A case study for modelling Human-Robotic Operations on Mars

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Abstract. Mars analogue scenarios are used extensively for the purpose of validating technologies, human contribution and operational design aspects of manned planetary surface missions. Simulated extra vehicular activity (EVA) mission teams include humans and robots operating to achieve common goals and learn basic operational lessons by conducting tasks under Mars-like constraints. While Mars Analogues have nearly a decade long history, simulations tend to be ad-hoc, and can benefit from complex systems modelling.

A sequence of analogue EVA experiments was conducted in July 2014 around Arkaroola, a desert environment in the Northern Flinders Ranges that is recognised to have similar geologic features to Mars. The experiments aimed to collect observational data such as biometric, tracking and local weather data in order to model EVA performance. Performance metrics were devised to track a wide range of factors which can affect the system. EVAs were conducted for several scenarios (for example exploration) over a range of terrain types. Human-robot teams included a tele-operated rover or drone (quad-copter), two-person astronaut teams and mission control.

Performance was modelled using an holistic framework and machine learning algorithm that encompassed the system and its operating environment within the same global, probabilistic model. Results indicate that the modelling approach is able to predict metric performance given the performance of other metrics in the test set. This presentation describes preliminary results of a case study modelling astronaut heart rate using non-biometric system and environmental information.