

Airborne C-band Scatterometer for Sea and Land Applications

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During year 2015, a C-band (5.7 GHz) Airborne Wind Vector Scatterometer (AWVS) has been designed and built at Harp Technologies in collaboration with the Finnish Geospatial Research Institute and Aalto University Department of Radio Science and Technology. The scatterometer is intended for wind speed and direction measurements over sea surface, but it is applicable in a variety of other applications. Such applications include for example vegetation research and ice monitoring.

The AWVS scatterometer is operated from the Skyvan aircraft of the Aalto University. It is mounted to look back from the rear cargo door of the aircraft with a 50° incidence angle. The aircraft may be flown at altitudes in between 300 to 3000 meters and its maximum operating time is four hours. Thus, it can serve as a platform for a variety of measurement scenarios.

The scatterometer is a frequency-modulated continuous-wave (FM-CW) radar. It has separate transmission and reception antennas and it operates at a 50 MHz bandwidth that results to a theoretical range resolution of 3 meters. The noise equivalent normalized radar cross section (NRCS) is better than -45 dBm² and the dynamic range is more than 70 dB. The absolute accuracy of instrument calibration is in the order of 1 dB, with clearly better relative accuracy. The scatterometer is capable in making both co- and cross-polarized measurements. The radar is operated in a thermally stabilized enclosure to achieve good stability in different ambient thermal conditions.

Wind scatterometers have been used to measure wind vector over ocean surface for decades. The measurement principle is based on the relationship between ocean surface roughness and reflectivity. The size and direction of small ripples on sea surface are proportional to the wind speed and direction, and can be used to estimate the wind conditions over the sea. In the current measurement geometry, at C-band frequencies and co-polarized measurements, the NRCS of sea surface varies from -27 dBm² to -10 dBm² in wind speeds of 3 m/s to 23 m/s, respectively.

The AWVS scatterometer has been tested at open sea for wind speed and direction retrieval with good results. In November 2015 the instrument will be used to support the measurements of Technology Demonstration Satellite 1 (TDS-1), which is also making wind scatterometry measurements simultaneously at the same sea area over the Gulf of Finland. The project is commissioned by the European Space Agency (ESA).

The presentation will consist of a description of the device, a review of the measurement campaign results, and a discussion of other possible applications of the AWVS scatterometer in the future.