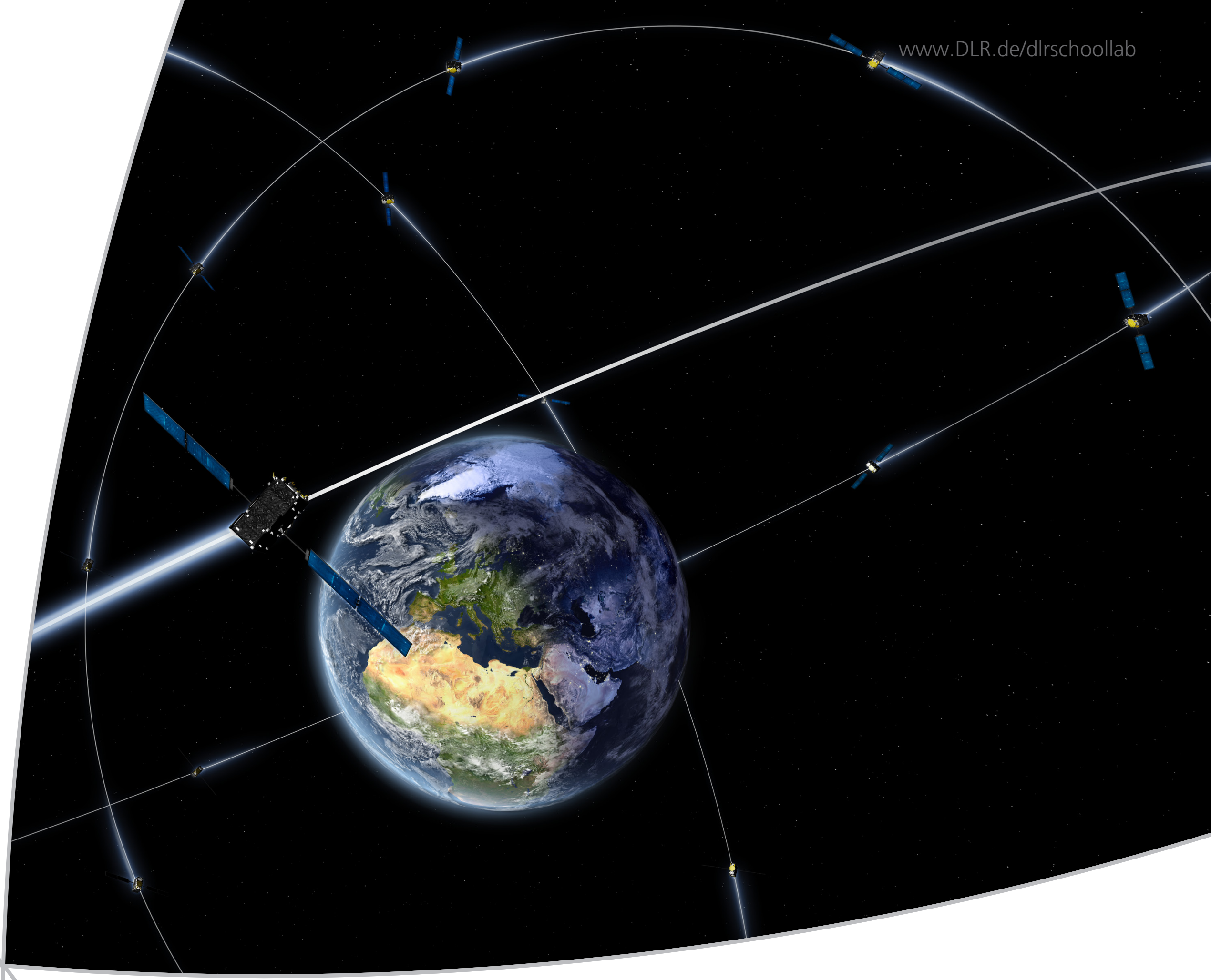
DLR



DLR_School_Lab Oberpfaffenhofen

Satellite Navigation

Orientation made easy

How to find the right way has been a human concern for millennia. Although orientation on land is relatively easy, this is no longer the case for ocean and air navigation.

Navigation systems help us to determine the necessary magnitudes which help us to get from some given location to another. Today, modern satellite technology not only makes it easier for hikers, bikers, motorists, aircraft pilots, ship captains and astronauts in the space shuttle to find out where they are, but also to set a course toward a particular goal.

One question remains: How precise can positioning be?

