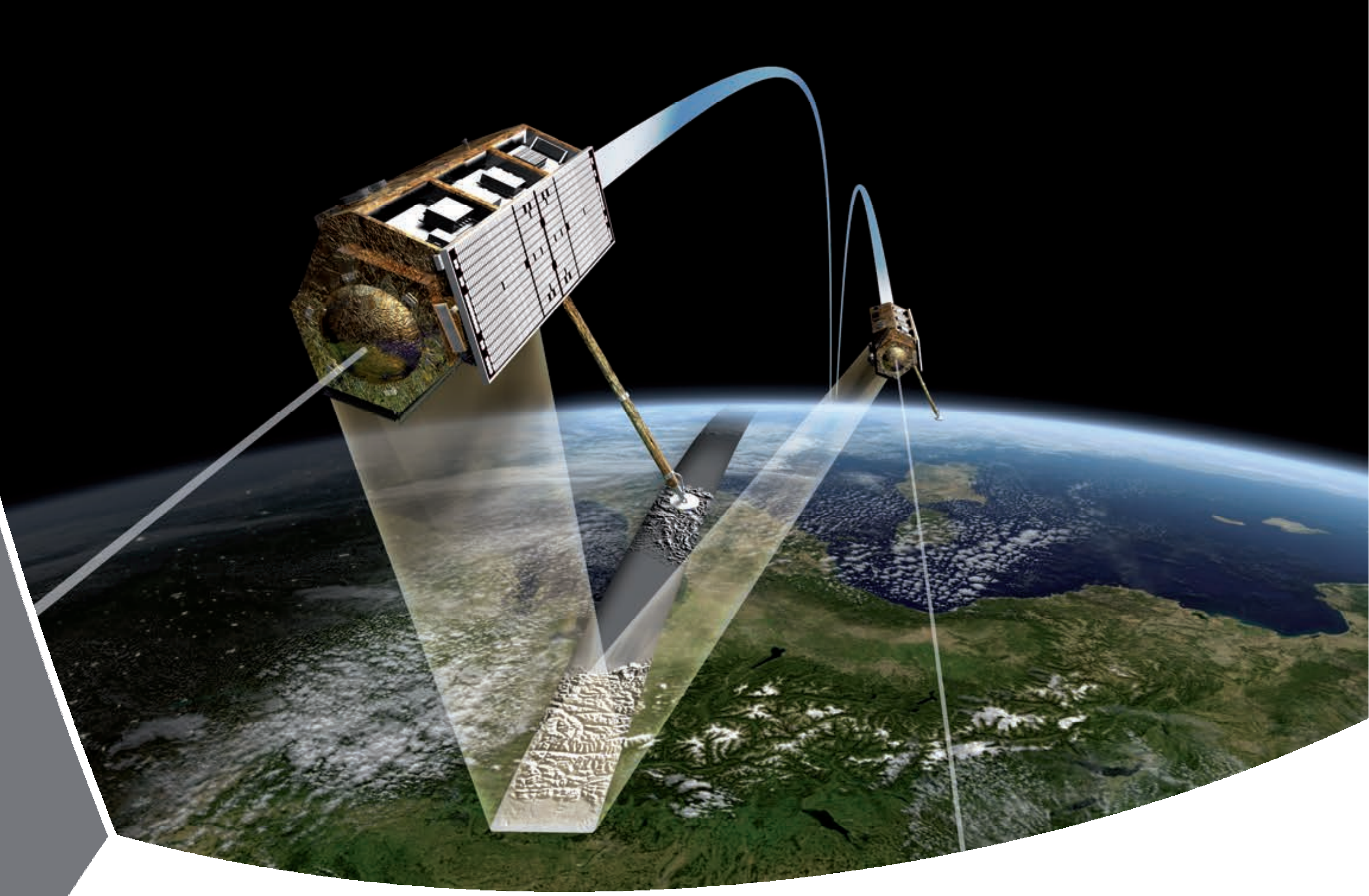

Institute´s Brochure

Microwaves and Radar Institute

Overview of Projects and Research Activities

DLR

German Aerospace Center
A member of the Helmholtz Association

Microwaves and Radar Institute

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Cover TanDEM-X Mission

Institute's Profile

Mission

With its know-how and expertise in passive and active microwave remote sensing, the Microwaves and Radar Institute contributes to the development and advancement of ground-based, airborne and spaceborne sensors.
The focus of its research work is on the conception and development of new synthetic aperture radar (SAR) techniques and systems, as well as sensor-specific applications. The Institute's strength is the execution of long-term research programs with applications in remote sensing, aeronautics and traffic monitor-ng, as well as reconnaissance and security. In line with the German space program, the Institute works in close collaboration with other DLR institutes, the German Space Administration, the European Space Agency, German industry and responsible ministries.
The education of young scientists in the form of hosting and supervising internships, as well as diploma and doctoral theses is also an important part of the Institute's mission.

Research and Projects

In the last 5 years, the Institute has actively participated and also initiated several SAR missions and research programs that are decisive for its long-term strategy. Important examples are TerraSAR-X, TanDEM-X, F-SAR (new airborne SAR) and SAR-Lupe. It is also working on future remote sensing and reconnaissance systems, such as Sentinel-1 (ESA GMES program), TerraSAR-X2 (follow-on to TerraSAR-X), HRWS (next generation X-band SAR with high-resolution wide-swath imaging), Tandem-L (L-band mission proposal) BIOMASS (ESA Earth Explorer mission), VABENE (DLR project for traffic monitoring with radar) and the SAR-Lupe follow-on program. These projects are accompanied by research programs that ensure the Institute keeps a step ahead in the development of new research fields.

Examples of such research programs are bistatic and multistatic SAR systems, digital beamforming, inverse SAR, polarimetric SAR interferometry and tomography, calibration, signatures, propagation, antennas, as well as radio-metry and imaging techniques for security.

Organization

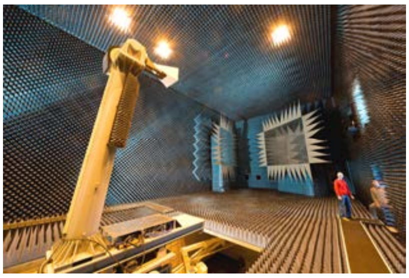
The Institute has 4 departments working in well established research programs, projects and external contracts.
The Institute has about 145 employees, comprising scientists, engineers, technicians, support personnel, as well as internship, diploma and doctoral students, and guest scientists.

Three Institute's departments are working on Earth observation and one on reconnaissance and security. The SAR Technology department is responsible for the development of the airborne SAR system F-SAR and contributes to the spaceborne SAR projects with airborne campaigns to simulate new data products, to validate and cross-calibrate the satellite data and to demonstrate new techniques.

