Computer Vision and Automated Boulder Counting on the Asteroid Bennu

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Fast and accurate rock and boulder detection is important to the goals of the OSIRIS-REx mission. Boulder identification and classification by hand, while accurate, is a slow, labor-intensive endeavor. The use of computer driven rock detection and classification algorithms would allow for automatic, real-time analysis of the size density distribution of rocks and boulders on Bennu's surface. Historically, rocks have presented a challenge to typical computer vision pattern matching frameworks. They have no uniform shape, texture, or size. Additionally, edges and contours are difficult to detect in situations where rocks are stacked, have unusual structures, or are partially buried. Because of this, no single algorithm can be expected to perform accurately in all rock and soil situations. However, current space science missions, particularly the Mars Exploration Rovers Spirit and Opportunity, have increased interest in and need for a robust, flexible group of rock detecting algorithms that can be mixed and matched to best suit a particular situation. Recent work has focused on performing individual segmentation using different characteristics of rocks including size, shape, texture, and shading, then combining and comparing the results. On average the accuracy of the combined results is significantly higher than the accuracy of the individual algorithms. Bennu presents additional challenges, the most significant being that we will not have clear images of the surface until after the spacecraft has launched, limiting the amount of time available to customize a suite of useful algorithms. However, the significant advancements in computer vision technology in recent years and access to diverse practice data (from Mars, Itokawa, and Ceres as well as images we have produced in our lab) will allow us to create a robust toolkit which can be adapted to Bennu's particular surface to allow for fast and accurate boulder identification.