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Author: Prof. Fabio Dovis
Politecnico di Torino, Italy, fabio.dovis@polito.it

Dr. Claudia Facchinetti
Italian Space Agency (ASI), Italy, claudia.facchinetti@asi.it

Mr. Mario Musmeci

ASI - Italian Space Agency, Italy, mario.musmeci@asi.it

Mr. Giancarlo Varacalli

Italian Space Agency (ASI), Italy, giancarlo.varacalli@asi.it

Mr. Joel Parker

NASA, United States, joel.j.k.parker@nasa.gov

Ms. Lauren Konitzer

NASA, United States, lauren.konitzer@nasa.gov

Mrs. Lisa M. Valencia

NASA, United States, lisa.m.valencia@nasa.gov

Mr. James Miller

National Aeronautics and Space Administration (NASA), United States, jj.miller@nasa.gov

Mr. Frank H. Bauer

NASA Goddard Space Flight Center Greenbelt MD 20771, United States, frank.h.bauer@nasa.gov

Dr. Alex Minetto

Politecnico di Torino, Italy, alex.minetto@polito.it

Dr. Andrea Nardin

Politecnico di Torino, Italy, andrea.nardin@polito.it

Dr. Samuele Fantinato

Italy, samuele.fantinato@qascom.it

Mr. Efer Miotti

Italy, efer.miotti@qascom.it

Ms. Matilde Boschiero

Qascom s.r.l, Italy, matilde.boschiero@qascom.it

Mr. Fabio Bernardi

Italy, fabio.bernardi@qascom.it

Mr. Simone Tedesco

Italy, simone.tedesco@qascom.it

Mr. Salvatore Guzzi

Italy, salvatore.guzzi@qascom.it

Dr. Matteo Pulliero

Qascom s.r.l, Italy, matteo.pulliero@qascom.it

Mr. Siddartha Sanathanamurthy

NASA Goddard Space Flight Center Greenbelt MD 20771, United States,
siddartha.sanathanamurthy@nasa.gov

ASSESSING THE USABILITY OF GNSS ON THE WAY TO THE MOON: GETTING THE LUGRE

PAYLOAD READY TO FLY

Abstract

The use of in-orbit Global Navigation Satellite Systems (GNSS) in the Space Service Volume (SSV), beyond GEO altitudes, has become of great interest in view of the future missions to the Moon. Nevertheless, the usability of Earth GNSS at such distances has been proved only up to around 150,000 km away from the Earth's surface. In July 2020, the NASA-Italian Space Agency (ASI) Lunar GNSS Receiver Experiment (LuGRE) was selected as the 10th payload of CLPS Task Order 19D. In February 2021, NASA awarded this task order to Firefly Aerospace. Firefly's Blue Ghost Mission 1 (BGM1) will deliver LuGRE and the other CLPS 19D payloads to 18.6 N, 61.8 E in the Moon's Mare Crisium.

The goal of the LuGRE project is to demonstrate the use of GNSS-based navigation and timing to the Moon, collecting and processing GNSS measurements along the mission. The payload, developed by Qascom srl, consists of a GNSS receiver specially designed and built for lunar applications, and it is based on their low altitude QN400-SPACE receiver product line. It will receive and process both Global Positioning System (GPS) and Galileo signals in the L1/E1 and L5/E5a bands, the results of which will be transmitted to Earth for further scientific processing. In fact, the Science Definition Team (SDT) of the LuGRE project worked in the past year to define a set of 20 science and engineering investigations to be undertaken by the project. The SDT is currently composed by NASA and ASI scientists, these latter supported by researchers of Politecnico di Torino. These core investigations will be augmented by additional investigations proposed by the scientific community under the auspices of the full LuGRE Science Team, which is planned to be formed in 2023. The LuGRE payload was delivered to Firefly in February 2023 and it will now be integrated on the BGM1 together with the other payloads of the mission. The current and future activities up to the launch of the mission, currently foreseen in 2024, focus on the development of the ground segment both for the payload operation as well as for the science investigations to be performed during and after the mission. The team's final contribution will present the overall LuGRE project, its scientific objectives for the testing of GNSS at the Moon, as well as the development status of the ground processing segment and the simulation results of the most meaningful scientific experimentations.