The Satellite SAR Systems department and the Radar Concepts department are engaged in new spaceborne SAR missions, and are developing new sensor concepts and techniques for future radar systems. The Satellite SAR Systems department is responsible for operating the radar instruments on TerraSAR-X and TanDEM-X and holds the position of the mission manager. The Radar Concepts department also contributes with the development of new sensor-related applications. For military spaceborne SAR activities, all major projects and activities are concentrated in the Reconnaissance and Security department. The Institute's expertise in passive microwave systems is also in this department, as most of the passive microwave projects are presently related to security applications.

Microwaves and Radar Institute.

TechLab: a new building for high-tech microwave sensor development.



Compact Test Range Facility.

F-SAR: The new airborne SAR system of DLR.

Expertise and Facilities

With the continuity of successful research in SAR over 35 years it has been possible to channel the experience gained from the planning and implementation of international space missions into a national SAR program. Due to the end-to-end system know-how from data acquisition (including the Institute's airborne SAR), system design to data interpretation and research into new applications, the Institute has become one of the leading international research institutions in SAR. The Institute is today recognized as a leading research center on synthetic aperture radar.

The Institute has a number of large-scale facilities to support its research activities in microwave sensor development and associated technologies. The **airborne SAR system F-SAR** is the successor of the well-known E-SAR system of DLR. F-SAR is a totally new development utilizing the most modern hardware and commercial off-the-shelf components. As for E-SAR, DLR's Dornier DO228-212 aircraft was the first choice as the platform for the new system. F-SAR is a modular system operating in X, C, S, L and P-band. Besides the fully polarimetric capability in all frequencies, it allows the operation of up to 4 frequencies at the same time with a data rate up to 1 Gbit/s per channel. The geometric resolution varies from 2.5 meters to 25 centimeters depending on the frequency band and user requirements. F-SAR is fully reconfigurable and will include innovative operation modes with digital beamforming on receive in future system upgrades. The main objectives of the airborne flight campaigns are the development of innovative SAR modes or operational configurations, the demonstration of novel techniques and applications, as well as performing preparatory experiments for future SAR satellite systems, supporting data product development, as well as SAR system specification.

