Lunar Circular Structure Classification from Chang 'e 2 High Resolultion Lunar images with Convolutional Neural Network.
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Introduction: Circular structures are widely distributed around the lunar surface, the most typical of them could be lunar impact crater, lunar dome et.al[1]. By the identification and analysis of these structures, the geological evolution process and a lot of other information about the Moon could be revealed. Most researchers have tried to identify these structures by recognition of their circular morphology from image data or topography data. With the image or topographic data, traditional edge extraction algorithms(such as SVM), and image data classification algorithm(such as MLE) are frequently used. With these method, most of the circular structures in the lunar surface could be located and a lot of structure database are originated from them. However, there still exist some drawback among these method, such as, the accuracy rate of identified result from these method are unstable which could upto 60%-80%, which means there are still many errors and missing among the result, however, it is very hard the improve the accuary rate with these traditional methods.

The great success of image calssfication with deep learning has attracted the attention of planetary science community, and many scientists are also trying to use deep learning method for image understanding in planetary science[2][3]. And, like the traditional image classification method, there are supervised classification and unsupervised classification in deep learning method, and Convolutional Neural Network(CNNs) is a supervised classification model. A typical CNN is comprised of one or more convolutional layers (often with a subsampling step) and then followed by one or more fully connected layers as in a standard multilayer neural network. The architecture of a CNN is designed to take advantage of the 2D structure of an input image. This is achieved with local connections and tied weights followed by some form of pooling which results in translation invariant features, which means it is good for image recognition. Another advantage of CNNs is that they are easier to train and have many fewer parameters than fully connected networks with the same number of hidden units. So, in this approach, we are trying to use the CNN method to classfy the lunar circular structures from the lunar images.

Method: Since it is difficult to build a CNN totally from the fundamental, while there are servral commercial deep learning framework such as Caffe,Theano,Torch, and TensorFlow, in this approach, we are going to build the CNN with the help of the Caffe Framework.

Preparation with Caffe. Caffe is a deep learning framework made with expression, speed, and modularity in mind[4]. As the request of this framework, we need to prepare the supervised sample images for cicular structures, non-circular structures,label these two kinds data with label like '1' and '2'(see Figure 1 and Figure 2), and divide the data into train dataset and value dataset, both in the specific data format required by the system; after that, we also need to select a CNN net model (such as AlexNet), the parameters of the net model needed to be modified; then we need to train the model with train dataset and export the model into a model file; and finally with the model file, we could classify the value dataset and get the classification result.

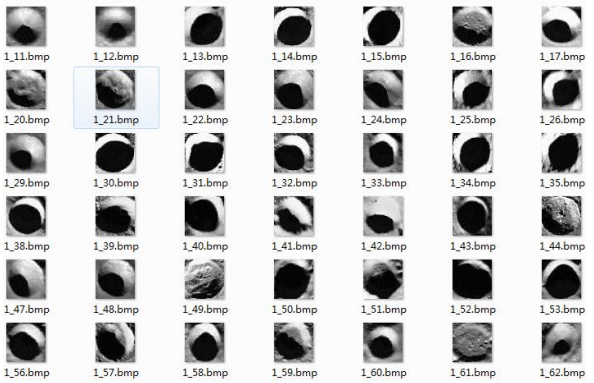

Figure 1 Circular sample images

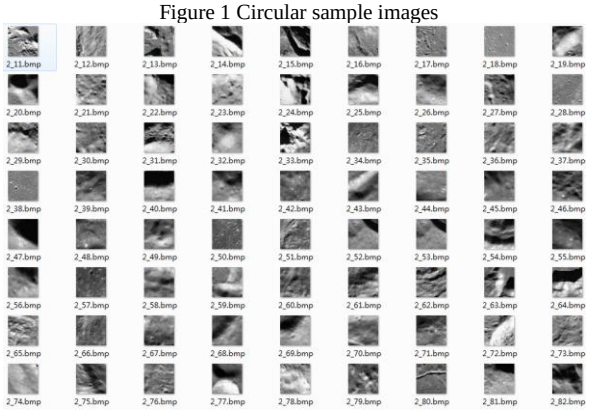
Figure 2 Non-Circular sample images

About the lunar image data. The source data of the lunar samele images are processed from the Chang'e 2 data, the resolution of the original data is 7m. We calibrated and divided each image into a single image with the size of 48pixel*48pixel.

Discussion: The study of this work is still under work, and the initial result of the work shows that the model of CNN needs a large amount of sample images, both for circular and non circular sample images, and the training rate is not so good at this moment, we have analysed the sample images and trying to use different net model, ajust the parameters to improve the accuracy of the model.

References:

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