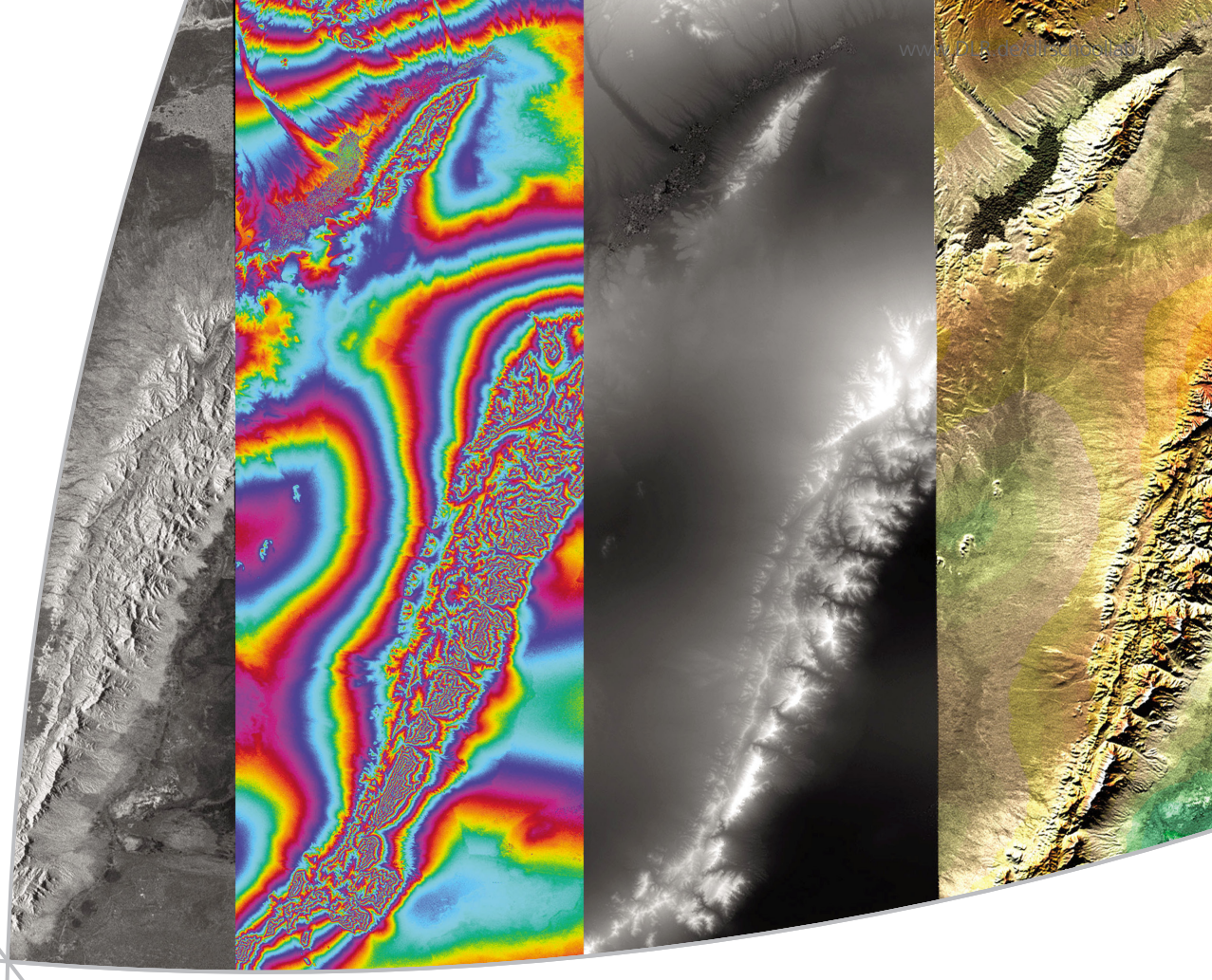

DLR_School_Lab

Oberpfaffenhofen

Radar Measurement Technology

Using microwaves

Ever since the young scientist Heinrich Hertz first supplied the evidence in 1886 that electromagnetic waves are reflected by metallic objects, methods involving microwaves have been numbered among the most important measurement technologies ever developed.

We now look back on over 100 years of radar technology. The developments that have taken place since 1904 (C. Hülsmeyer's "telemobiloscope") progressed at an enormous pace. The DLR_School_Lab radar experiment illustrates the basic principles and provides an introduction to radar technology.

Aerospace and shipping, but also land surface traffic, would hardly be possible without the accurate measurements provided by radar systems. The precise measurement and mapping of planet Earth is also based to a large extent on radar data.