Satellite Navigation

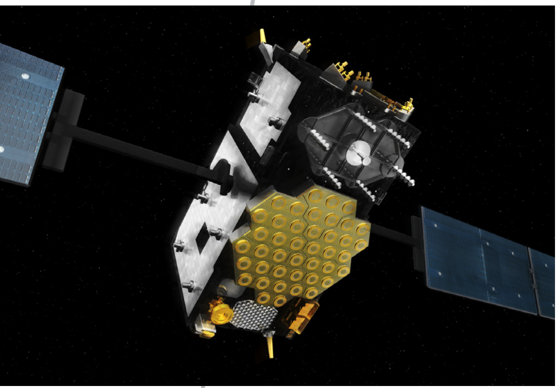


Fig. 1: Galileo satellite (artist's conception)

Galileo

GALILEO in this context does not directly refer to the astronomer Galileo Galilei, but rather to the first navigation system developed by Europeans, which is scheduled for completion by 2015.

On the one hand, GALILEO guarantees European independence from the two existing, military-controlled systems GPS (USA) and GLONASS (Russia), thereby emphasizing Europe's sovereignty. On the other hand, the planned compatibility with GPS guarantees the greatest convenience for the user by providing navigation signals of a reliability unavailable up to now. It is intended to install 30 satellites in three orbit planes around the earth at an altitude of about 24,000 km. Each satellite will be continuously monitored from ground stations. This enables precise positioning in space at any time, which is the precondition for precise positioning on earth.

Applications
GALILEO will primarily improve navigation for the aviation, traffic and logistics sectors. But the public will to a certain extent also have free access to information about location, velocity and time.

More information about Galileo can also be found via the Internet at: http://www.esa.int/esaNA/galileo.html

The Experiment

Navigation systems like the U.S. GPS system have become commonplace. The necessary equipment can easily be purchased and is not prohibitively expensive. Three of these receivers are also available to students for the DLR_School_Lab experiment "Satellite Navigation." Using the example of the GPS system, students learn how precisely a private user can navigate with GPS. They can also learn about what errors have to be taken into account, for example those caused by the

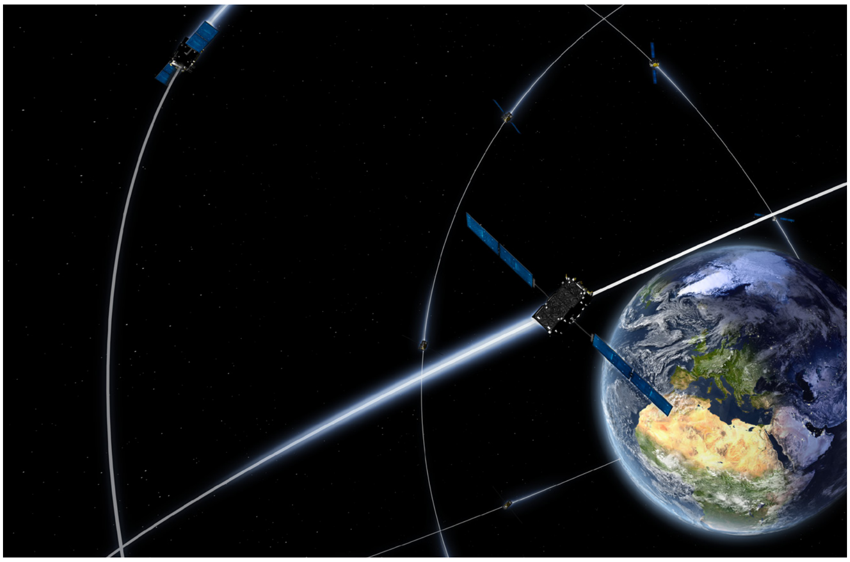


Fig. 2: The Galileo satellites make precise positioning possible down to the centimeter

atmosphere and the surroundings. This is because as modern and fascinating as this technology is, it is not infallible, by far.

Measurement errors
The experiment also deals with tracking down possible sources of error leading to imprecise measurement data. For example, changes in the atmosphere can really mess up the measurements, but something as simple as a tunnel can also be an apparently insurmountable barrier.

However, since the technology is constantly improving, new applications are gradually becoming available which are hardly imaginable. The available systems can provide positioning information accurate to a few meters. But once Galilio is fully functional, positioning should be even more precise.

But beware! Ever since Einstein we know that time on board a satellite passes slower (or is it faster?) than on earth. What has to be kept in mind to get absolutely precise time information?

You can find out the answer at DLR_School_Lab!

Fig. 3: Students determining their position

Application Fields
There are more and more applications for navigation systems in agriculture, rescue services, and science, but also for personal leisure activities such as hiking or sailing.

Fig. 4: DLR measuring vans are equipped with DGPS for positioning down to the decimeter

Glossary

Navigation
Navigation is the "art of steering"; the word comes from Latin navigare. In general navigation refers to the ability to find one's way in geographic space.

GPS
GPS stands for Global Positioning System and is the abbreviation for the U.S. satellite navigation system, which is controlled by the military.

GLONASS
GLONASS is the Russian satellite navigation system. Its structure and manner of operation are comparable to the U.S. GPS system.

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.

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