In 2009, all Institute's facilities and technological developments have been concentrated in a new building – **TechLab** – a center for high-tech microwave sensor development with several laboratories and measurement facilities, and approx. 25 employees. The main facility is a **compact test range** for highly accurate antenna characterization, as well as for radar cross-section measurements. Further facilities are a microwave chamber for measuring monostatic and bistatic radar signatures of scaled target models, facilities for determining the dielectric properties of material samples and a pool of ground equipment for spaceborne SAR calibration. Also included in TechLab are several research laboratories, especially equipped for the development, optimization, integration, testing and calibration of radar and radiometer systems.

The Institute operates also a **microwave mechanical laboratory** for the design, development and manufacture of microwave components, instruments and models, using numerically controlled machines. The laboratory also manufactures miniaturized and hollow components using galvanic and galvanoplastic techniques. It provides valuable consultancy for the researchers and developers in the specification and design of microwave instruments and experimental set-ups.

Synthetic Aperture Radar

Synthetic Aperture Radar (SAR) is an indispensable source of information in Earth observation, since SAR is the only spaceborne sensor that has high-resolution, all-weather and day-and-night imaging capability. SAR plays a major role in a wide spectrum of applications, such as environmental monitoring, retrieval of bio/geo-physical parameters of land, vegetation, water, snow and ice surfaces, hazard and disaster monitoring as well as reconnaissance and security related applications. Further measurement capabilities are achieved by repeat-pass interferometry (e.g. deformation of the Earth surface to millimeter accuracy), single-pass across-track interferometry (e.g. generation of digital elevation models), e.g. polarimetry (e.g. soil moisture estimation), polarimetric SAR interferometry (derivation of forest height and above-ground biomass), as well as SAR tomography (e.g. forest structure profiling).

Today, we have entered into a new era of spaceborne SAR systems. Satellite systems like TerraSAR-X, TanDEM-X, Radarsat-2 and COSMO-SkyMed are providing radar images with a resolution more than one order of magnitude better than that of previous SAR systems. They are also outperforming by far previous systems with respect to their imaging flexibility and interferometric modes.

German Space Radar Program

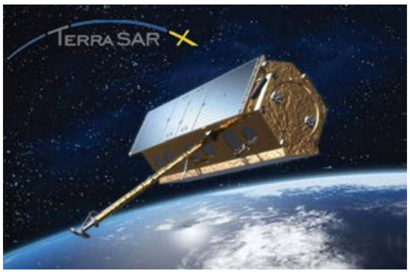
Germany has focused its national space radar program on the development of X-band SAR instruments. MRSE – Microwave Remote Sensing Experiment – was the first spaceborne X-band SAR instrument and was carried on-board the Space Shuttle mission Spacelab-1 in 1983. In cooperation with NASA/JPL and ASI, the next X-band SAR instrument flew on-board two Shuttle radar imaging missions (SIR-C/X-SAR) in 1994, followed by the Shuttle Radar Topography Mission (SRTM/X-SAR) in 2000. A next important step in Germany's radar roadmap was taken in 2001 with the decision to build the first dedicated radar satellite. TerraSAR-X was launched in 2007 and is providing high-quality images with a resolution up to 1 m. TanDEM-X, a rebuild of TerraSAR-X with some modifications for allowing bistatic interferometry in close formation flight, was launched in 2010 and is acquiring a digital elevation model of the entire land surface of the Earth with a height accuracy better than 2 m. The roadmap for the German radar program foresees the launch of a next generation X-band SAR satellite by the end of this decade. The SAR instrument will have a digital beamforming capability on receive, in order to allow simultaneously high-resolution and wide-swath imaging.

