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## SEA STATE DETERMINATION WITH GNSS REFLECTOMETRY ON TECHDEMOSAT-1

**Abstract**

TechDemoSat-1 (TDS-1) is a UK technology demonstration mission due for launch in Q2 2014, and hosts cutting-edge UK payloads. SSTL is responsible as the platform provider and mission prime, and also provides the SGR-ReSI instrument, the company's most advanced Global Navigation Satellite System (GNSS) Reflectometry (GNSS-R) remote sensing instrument. GNSS-R is the measurement of GNSS signals reflected off the Earth's surface. These signals should contain the geophysical imprint of the Earth's surface, be it the ocean, land or ice. The primary target of SSTL and its partner, the National Oceanographic Centre (NOC), is the use of GNSS-R to determine ocean roughness, wind speed and wind direction. Potential applications for ocean surface GNSS-R include weather forecasting, climate change modelling, and logistical planning in the offshore energy and shipping industries.

The first dedicated GNSS-R in-orbit experiment was flown on SSTL's own UK-DMC spacecraft in 2003. Raw data collections were made over multiple Earth surface types and were reprocessed on the ground with a software receiver to generate Delay Doppler Maps (DDM); these show how the energy from the reflected signals are spread across the delay and Doppler domains. NOC has shown, through cross-correlation of UK-DMC data with buoys, that there is a reasonable inverse-exponential relationship between the DDM Signal to Noise Ratio (SNR) and the ocean surface wind speed.

The new SGR-ReSI instrument has a number of improvements over the original UK-DMC instrument and uses high performance COTS technology to perform on-board DDM generation, now making it feasible to collect continuous GNSS-R measurements on a small satellite. The instrument also has a fixed gain RF front end, overcoming the UK-DMC AGC limitation. The SGR-ReSI forms the core technology for SSTL's next generation of GNSS receiver, the SGR-Axio. The SGR-ReSI will also be flying as the primary payload on CYGNSS constellation, funded under NASA's Earth Venture 2 programme. This eight nano-satellite constellation is primed by the University of Michigan and being constructed by Southwest Research Institute (SwRI). Its target application is to take wind speed measurements within hurricanes, helping to save lives through improvements to forecasting and monitoring.

The paper will provide details on the instrument design and its use, and provide early in-flight results from the UK TechDemoSat-1 flight.