Paper ID: 71317
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IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advances in Space-based Navigation Systems, Services, and Applications (7)

Author: Mr. Nikolas Dütsch
Universität der Bundeswehr München, Germany

Mr. Rishi Jaiswal
Universität der Bundeswehr München, Germany
Prof.Dr. Roger Förstner
Universität der Bundeswehr München, Germany
Prof. Thomas Pany
Universität der Bundeswehr München, Germany
Mrs. Hepzibah Ernest
Universität der Bundeswehr München, Germany

DESIGN AND DEVELOPMENT OF A DEDICATED LEO SATELLITE PAYLOAD FOR DETECTION AND LOCALIZATION OF EARTH BOUNDED GNSS INTERFERENCE SOURCES.

Abstract

The evolution in space technology significantly contributes to the improvements in Global Navigation Satellite Systems (GNSS) and its compatible receiver technology. In recent times, satellite-based positioning techniques have become one of the primary tools to obtain globally available, highly accurate position and timing solutions. The GNSS ranging signals are emitted in different frequency bands from the satellite towards the user to further enhance the positioning and timing accuracy by compensating for ranging errors when the signal propagates through dispersive media (e.g. ionosphere). Therefore GPS and Galileo GNSS provide signals in both L1 and L5 frequency bands. Recent experiments of GNSS radio occultation from the International Space Station (ISS) had observed some interesting cases of spoofing and jamming activity on Earth. These instruments were optimized primarily to perform radio occultation. However, with the rising threat from sources that can potentially deny and provide deceptive GNSS service, the need for an interference monitoring system on the LEO platform opens up various research opportunities. A payload specialized for the task of GNSS interference monitoring would contribute greatly towards analysing the underlying threat signal structure and globally geolocating of interference sources, without the need for setting up a cost-intensive ground-based monitoring station.

As part of the research project, SeRANIS (Seamless Radio Access Networks for Internet of Space) by the Universität der Bundeswehr, München (UniBW M) the satellite ATHENE-1 will house the hardware for monitoring of the GNSS interferences amongst the other experimental payloads on the satellite platform.

This paper will discuss the design of the mission, along with the work carried out on some key areas surrounding the development of the payload. It will also provide an overview of the experimental setup of the hardware with interfaces to the satellite platform and highlight the methodology of the interference capturing using the GNSS signal and onboard processing. This paper also presents preliminary insights into the simulation testbed that generates different spoofing and jamming scenarios. The work presented is intended to be used as a reference, such that other university satellites or related research projects may get useful insights for their research activities.