

3D Printing Martian Rocks

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Rover missions have made visualizing Mars's terrain a reality. With the touchdown of Curiosity on Mars, we have had a first person view of craters, mountains and ancient rivers with amazing definition. But what if we view Mars in 3D in person rather than 2-Dimensionally? We can, and the answer lies in utilizing the power of stereo-vision. Stereo reconstruction algorithms tries to solve this question. Given two images, a stereo reconstruction algorithm aims to recover the full 3D structure of the images. By matching two color channels (red and blue) of features of the stereo image and utilizing a function which relates the difference in location of features in the two color channels, we can recover the distance between the rover and the selected features of Martian terrain. With this we can interpolate the distance in order to create a continuous depth-map. From this depth-map, we can transform the stereo image into a 3D object. We show an example image from Martian rover Curiosity's journey in figure 1.

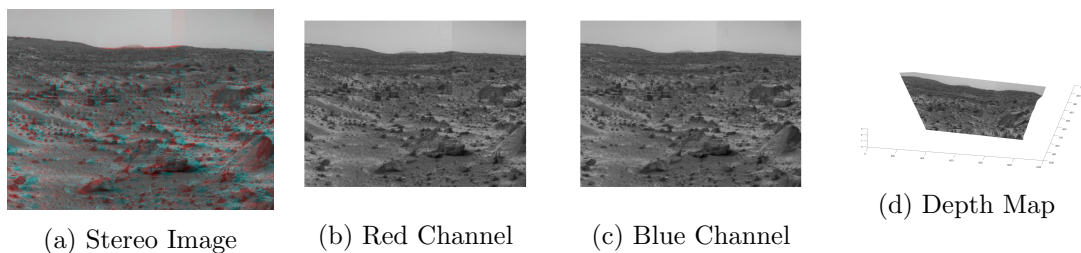


Figure 1: Preliminary Stereo Reconstruction Example

In this project, we aim to develop an algorithm that can take stereo images from Curiosity's Mars Mission ¹ and past archives of older rover missions ² and transform them into 3D models for printing. Even with stereo reconstruction, we would still have to solve for the hidden surfaces such as the side of the rock the viewer cannot see. This would be solved initially with a statistical model that would fill-in the unseen holes of 3D rocks/scenes. If this statistical model proves rudimentary, we would like to take a step further and implement a 3D-GAN which would create a plausible model of the 3D terrain as described in previous works ³.

¹<https://mars.nasa.gov/mars3d/>

²<https://mars.nasa.gov/MPF/mpf/stereo-arc.html>

³<https://papers.nips.cc/paper/6096-learning-a-probabilistic-latent-space-of-object-shapes-via-3d-generative-adversarial-modeling.pdf>