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Segmentation of textural features using the Context Camera aboard the Mars Reconnaissance Orbiter

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Abstract

This paper presents a simple technique to segment imagery from the Context Camera (CTX) aboard the Mars Reconnaisssance Orbiter (MRO). Using a technique known as *Texton* analysis, features are highlighted based upon texture. This technique is susceptible to variations in view and illumination (phase) angle however provides an effective method of segmentation.

1. Introduction

Segmentation is a desirable feature for researchers to exploit when working with high resolution imagery. Commonly used for medical imagining purposes, textural based segmentation is often used on imagery obtained from MRI scans and X-Ray machines. Planetary scientists can use these machine vision techniques to provide an advantage when exploring these vast amounts of data.

2. Method

Varma and Zisserman [1] used clustered, row ordered $N * N$ kernels to represent textures in an image. This follows the Leung and Malik method [2] that uses clustered, row ordered filter kernels known as *Textons* to represent a texture. The *Texton* method described by Varma and Zisserman was used to classify textures from the CUReT database [3]. In this paper it is used to segment features automatically into a number of classes. The K-Means [4] clustering algorithm is used to achieve this. This allows an image to be segmented into k classes based upon texture.

3. Data

To demonstrate the method described above, a subset of CTX image P01_001438_2159_XI_35N303W, taken in the Coloe Fossae region, was used. Coloe Fossae lies in Mars' northern mid-latitudes and is topographically dominated by 'fretted terrains' as described by [5]. These terrains are believed to contain a great deal of water ice (e.g. [6] and [7]) and a great deal of attention has recently been focussed on landforms resulting from processes within this ice deposit. One example of such formations are glacier like forms (GLFs) as described by Hubbard et al (2011) [8]. Two such GLFs are shown in the northern section of Figure 1.

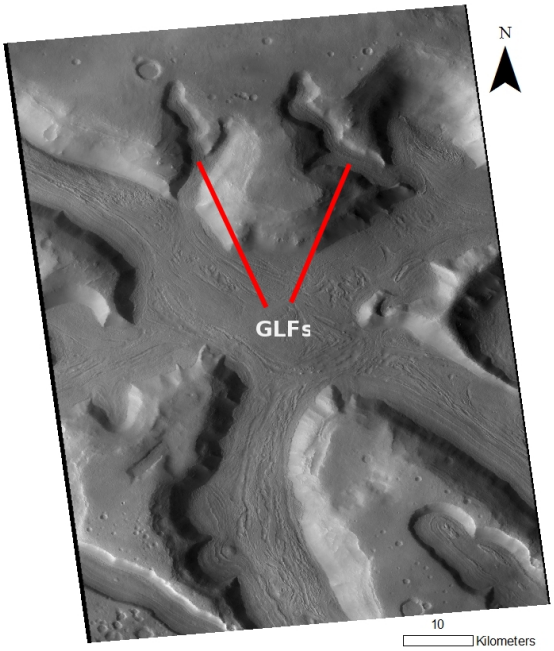

Figure 1: Coloe Fossae region on Mars taken using CTX aboard MRO. P01_001438_2159_XI_35N303W

4. Results

Using a $7 * 7$ row-ordered kernel, clustered into five classes, one can see that at point A in Figure 2, the

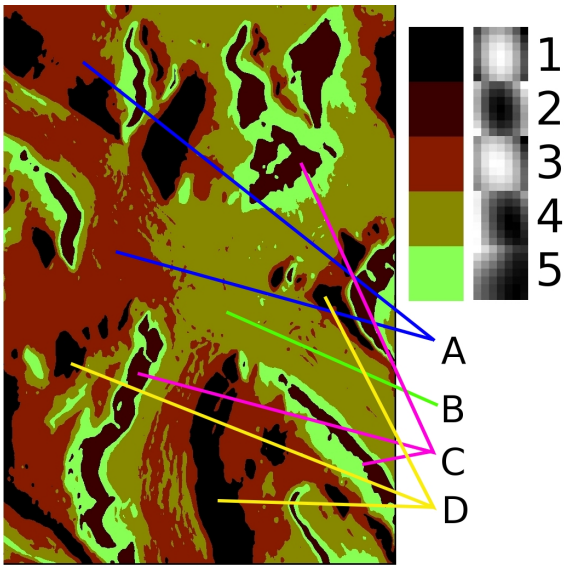

Figure 2: Segmented Coloe Fossae region using 7x7 row-ordered kernel clustered into five classes. The legend shows each class and it's corresponding *Texton*. Full sized imagery from this paper can be viewed at http://users.aber.ac.uk/mjv08/current.html

plateau and valley floor of the left side of the image are assigned to the same class. Moving on to point B, when viewed in Figure 1, it is clear that they are the same type of texture. Valley walls that are shadowed on the right, e.g. point C, contain a pattern of *Texton* 2 and 5. Similarly point D is a pattern of *Texton* 1 and 3 displaying a left side illuminated valley wall.

It is also interesting to note, that since the GLFs highlighted in Figure 1 are narrow valleys highly illuminated from the left of the image, they correspond to the pattern of *Texton* 2 surrounded by 5, much like point C.

5. Summary and Conclusions

The initial results of this technique show distortions due to illumination, namely the failure to segment the valley floor at point A and B in Figure 2. However it does show promise for the creation of feature detection rules to search for valley walls at point C and D. These points correspond to the GLFs displayed in Figure 1. This type of textural analysis technique shows promise beyond medical imaging use and can assist planetary scientists to search large amounts of imagery for features of interest.

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References

[1] Varma, M. and Zisserman, A.: A Statistical Approach to Texture Classification from Single Images., International Journal of Computer Vision: Special Issue on Texture Analysis and Synthesis, Vol. 62, pp. 61-81, 2005.

[2] Leung, T. and Malik, J.: Representing and Recognizing the Visual Appearance of Materials using Three-dimensional Textons., Int. J. Comput. Vision, Vol. 43, pp. 29-33, 2001.

[3] Dana, K.J., van Ginneken, B., Nayar, S.K. and Koenderink, J.J.: Reflectance and Texture of Real World Surfaces, Technical Report, Department of Computer Science, Columbia University CUCS-048-96, 1996.

[4] Hartigan, J.A.: Clustering algorithms., Wiley New York, 1975.

[5] Sharp, R.P.: Mars: Fretted and chaotic terrains., J. Geophys. Res., Vol. 78 (20). pp. 4073-4083, 1973.

[6] Kargel, J.S.: Mars: A warmer, wetter planet., Springer Praxis Books, 2004.

[7] Baker, D.M.H., Head, J.W. and Marchant, D.R.: Flow patterns of lobate debris aprons and lineated valley fill north of Ismeniae Fossae, Mars: Evidence for extensive mid-latitude glaciation in the Late Amazonian., Icarus, Vol. 207, pp. 186-209, 2010.

[8] Hubbard, B., Milliken, R.E., Kargel, J.S., Limaye, A. and Souness, C.: Geomorphological characterization and interpretation of a mid-latitude glacier-like form: Hellas Planitia, Mars., Icarus, Vol. 211(1), pp. 330-346, 2010.