SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 1 (2A)

Author: Mr. Pedro Rodrigues
Tekever, Portugal, pedro.rodrigues@tekever.com

Mr. André Oliveira
Tekever, Portugal, andre.oliveira@tekever.com
Mr. Pedro Sinogas
Tekever, Portugal, pedro.sinogas@tekever.com
Dr. Guido Oddi
University of Rome "La Sapienza", Italy, oddi@dis.uniroma1.it
Mr. Federico Lisi
Sapienza University of Rome, Italy, lisi@dis.uniroma1.it
Mr. Francisco Alvarez
Arquimea, Spain, falvarez@arquimea.com
Dr. Ramiro Cabas
Arquimea, Spain, rcabas@arquimea.com
Prof. Tanya Vladimirova
University of Leicester, United Kingdom, tv29@leicester.ac.uk
Dr. Xiaojun Zhai
University of Leicester, United Kingdom, xz151@leicester.ac.uk
Dr. Michael Crosnier
Airbus Defence and Space SAS, France, michael.crosnier@airbus.com

TEST OF A ROUTING ALGORITHM FOR WIRELESS SENSOR NETWORKS WITH APPLICATION TO PLANETARY EXPLORATION APPLICATIONS

Abstract

The idea of sending a man to the Moon has recently regained strength and now almost all agency roadmaps have manned missions as an important goal. For this purpose, it is necessary to continuously monitor the environment on the planetary surface to achieve a clear understanding of its conditions. This paper presents the results of the FP7 European project SWIPE (Space Wireless sensor networks for Planetary Exploration), which aims to apply Wireless Sensor Networks (WSNs) to monitoring of interplanetary environments, focusing on the exploration of the Moon. Moreover, the project aims at increasing our scientific knowledge of the Moon environment, such as swirls and potential dust levitation. It is proposed that thousands of miniaturised sensor nodes, which are deployed on the lunar surface, cooperate to monitor physical and environmental conditions. These sensor nodes are capable of creating their own ad-hoc network and establishing a communication link with an orbiting spacecraft to deliver data to Earth. The SWIPE sensor nodes and network are highly reconfigurable, which makes them robust against the harsh environment conditions on the Moon surface. Moreover, since many WSN nodes are needed, it is essential that they are low mass and low power devices. This requires that the usage of the limited energy is optimized through the design of energy-efficient hardware, software and radio equipment, especially when solar energy cannot be used (i.e., during lunar nights).

The paper will present the main achievements of the SWIPE project in terms of sensor node manufacturing, network design and laboratory/Earth-analogue field test results. All the developed hardware modules have been integrated into a node housing, in the form of a tetrahedron. Details of the hardware and software development of the nodes will be reported with regards to: (i) the communications module, based on the Software Defined Radio (SDR) paradigm, (ii) the payload subsystem, allowing to continuously measure environmental parameters, (iii) the node control system, including data fusion/processing techniques and (iv) the power generation, storage and distribution subsystem. The paper will also provide details about the ad-hoc network protocols for the optimized control of the WSN. Finally, results of laboratory and Earth-analogue field tests will be presented, showing the effectiveness of the SWIPE concept in representative and realistic scenarios.