More accurate than Santa Claus: First Galileo satellite orbit determination with high precision

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Every year for Christmas, the North American Air Defence Command NORAD posts an animation on their website, in which the exact flight path of Santa Claus' sled led by reindeer Rudolf is precisely located (http://www.noradsanta.org/en/). The path of navigation satellites, however, has to be determined much more accurately than Santa's flight path, when precise ground positioning is required. GPS is the best known system of this kind, the European system Galileo is planned to be decidedly more accurate.

On 10 December, seven weeks after the start of the first two Galileo navigation satellites, scientists at the GFZ German Research Centre for Geosciences received the first signals from one of the two satellites (GSAT101). Four days later, the signals could be successfully recorded on a second frequency with a worldwide network of 18 ground stations of the European Space Agency (ESA).

By analysing these first observational data, the GFZ scientists were able to determine the orbit of the satellites, which are flying at an altitude of 23222 km, for the first time to a few decimetres. Besides the calculations of the highly accurate atomic clocks on board, this is a significant factor for the overall performance of the system and the satellites. The independent examination of the satellite orbit parameters undertaken at the GFZ is used for the precise determination of the orbit. This is ultimately of great importance to the end user, e.g. motorists,

since the orbit is the basis for the highly accurate location determination on the ground. Additionally, the possible linkage with the U.S. GPS would improve this positioning, because more satellites are available – an advantage for example in densely developed cities.

The GFZ German Research Centre for Geosciences in Potsdam acts in the context of the Galileo project as an external service for the Galileo Ground Mission Segment (GMS), both in the operation of four ESA receiver stations as well as the scientific analysis of the data obtained. The currently still low number of available ground stations requires a decidedly more careful validation, as it is the case for the hundreds of receiver stations for GPS observations. Especially in this area, the GFZ has many years of experience in satellite orbit determination.

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