Projects

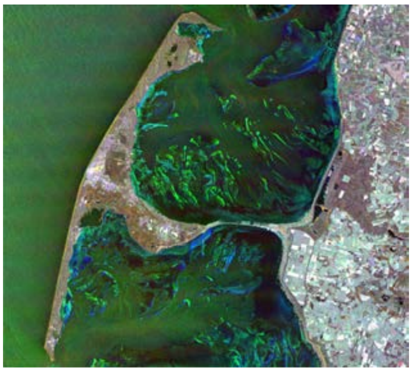
TerraSAR-X

On June 15, 2007, Germany's first operational radar satellite TerraSAR-X was launched into orbit. The mission is implemented in a public-private partnership (PPP) between DLR and EADS Astrium GmbH. The TerraSAR-X satellite has been developed by EADS Astrium GmbH; four DLR institutes in Oberpfaffenhofen have developed the ground segment and are operating the mission.

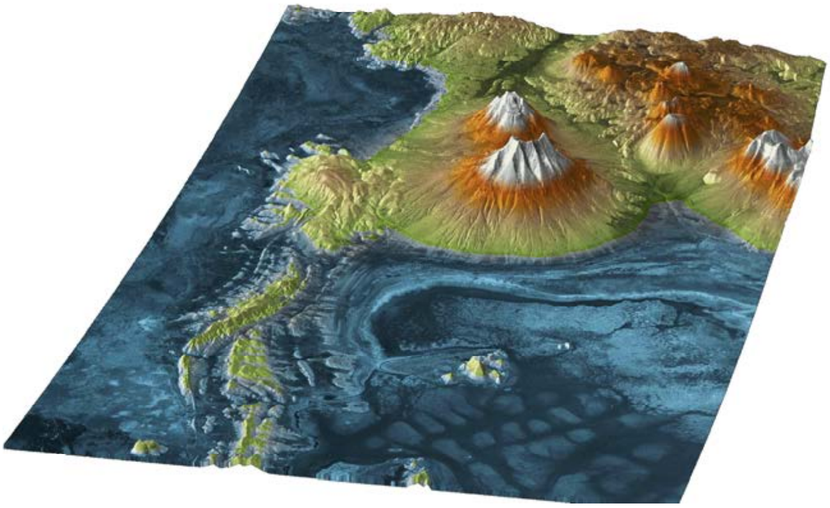
TerraSAR-X supplies high-quality radar data for a mission life-time of at least five years (current expectation is more than six years). In this context, TerraSAR-X serves two main goals: 1) To provide the scientific community with multi-mode X-band SAR data, and 2) to establish a commercial Earth observation market, i.e. to develop a sustainable EO business, so that follow-on radar satellite systems can be completely financed by industry from the revenues. TerraSAR-X is an advanced X-band radar satellite with a phased array antenna consisting of 384 transmit and receive modules. The antenna is fixed mounted to the



TerraSAR-X satellite was launched in June 2007 and is providing since then high-quality images with a resolution up to 1 meter.



Multi-temporal TerraSAR-X image of the Sylt island in North Germany (green: 22 Oct., blue: 24 Oct., and red: 27 Oct., 2007).



Digital elevaton model generated by TanDEM-X showing the largest salt flat in the world (Salar de Uyuni, Bolivia). Since the start of the operational phase in December 2010, TanDEM-X is mapping ca. 12 million square kilometers per month in interferometric mode.

TanDEM-X (TerraSAR-X add-on for Digital Elevation Measurement), initiated jointly by the Microwaves and Radar Institute and EADS Astrium GmbH, opens a new era in spaceborne radar remote sensing.

spacecraft body and spans an overall aperture size of 4.8 x 0.7 m. The center frequency of the radar instrument is 9.65 GHz with a selectable system bandwidth of up to 300 MHz. Variable antenna beams and multiple operation modes can be selected like stripmap (3 m resolution, 30 km swath width), scanSAR (16 m, 100 km swath width), or high-resolution spotlight mode (1 m, 5/10 x 10 km image size). The imaging modes can be further combined with different polarization settings. In the scope of the calibration activities for TerraSAR-X, it has been demonstrated that the calibration accuracy of the radar images is better than 0.3 dB and that the geo-localization accuracy is in the order of 30 centimeters.

