GNSS reflectrometry using the L5 and E5a signals for remote sensing applications

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Signals from the Global Navigation Satellite Systems, GNSS, can be viewed as a passive source of radiation and therefore be used for remote sensing purposes. When reaching a surface, for example the ocean, the signal is reflected off the surface. The reflected signal can be used together with the direct signal to obtain observables such as altitude and wind speed.

The strongest reflected signal comes from the specular point, the point on the surface where the angle of incidence and angle of reflection is equal. Signals used for GNSS reflectrometry are scattered from a small area around the specular point, the glistening zone. Analysis of the correlation function for the reflected waveform can provide information about the surface roughness and wind speed. The measured difference in delay between the direct and reflected signal is used to determine the altitude of the receiver.

During this work a bistatic system which provides signals in the L1, L2 and L5 bands has been improved and tested. GNSS signals are on incidence right hand circular polarized but when reflected the signals are received by using a left hand circular polarized antenna. This system uses a two stage receiver; the signal is first received with a front-end and thereafter post processed by software. Bistatic post processing software is being developed for GPS L1 and L5 and Galileo E1 and E5a. The primary focus is on L5/E5a signals, which have a ten times higher chipping rate than L1/E1 and will result in a sharper correlation peak and therefore more accurate measurements.

The bistatic system was installed and tested on the NOAA BAO tower and GNSS data was collected when satellites for both L5 and E5a signals were visible. The system has been installed on the NOAA P3 aircraft and is expected to provide flight data over the ocean.

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