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AN EYE ON THE HORIZON: ANALOG MARS ROVER LOCALIZATION AND ASTRONAUT DETECTION

Abstract

Human robotic teams in space exploration are becoming ever prevalent. Autonomous robotics can prove beneficial during human spaceflight and crewed planetary missions, however, analyses of human-robotic interactions through levels of autonomy and task management become increasingly less transparent. A platform to aid in technology development regarding human-robotic interactions can be found through current crewed mockups and analog habitat mission studies. In this study the test bed of an Inflatable Lunar/Mars Analog Habitat (ILMAH) is utilized to develop and test an object detection machine vision algorithm for analog astronaut identification and rover localization using horizon features.

By applying Speed Up Robust Features (SURF) techniques for feature extraction in tandem to camera triangulation, accurate descriptions of an analog space suit, fiducial markers and the horizon have been identified. Through the use of SURF features and Random Sample Consensus (RANSAC), image stitching techniques were created to generate a 180 panoramic image of the analog habitat environment. Correlation of feature matching and object detection allowed for successful identification of an analog astronaut within the panoramic view of the habitat. A zero-horizon line was detected within the panorama allowing interpolation between the matched horizon pixel position to a 180 array. A corresponding pixel position value of the detected analog astronaut is quantified by an angle of rotation of 111.1 within the environment correlated to the 0 to 180 view. This angle will be used in future studies for autonomous rover movement.

Keywords — Machine Vision, Mars, Rover, Localization, Object Detection, Habitat, Analog Mission, Human Robotic Interaction