Antennas in GNSS Reflectometry Applications

Abstract:
The processing of signals transmitted by the Global Navigation Satellite Systems (GNSS) and reflected off the Earth surface can be used as a very practical tool for remote sending, known as GNSS Reflectometry (GNSS-R). Key to the utilization of this technique from space is the antenna, which has to access tens of reflection points over a very wide area while presenting significant gain to achieve good quality observations. This short tutorial aims at explaining the basics of GNSS reflectometry as well as the requirements set on the antenna. Some illustrative examples are given and future paths hinted.

Graphical abstract:
Recommended prerequisites for attendees:
The course is provided from the basics of reflectometry up to antenna requirements and some illustrative examples. There is no specific knowledge required to follow this course.

Learning objectives:
The participant to this course will learn the basic concepts on GNSS reflectometry (GNSS-R) and will be able to understand the differences, advantages and limitations between this technique and other remote sensing techniques used by other instruments such as real and synthetic aperture radars or radiometers. By acquiring the basics, he will be able to derive the general requirements a GNSS-R antenna would need to fulfil. Depending on the particular GNSS reflectometry technique, some specific details on the different antenna architectures shall be presented to the participant. The key trade offs around an antenna for GNSS reflectometry will be learnt. The participant will also know about current state of the art GNSS-R space missions and antenna concepts employed in those. To complete the view, the most relevant applications developed up to now will be described and a hint on future paths in this field given to the participant. In summary, the participant shall get an introduction to the topic of GNSS reflectometry and the desirable features an antenna should have for this purpose.

Course outline:
The tutorial on Antennas in GNSS Reflectometry Application is to be provided in person, pandemia-permitting, otherwise on-line. The course is to be given through several slides presentations, including time for questions and answers. There is no specific need set for the participants. The tutorial shall be covering the following three main topics:

1.- Introduction to GNSS Reflectometry

2.- Antennas in GNSS Reflectometry

3.- Main Applications and Space Missions in GNSS-R

Manuel Martin-Neira received the M.S. and Ph.D. degrees in telecommunication engineering in 1986 and 1996 respectively from the School of Telecommunication Engineering, Polytechnic University of Catalonia, Spain.

In 1988, he was awarded a fellowship to work on microwave radiometry at ESA (European Space Agency), in The Netherlands. From 1989 to 1992 he joined GMV, a Spanish firm, as responsible for several projects on GPS spacecraft precise navigation and attitude determination. Since 1992, with ESA, in charge of the radiometer activities within the RF Payloads and Technology Division.

He has developed new concepts for constellations of small satellites for Earth Observation. In 1993 he proposed the Passive Reflectometry and Interferometry System to perform remote sensing with GNSS reflected signals. Since 2001 he is the Instrument Principal Engineer of ESA’s Soil Moisture and Ocean Salinity (SMOS) mission, still fully operational. In 2015 he proposed a system to perform Space-to-Space Very Long Baseline Interferometry from Medium Earth Orbit to image the event horizon of Super Massive Black Holes like Sagittarius A* or M87.

Manuel is an ESA-confirmed inventor, has received the Jaime I Prize, other awards and recognisitions, and is IEEE Fellow. He is currently following the two ESA’s GNSS reflectometry missions: PRETTY, launched in 2023 and HydroGNSS, a two-satellite mission to be launched end of 2024.
Key bibliography


