German Aerospace Center

News Archive Weilheim

DLR researchers conduct world’s first analysis of next-generation GPS navigation signal

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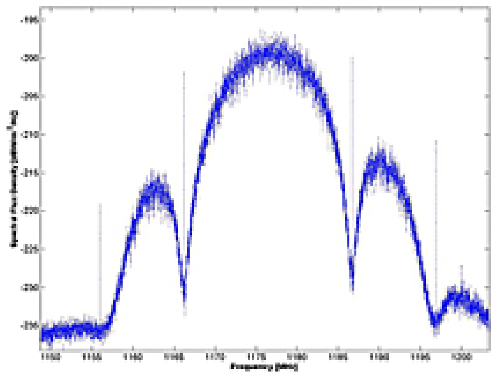
DLR’s 30-metre parabolic antenna at Weilheim

Researchers at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) have received and analysed navigation signals transmitted from the first GPS ‘IIF’ satellite using the 30-metre antenna at the German Space Operations Centre, GSOC, in Weilheim.

The satellite, which has been in orbit since 27 May 2010, is transmitting a signal in the L5 band – the third civilian frequency range – for the first time, and promises to enhance the reliability and accuracy of the navigation service. DLR possesses a globally unique capacity for the analysis of such signals – and expertise that will make future fine-tuning and corrections to the satellite possible.

Signal for even more precise and reliable navigation

"In future, the L5 signal will play a central role in satellite navigation and especially in aircraft navigation, where safety is critical," explains Dr Michael Meurer from the DLR Institute of Communications and Navigation (Institut für Kommunikation und Navigation). The L5 signal is the third civilian GPS signal to be transmitted, and the second in the aircraft navigation frequency band. As with the standard L1 signal, this signal lies within a frequency range reserved for aeronautical radio navigation services. The use of the two signals together enables the elimination of propagation errors caused by the ionosphere, which affect the accuracy of the system. The ionosphere is an atmospheric layer that begins at about 80 kilometres above the Earth’s surface and it contains large quantities of ions and free electrons. Radio signals, even in the higher frequency range where a GPS satellite transmits, decelerate when they pass through this layer, causing errors to arise in position determination. Transmission of the signal at two different frequencies allows the correction of these errors, with the result that position determination becomes more precise and reliable. Over the next two to three years, a total of twelve new GPS ‘IIF’ satellites will be launched.



New GPS L5 signal

Navigation satellites orbit at altitudes in excess of 20,000 kilometres and the navigation signal transmitter power is roughly equivalent to that of a domestic light bulb. When they arrive at Earth’s surface, the signals are so weak that they are lost in the thermal noise. The navigation signals are specially encoded, so that a GPS receiver can extract the signal from the noise using correlation.

Using DLR’s 30-metre antenna at Weilheim, the researchers can detect the signals without needing to use the encoding and correlation to extract them from the noise. The antenna has a gain of 150,000 and when it is aligned with a particular satellite, the signals stand out clearly from the noise. This allows the researchers to perform analyses of the signals that would be impossible with a conventional navigational receiver. This requires complicated calibration of the equipment and extensive processing of the measurement data. This expertise, developed by DLR, is used in co-operation with the European Space Agency in order to verify and optimise the navigational signals for Galileo, the European satellite navigation system. In addition, joint measurements and analyses are carried out with Stanford University as part of DLR’s international cooperation.

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