Paper ID: 25563
oral

SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Poster session (2D)

Author: Mrs. Maria Manzano-Jurado
GMV Aerospace & Defence SAU, Spain

Ms. Julia Alegre-Rubio
G.M.V. Space and Defence, S.A., Spain
Mr. Andrea Pellacani
GMV Aerospace & Defence SAU, Spain
Prof.Dr. Gonzalo Seco-Granados
Universidad Autonoma de Barcelona, Spain
Prof.Dr. Jose A. Lopez-Salcedo
Universidad Autonoma de Barcelona, Spain
Mr. Enrique Guerrero
Universidad Autonoma de Barcelona, Spain
Mr. Alberto Garcia
European Space Agency (ESA), The Netherlands

DESCRIPTION AND SIMULATION RESULTS FOR A GNSS SIGNAL-BASED NAVIGATION SYSTEM FOR A MISSION TO THE MOON

Abstract

In the frame of an ESA activity, the objective of the Moon-GNSS study has been to determine the feasibility using weak-signal GNSS (GPS/Galileo) technology in future lunar exploration missions, to improve the navigation performance in terms of accuracy, cost reduction, robustness and autonomy. During the Moon-GNSS activity, the analysis and the identification of the navigation receiver requirements for the upcoming lunar exploration missions have been performed. An extensive simulation campaign has been carried out to assess the achievable performance (signal acquisition and tracking, raw data accuracy, navigation accuracy and robustness) and to provide with the due inputs for the derivation of the Moon-GNSS navigation receiver requirements. The architecture of the GNSS receiver module has been proposed and designed to achieve the low levels of sensitivity required. It is based on the ESA patented "Double-FFT Method" for an efficient implementation of the high-sensitivity processing. Besides, the synergies between GNSS signal/navigation processing and other navigation sensors have been analyzed, using the state of the art of sensors integration for space missions. A Proof-of-Concept demonstrator of the weak-signal Moon-GNSS navigation has been designed and implemented, showing the main functional and performance capabilities of the Moon-GNSS receiver. A test campaign representative of a real Moon-GNSS mission has been performed, covering all the mission phases representative of the real mission conditions in terms of dynamics and signal disturbances. The main conclusions are that a specifically designed GNSS receiver should be capable of receiving and processing GNSS signals coming from Earth during a lunar mission, and that the resulting GNSS measurements can be hybridized with other navigation sensors to improve the standard navigation performances. Furthermore, GNSS stand-alone navigation should be possible in some phases, allowing a dramatic reduction of the frequency of ground operations. A possible roadmap to eventually bring the Moon-GNSS navigation system into an operational status has been proposed and will be presented.