Depth Estimation Based on Monocular Image for the Moon With Machine Leaning and Shape-From-Shading

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1. Introduction

Digital Terrain Models (DTMs) of the lunar surface are widely used for lunar exploration planning and studies based on topography and geology [1]. LRO NAC DTMs with the highest resolution (~2 m/pix) show little coverage with only 470 pieces [2], because suitable geometry for stereo-grammetry is rare. Time consuming process for making DTMs manually also prevents from generating larger coverage of DTMs [3].

The purpose of this study is to generate high-resolution DTMs automatically with the restrictions. This research proposes a method to complement LRO NAC DTMs by generating image patches with almost the same resolution using Machine Learning & Shape-From-Shading (SFS) [4]. The goal of this study is to implement and to evaluate a pipeline for generating DTMs.

2. Method

This proposed system is integrated with machine learning and SFS in Figure 1. We use a Pix2Pix [5] as this machine learning model. This model can transform the type of image by learning the relationship between two sets of images. DTMs are generated from massive datasets by training Pix2Pix on both DTMs and visible images.

SFS is a technique for estimating the shape of an object from a single shaded image. We improve DTMs generated from Pix2Pix adapting SFS likely to previous studies [5].

3. Current Status

This study has established procedures for preprocessing dataset. Figure 2 shows the processing Pix2Pix training data. This research selects SLDEM 2015 [6] & LRO NAC Orthoimage [7] as dataset. First, LRO NAC Orthoimages are downsampled to match the resolution of SLDEM 2015. Next, the images are cut and shaped to 256x256 pixel. Finally, histogram smoothing is applied to images and aligned into a 512x256 pixel image.

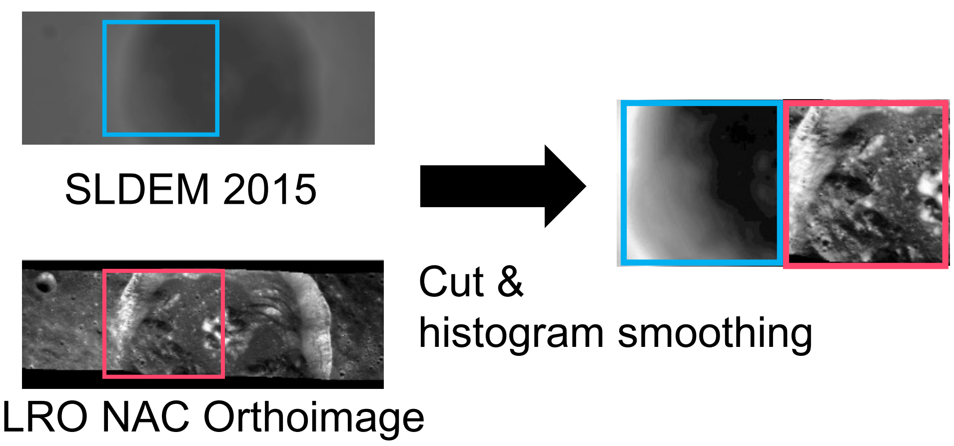
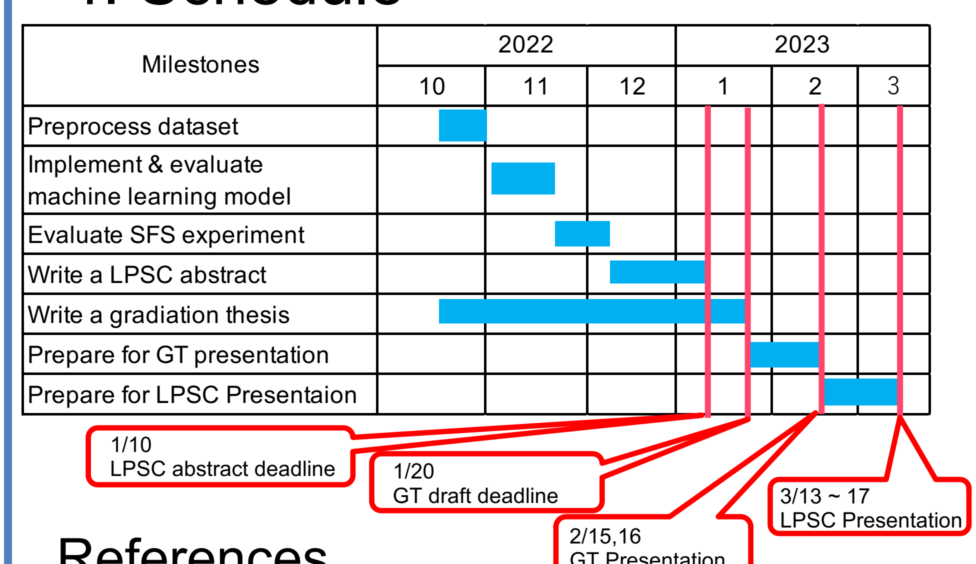


Figure 2. Preprocessing dataset

4. Schedule



References

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[5] Isola, P., et al., Image-to-Image Translation with Conditional Adversarial Networks, 2016. doi:10.1109/CVPR
[6] http://imbrium.mit.edu/EXTRAS/SLDEM2015/
[7] https://wms.lroc.asu.edu/lroc/rdr_product_select

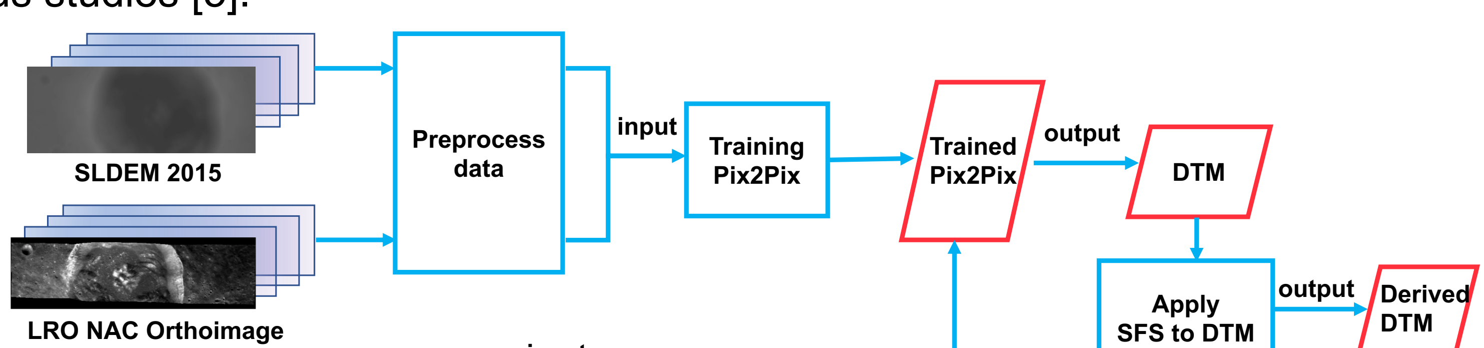

Figure 1. DTM processing flow