SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
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Author: Dr. Jürgen Letschnik
LSE Space GmbH, Germany, j.letschnik@mytum.de

Mr. Lars Schelde
Technical University of Munich, Germany, l.schelde@tum.de
Prof. Ulrich Walter
Technical University of Munich, Germany, u.walter@lrt.mw.tum.de

AN ADVANCED RESEARCH ENVIRONMENT FOR KA-BAND SATELLITE COMMUNICATIONS

Abstract

The Institute of Astronautics (LRT – Lehrstuhl Raumfahrttechnik) at Technische Universitaet Muenchen has a strong background in inter-satellite communication. The efforts were driven by the need of developing key methods and hardware for controlling robotic space applications by a user on ground. In this framework, research was conducted to control robotic applications on Earth via a geostationary relay satellite. As a first step of the research activities, LRT focused on one of the common used frequency bands, S-band (2 GHz). Therefore LRT was using its own S-Band ground station antenna for communicating with the European relay satellite ARTEMIS.

However, extensive tests showed that a higher bandwidth is necessary to fulfill the high performance requirements on a communication link for robotic systems with haptic and visual feedback. Thus, a Ka-band ground station and a Ka-Band satellite mock-up system was set up at the LRT. The Ka-Band ground station, which features a 4.8 m diameter Cassegrain antenna, was realized in collaboration with General Dynamics SATCOM. The antenna system supports all linear and circular polarizations in reception and transmission. The ground station is equipped with an inject-pilot system in the reception path for high precision downlink measurements. The high precision coupler and power meter in the transmission path allow a well adjustable uplink power to the satellite. The performance of the ground station was verified with an extended ESVA (Earth Station Verification Acceptance) test together with EUTELSAT and ESA. The whole antenna system was calibrated with a high precision Standard-Gain-Horn to increase the measurement performance. The calibration test was realized with the new developed Ka-band satellite mock-up at LRT. This Ka-band mock-up is mounted to an outdoor 3-axis attitude simulator. Using this mock-up in combination with the attitude simulator, it is possible to mount reflector antennas up to a size of 80 cm in diameter establishing a real satellite link to a geostationary satellite. Over a wide frequency bandwidth, different measurements, such as antenna pattern, gain determination, and satellite downlink level etc. can be achieved.

This paper describes ongoing activities at the LRT, focusing the Ka-band ground station and on the Ka-band mock-up system. It further outlines the possibilities that arise from using a Ka-band environment (ground station and mock-up) that can be easily accessed and used by research partners, since the ground station and the mock-up are not dedicated to one satellite operator only.