The Institute has contributed to the TerraSAR-X project with a dedicated SAR system engineering activity with the design, implementation and operation of the Instrument Operations and Calibration System (IOCS) and with the development and execution of the end-to-end system calibration. Beyond these tasks, the Institute also holds the position of the Mission Manager who chairs the Mission Board, also including the science and the commercial coordinators.
The Mission Board decides on the strategic planning and all issues related to daily business, nominal operations and contingencies. Representing the German federal government, the DLR is the sole owner of the TerraSAR-X data and coordinates the scientific data utilization.

TanDEM-X

TanDEM-X (**T**erraSAR-X **a**dd-o**n** for **D**igital **E**levation **M**easurement), initiated jointly by the Microwaves and Radar Institute and EADS Astrium GmbH in 2003, opens a new era in spaceborne radar remote sensing. A single-pass SAR interferometer with adjustable baselines in across and along-track directions is formed by adding a second, almost identical spacecraft to accompany TerraSAR-X in a closely controlled formation. With typical across-track baselines of 200 – 400 m, a global digital elevation model (DEM) with 2 m relative height accuracy at 12 m horizontal posting is being generated. DEMs are of fundamental importance for a broad range of scientific and environmental applications. For example, many geo-science areas, like hydrology, glaciology, forestry, geology, oceanography, and environmental monitoring require precise and up-to-date information about the Earth's surface and its topography. Beyond the primary mission objective, TanDEM-X provides a configurable SAR interferometry test bed for demonstrating new SAR techniques (multistatic SAR, polarimetric SAR interferometry, digital beamforming and super resolution) and associated applications.

An orbit configuration based on a helix geometry has been patented by the Institute and was selected for safe formation flying of the two satellites. In order to allow accurate phase information in the bistatic acquisition mode, the radar instruments feature a new technique for exchanging phase information via dedicated microwave links.

Combined data acquisition planning for both the TerraSAR-X mission with single localized requests as well as for the TanDEM-X mission with a global DEM mapping strategy is a major challenge under the constraints of limited space segment resources. For generating the global DEM roughly 350 TByte of raw data will be acquired using a network of ground receiving stations. Processing to DEM products requires advanced multi-baseline techniques and involves mosaicking and a sophisticated calibration scheme on a continental scale. The global DEM will be available by end 2014. Besides the tasks in the development of the ground segment, the Institute is managing the ground segment project in Oberpfaffenhofen and coordinates the scientific activities of the TanDEM-X mission.

TanDEM-X represents an important step towards a constellation of bistatic and multistatic radar satellites and will provide sustained support for Germany's leading role in spaceborne SAR technologies and missions.

Tandem-L

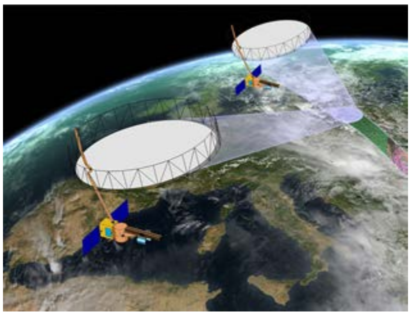
Tandem-L is a mission proposal initiated by the Institute for an innovative interferometric L-band radar instrument that enables the systematic monitoring of dynamic Earth processes using advanced techniques and technologies. The mission is science driven, aiming to provide a unique data set for climate and environmental research, geodynamics, hydrology and oceanography. Important application examples are global forest height and biomass inventories, measurements of Earth deformation due to tectonic processes and/or anthropogenic factors, observations of ice/glacier velocity fields and 3-D structure changes, and the monitoring of soil moisture and ocean surface currents.

The Tandem-L mission concept consists of two cooperating satellites flying in close formation. The Pol-InSAR and repeat-pass acquisition modes provide a unique data source to observe, analyze and quantify a wide range of mutually interacting processes in the biosphere, lithosphere, hydrosphere and cryosphere. The systematic observation of these processes benefits from the high data acquisition capacity and the novel high-resolution wide-swath SAR imaging modes that combine digital beamforming with a large reflector antenna.

One key technology of Tandem-L is the use of a large reflector antenna in combination with digital beamforming in the feed array that illuminates the reflector. While all feed elements are used during transmission, allowing the illumination of a large image swath, 2-3 feed elements are activated during the receive window. The feed element positions are periodically shifted following the systematic variation of the direction of arrival of the swath echoes.

