Smart power grid topology for space application

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Abstract. Within the Helmholtz Alliance's "Robotic Exploration of Extreme Environments (ROBEX)", a significant effort is being put towards exploring synergies between two up to now unrelated research fields: deep sea exploration and lunar exploration. Drawing upon this collaboration the deployment of a possible geophysical study network on the Moon's surface is designed. Breadboards are planned to be built and field test should be done in the end of the project (from 2016 on). Since the Apollo missions, the internal composition and structure of the Moon has been a primary topic of study. Despite the importance of the Apollo data, execution of complex tasks in extreme, uncooperative and difficult-to-access areas was not possible by the Apollo astronauts.

A higher degree of autonomy in terms of energy supply, when realized as a smart, scalable and modular power architecture, could guarantee a wider and longer range of operations. Thus a smart grid like solution approach, for the power subsystem, is adopted. The development of such a technology is attempted through a number of steps:

- Initially, a literature review to assess the state of practice of space power and energy systems is conducted.
- Drawing upon this heritage, a conceptual baseline design is designed and modeled. Control algorithms are developed towards smart management of the energy resources.
- Based on the model results, hardware is developed to advance the state of the art in power generation, energy storage, power management and distribution for space applications.
- Finally, a breadboard level power system would be tested in lab to be later accommodated into an analogue mission scenario intended to demonstrate the developed technology.
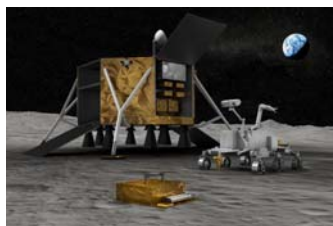
Fig.1.Right: An example of a modular Lunar outpost as presented in the CEF study in DLR Bremen. Left: the ROBEX logo.