IAF SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – Science, Instruments and Technologies (3B)

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# ADE: ENHANCING AUTONOMY FOR FUTURE PLANETARY ROBOTIC EXPLORATION

**Abstract**

The Autonomous DEcision Making in Very Long Traverses (ADE) H2020 project (https://www.h2020-ade.eu/) is part of the PERASPERA SRC programme, a cluster of projects, funded by the European Commission, aimed at Space Robotics technologies. In particular, ADE focuses on increasing the performances of future planetary exploration robotic missions. The goal for ADE is to design, develop, and test in an analog scenario a fully autonomous rover, inspired by the Mars Sample Fetching Rover. The ADE demonstrator leverages and furthers the state of the art for the autonomy of a rover system, not only

applied to the rover's mobility but more generically, to the capability of the whole system to perform its tasks without human interaction. Current limitations of existing rovers are mostly due to the rover locomotion system, its power storage capabilities, and the reduced skills in terms of autonomous capability to take decisions on-board. This compromises its ability to cover large areas of a potential planetary surface, reduces drastically the scientific return, and increases the time required for mission operations, as well as their complexity. ADE takes up these challenges and proposes a completely autonomous solution. It can generate dynamically mission plans on-board, taking those decisions required to reach mission objectives, performs autonomous long traverse surface exploration, and guarantees optimal exploitation of resources. The ADE system can detect and analyse during its traverse scientific events of interest. It reacts quickly to hazardous events, increasing mission reliability. Moreover, ADE includes a ground segment control centre used to command the rover in different modes: from direct telecommanding to high-level goal commanding (full autonomy). ADE reaches its objectives by developing and integrating a plethora of technologies, ranging from model-based design to artificial intelligence to guidance and control to formal methods. Some of its components are part of the heritage from previous PERASPERA SRC projects, while others have been specifically developed in ADE to further the state-of-the-art in autonomous planetary robotics exploration. The ADE demonstrator has been tested during the field tests under similar conditions to the ones required for rover missions: high uncertainty of the environment, low bandwidth in the communications with the ground system, and complex mission operations involving multiple subsystems. In this paper, we will describe our experience in ADE: from the requirements and design to the main challenges we had to face, to the solutions implemented, as well as the results and the performance parameters obtained during the field tests.