The advantages of this concept are manifold. First, the use of a large reflector antenna in connection with digital beamforming allows the reduction of the transmit power by a factor of 3-4 compared to the traditional SAR concept for the same imaging parameters. Second, it allows the mapping of a much wider swath (approx. 350 km) in high-resolution stripmap mode. The fully polarimetric acquisition in stripmap mode with a wide swath is possible without the constraints of conventional SAR systems.

It is planned to realize the Tandem-L mission in cooperation with an international partner. The mission concept was developed in detail in a two-year pre-phase A study and it will be further investigated in the next 18 months. The cooperation with an international partner will allow a cost-effective implementation, whereby each partner contributes with its predevelopments and experience. According to current planning, the Tandem-L satellites could be launched in 2019.



Tandem-L: Proposal for a highly innovative L-band mission.

Tandem-L: Simulation of the forest height derived from two radar acquisitions using polarimetric SAR interferometry. The forest biomass can be estimated from the forest height using an allometric equation and the forest profile. This image shows the area of Traunstein, Germany.

Future Research Activities & Projects

Looking ahead to the next 5 years, the Institute will continue to initiate and contribute to several projects that will be decisive for its long-term strategy. The table below shows the most important projects in the Institute. The number of projects since 2006 has increased considerably. By means of the Institute's contributions to the TerraSAR-X, TanDEM-X and SAR-Lupe projects, a highly qualified project team has been established. Due to the high degree of innovation in science and technology, the mission Tandem-L represents the most important project for the Institute in the years to come and can be seen as a next milestone in the national radar roadmap after TanDEM-X.

National Missions and Projects

TerraSAR-X and TanDEM-X are national high-resolution radar satellites launched in 2007 and 2010. The tandem operation of both satellites for DEM generation is planned until mid 2014, but an extension of the operation is expected, because TerraSAR-X is still fully functional and has sufficient resources available. Although the nominal lifetime of TerraSAR-X is specified to be 5.5 years, an extension to more than 7 years is expected.

Most important projects in the Institute. Bars in orange show the planned continuation of the respective project. Satellite launches are indicated by triangles.

Tandem-L is a radar mission proposal in L-band. A pre-phase A study has been performed from 2008 to 2011. The study has been extended until 2014 in order to investigate a joint relization of Tandem-L with JAXA. The decision for implementation depends on an approval of the required funding which is expected to occur by the end of 2014.

The project RSE is fully funded by the German MoD and encompasses all activities of the Institute related to security and reconnaissance. It includes the technical support, engineering and mission analysis of SAR-Lupe and its follow-on system, as well as the passive microwave sensor developments.

Since 2009 the Institute has contributed to the TerraSAR-X2 phase A study. It is expected that TerraSAR-X2 will include new technological parts of a high-resolution wide-swath (HRWS) SAR system. Different to TanDEM-X, the requirements for TerraSAR-X2 are mainly driven by commercial applications. However, according to the PPP agreement, TerraSAR-X2 will ensure X-band data continuity for the scientific community.

European Projects

Sentinel-1a and Sentinel-1b are two C-band radar satellites from the EU/ESA GMES program with a launch scheduled for beginning 2014 and 2015, resp. The Institute's contribution lies in the definition of the end-to-end system calibration concept and algorithms. It is expected that the Institute will participate in the calibration during the commissioning phase of the satellites and also contribute to the envisaged calibration and image quality control center of ESA.

BIOMASS (P-band SAR, fully polarimetric) is an Earth Explorer mission recommended for implementation. The Institute is involved in the calibration and several science studies for the two radar missions. For BIOMASS, the Institute is the prime contractor for the development of the complete end-to-end mission performance simulator. Further activities include flight campaigns with the airborne SAR.

The Institute also contributes to the Spanish PAZ satellite with the delivery of the SAR related software modules for instrument operations and calibration. The PAZ satellite is a TerraSAR-X based satellite, the launch is scheduled for beginning 2014.

DLR Internal Projects

F-SAR is the new airborne SAR system of DLR that became fully operational by 2012. It is planned to expand the F-SAR system to include a digital beamforming capability by 2015. Several internal and external flight campaigns have already been executed with F-SAR since 2008, the intensive operational phase started in 2012.