Radar Measurement Technology

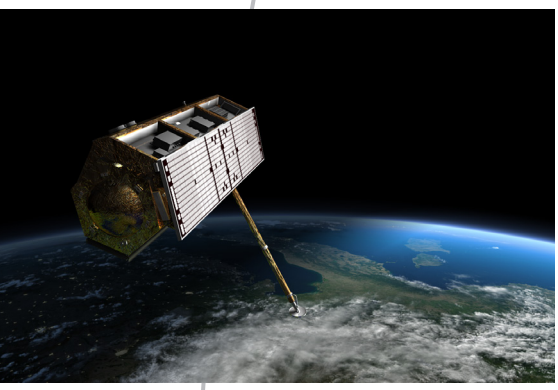

Fig. 1: The German radar satellite TerraSAR-X

The Radar Principle

Radar
Radar has significant advantages compared with optical and acoustic measurement methods. The reason is the methodology: radar actively emits microwaves. On their path these waves encounter objects which reflect them back. Also called the "echo," these returning waves are systematically analyzed at their place of reception. Because it emits microwaves, radar can function independently of weather conditions and the time of day to supply reliable data.

Applications for Radar Measurement Technology

TerraSAR-X
At DLR radar is used in a wide variety of fields. It is especially common in aviation and aerospace. One example is the TerraSAR-X mission, a joint undertaking of DLR and the space company Astrium. This radar satellite provides images of the earth's surface with a spatial resolution down to one meter; a performance now available for the first time to civilian users. Other radar satellites are in the planning stage.

Aviation
Because of its independence of weather conditions and time of day, radar measurement technology is also used in aviation. The screens in air traffic control centers constantly reveal the location of aircraft, as well as their velocity and altitude. Radar is also used at DLR for flight monitoring.

Road traffic
Radar measurement technology is also routinely used to measure road traffic velocities.

Meteorology
Another application field is meteorology, where radar is used for early identification and location of storm fronts in order to increase the quality of weather forecasts.

Fig. 2: TerraSAR-X radar image of the pyramids of Giza

Fig. 3: The DO-228 research aircraft with an E-SAR radar system

Glossary

Radar
Radar is a detection method involving the emission of electromagnetic waves, their reflection by some object and their subsequent recapture. This sequence allows deductions to be made about the velocity and location of the object.

SAR
SAR is an abbreviation for Synthetic Aperture Radar. It is demonstrated using the E-SAR system on board a DLR research airplane, the Dornier DO-228. This imaging radar sensor uses five different frequency ranges so that wavelengths between 3 cm and 100 cm can be covered.

Microwaves
Microwaves are electromagnetic waves whose wavelengths range from 1 mm to 1 m.

The Experiment

The focus of the radar measurement technology experiment is on conveying the principle behind radar range and velocity measurements. The experiment is for those students for whom practical aspects of wave propagation may not have been dealt with in physics classes.

At the end of the experiment the students will know how to detect and locate objects using microwaves, how to determine their velocity and direction of movement, and even how the total air traffic situation can be monitored.

For this purpose there is a complete system for measuring distance and velocity available at the DLR_School_Lab. The students can gain experience in radar measurement technology at two experiment set-ups equipped with various radar sensors. The possibilities and limitations are revealed, and by making connections to daily life their understanding of technical measurement procedures is deepened.

Fig. 4: Students at DLR_School_Lab

List of Figures

DLR at a Glance

DLR is Germany's national aeronautics and space research center. Its extensive research and development activities in the fields of aeronautics, space, transportation and energy are integrated in national and international cooperative ventures. In addition to this research, as Germany's space agency the federal government has given DLR the responsibility to plan and implement the German space program and to represent German interests internationally. DLR is also the umbrella organization for Germany's largest project management agencies.

Approximately 6,500 people are employed at DLR's 13 locations, which include Köln (headquarters), Berlin, Bonn, Braunschweig, Bremen, Göttingen, Hamburg, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stuttgart, Trauen and Weilheim. DLR also operates offices in Brussels, Paris and Washington D.C.

DLR Oberpfaffenhofen

Aerospace, environment and transportation are DLR's primary fields of interest in Oberpfaffenhofen. Some 1,500 people work there in nine different institutes and facilities, making DLR Oberpfaffenhofen the largest DLR location.

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

DLR_School_Lab Oberpfaffenhofen
Münchner Straße 20
82234 Weßling

Contacts:
Head: Dr. Dieter Hausamann
Telephone +49 8153 28-2770
Telefax +49 8153 28-1070
E-Mail schoollab@dlr.de

School_Lab team assistant: Stefani Krznaric
Telephone +49 8153 28-1071
Telefax +49 8153 28-1070
E-Mail stefani.krznaric@dlr.de

www.DLR.de/dlrschoollab