TECHNOLOGY ROADMAP FOR FUTURE GNSS RADIO OCCULTATION AND REFLECTOMETRY

T. Burger

European Space Agency

GNSS Radio Occultation (GNSS-RO) is meanwhile operationally used e.g. for numerical weather prediction. Many groups have supported this in various ways, from technology and processing developments through instruments to best ways to incorporate radio occultation measurements into applications.

The moderate RF hardware complexity needed for GNSS RO receivers allows a very efficient combination with the New Space approach for affordable highly integrated and miniaturised cubesat design. Consequently, a production type of RO receiver is manifesting, with limited performance as needed by the application, and integral part of the cubesat system. There are now several commercial satellite constellations for GNSS RO, providing worldwide coverage at a good re-observation rate. Their measurement quality can be sufficient to allow use in operational applications.

Still, high-end receivers with superior performance on larger satellites continue to be meaningful; they serve as reference and support future evolution of observables, processing, and products.

The portfolio of measurement types from GNSS RO continues to grow. Polarimetric RO (e.g. ROHP-PAZ) and grazing angle GNSS altimetry (GAA) are examples. The step from GAA to reflectometry using steeper reflections (GNSS-R) requires an additional LHCP Nadir RF chain for specular reflected and forward scattered signals from Earth, and GNSS-R specific processing capability preferably integrated in the receiver digital frontend. TDS-1 and CyGNSS are examples of GNSS-R missions. The ESA Scout mission HydroGNSS kicked off in 2022 aims to collect an exhaustive portfolio of GNSS-R measurements including dual frequency, co/crosspol, and coherent channel, to support the extraction of Earth surface properties like presence of ice, freeze/thaw, vegetation, inundation, and more.

ESA supports GNSS-RO and GNSS-R through development targets and activities adjusted to this scenario, targeting space related technology aspects but also evolution of observables and measurement techniques, and evaluation of products. This paper provides an overview of ongoing and discussed new activities and their rationale. Hardware oriented developments are more aimed towards high performance receivers, comprising RF chains, flexible digital GNSS frontends, and receiver demonstrators to prepare for flight opportunities. Beyond that, ESA is regularly working together with scientific and application partners on data modelling, verification, quality and use.