F-SAR has been extended to a 4-channel system for road traffic monitoring (DLR internal project VABENE). The Institute has submitted a proposal for developing a low-cost, compact airborne SAR for road traffic monitoring based on the F-SAR technology. This project has started mid 2012.

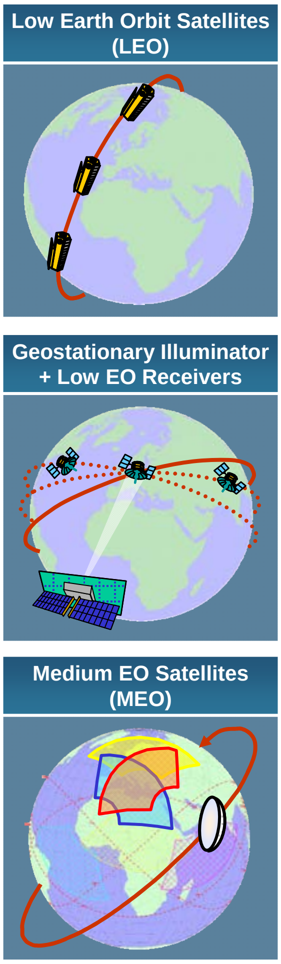
The DLR projects FaUSST and FFT-2 deal with UCAVs (Unmanned Combat Aerial Vehicles) and agile missiles, respectively. Several disciplines, like aerodynamics, flight control, material sciences, actuation, radar and infrared signatures are represented. The Institute's contributions are investigations concerning radar signatures, radar detection probabilities and radome microwave transmission.

Resource allocation in the Institute for the projects and research programs. More than 70% of the Institute's resources are allocated to DLR projects and external contracts.

DLR's programmatic area	Main research theme at the Institute	Projects	Institute's research topics	Resource allocation
Space	Earth Observation	TerraSAR-X, TanDEM-X, Tandem-L Sentinel-1, PAZ, TerraSAR-HD, HRWS, BIOMASS	Spaceborne SAR concepts, digital beamforming, signal processing, airborne SAR, information retrieval, calibration, antennas	56%
	Reconnaissance and Security	Space-based reconnaissance and security (RSE)	–	29%
Aeronautics	Reconnaissance and Security	FaUSST, FFT-2	Signatures, metamaterials	8%
Transportation	Traffic Monitoring with Radar	VABENE	Airborne SAR, signal processing	7%

Research Programs

The above mentioned projects are accompanied by several research programs. The table on the top summarizes the internal and external projects as well as the research programs that are funded by the DLR program directorates in the areas of space, aeronautics and transportation. Examples of research programs are new SAR concepts, signal processing, airborne SAR, information retrieval, calibration, and signatures. The research programs are closely interconnected with the project activities. As a matter of fact, most of the current projects of the Institute have started as research programs with typical durations of 2 to 5 years. Due to the long-term aspect of the Institute's projects, it has developed a roadmap for the future radar activities jointly with its partners in industry and research. This roadmap is being updated on a regular basis. As of today, the Institute has more than 70% of its resources allocated to DLR projects and external contracts. Considering the success in the approval of the new mid-term and long-term projects, it is expected that this percentage will be maintained above 70% in the next 5 years.



Concepts for a future constellation of radar satellites for quasi-continuous monitoring of the Earth.
Top: low Earth orbit (LEO) satellites, middle: geostationary Earth orbit (GEO) transmitter with LEO receivers; bottom: medium Earth orbit (MEO) satellites.

Vision

In a changing and dynamic world, timely and high-resolution geospatial information with global access and coverage becomes increasingly important. Constellations of SAR satellites will play a major role in this task, since SAR is the only spaceborne sensor that has all-weather, day-and-night, high-resolution imaging capability. Examples of applications for such a constellation are environmental remote sensing, road traffic, hazard and disaster monitoring, as well as reconnaissance and security related applications.

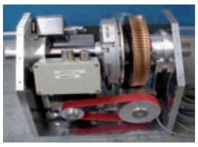
One challenge for future spaceborne SAR systems is to optimize the performance/cost ratio as much as possible, so that a constellation of satellites becomes affordable. Innovative concepts with bistatic and multistatic system configurations represent an attractive solution, exploiting the use of small receiver satellites which acquire the backscattered signal of active MEO or GEO satellites. Utilization of the same transmit signal for different applications can also be explored, as in the case of GPS reflectometry for ocean and land remote sensing. Digital beamforming on transmit and/or receive will solve the contradiction posed by the antenna size in traditional SAR systems that prohibits the SAR sensor from having high azimuth resolution and a large swath width at the same time. Digital beamforming is a clear trend for future systems, allowing enormous flexibility in the sensor imaging mode, sensor calibration, interference removal, and ambiguity suppression. These concepts will allow the implementation of a flexible SAR sensor network with a faster access time and almost continuous imaging capability, necessary for time-critical applications.

High-flying and unmanned vehicles will certainly act as a complementary platform for this network of sensors. Furthermore, radar satellites flying in close formation will allow the construction of sparse arrays with enhanced imaging capabilities.

Another important aspect for present and future microwave sensors is the ability to provide quantitative and reliable data products to the user community. Today, the sensor information becomes multi-dimensional, as different sensor sources, polarizations, temporal and spatial baselines, aspect angles and frequencies are used for parameter retrieval. The Institute will direct its efforts towards more accurate system calibration to improve product quality and reliability, as well as towards the development of algorithms for sensor-specific parameter retrieval, as in the case of multi-baseline polarimetric SAR interferometry and tomography.

In some respect, the vision of a SAR sensor network is not too far away. The successful TanDEM-X mission is an important milestone and the implementation of Tandem-L would be a further major step towards this vision. The Institute is committed to increase its role in the development of future microwave satellites for remote sensing, reconnaissance and traffic monitoring. It aims to expand its expertise and leadership in strategically important projects and research areas. Together with its cooperation partners in DLR, industry and science, the Institute will play a key role in the realization of this vision.

Overview of the Institute's facilities.

Facility		Description
F-SAR		New airborne SAR system with polarimetric and interferometric operation in X, C, S, L and P-band. Geometric resolution varies from 4 meters to 25 centimeters depending on the frequency band and user requirements.
TechLab		Center for microwave development, including several laboratories and facilities for sensor development, integration and testing for airborne radar, radiometers, antenna and calibration devices.
Compact Test Range		Microwave anechoic chamber (24 m x 11.7 m x 9.7 m) with a dual cylindrical parabolic reflector configuration for highly accurate antenna characterization and radar cross-section measurements. The frequency range is from 300 MHz up to 100 GHz.
Bistatic Signatures Chamber		Microwave anechoic chamber (8.5 m x 5.7 m x 5 m) for measuring quasi-monostatic and bistatic polarimetric radar signatures of canonical test objects, as well as scaled target models operating in W-band under stable temperature conditions.
Material Property Measurements		Material characterization using free-space transmission and reflection measurements at X-band, Ka-band and W-band. Waveguide measurements are also provided for frequencies from 1.1 GHz up to 110 GHz.
CALIF		A suite of passive and active calibrators, as well as software tools for accurate calibration of spaceborne SAR sensors. The test site for the deployment of the calibration devices can cover a swath width of up to 450 km.
Mechanical Lab		Design, development and manufacture of microwave components, instruments and models in machining and electroforming techniques, as well as mechanical drives, positioning systems and various racks and housings.

DLR at a Glance

DLR is Germany's national center for aeronautics and space. 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 execution organisation.

DLR has approximately 7400 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.

Microwaves and Radar Institute

With its know-how and expertise in passive and active microwave remote sensing, the Microwaves and Radar Institute contributes to the development and advancement of ground-based, airborne and spaceborne sensors and missions. The Institute's expertise encompasses the whole end-to-end system know-how in microwave sensors. It has a number of large-scale facilities to support its research activities, including the airborne SAR (F-SAR) and a new building for microwave sensor and technology development (TechLab).

The Institute is located in Oberpfaffenhofen near Munich and has a long history dating back to the beginning of the last century. Today, the Institute focuses its research on synthetic aperture radar (SAR) techniques, sensors and applications related to remote sensing, environmental monitoring, reconnaissance and surveillance, as well as road traffic monitoring. The Institute has about 145 employees and has become the driving force of the SAR Center of Excellence at DLR. It is a leading institution in synthetic aperture radar remote sensing in Europe and worldwide.

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in der Helmholtz-Gemeinschaft

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