IMPACT CRATER DETECTION ON MERCURY SURFACE FROM DIGITAL IMAGE. M. M. Pedrosa[1] and E. A. Silva[2], [1,2]São Paulo State University, Roberto Simonsen street nº305, Presidente Prudente, Brazil, email: miriammmp@hotmail.com, silva.erivaldo@gmail.com

Introduction: Impact craters are structures formed by collision of meteoroids with planetary surface. The study about these structures is important in the study about the planets, moreover they are the features that most stand out visually on a planetary surface [1]. The study about impact craters helps understanding of the process itself craterismo, the knowledge of the nature of the land that were targeted impacts, the analysis and understanding of the degradation processes [2], among others. Craters counts are the only available tool for measuring remotely the relative ages of geologic formations on planets [3]. Currently, there are some probes getting information about the solar systems, these probes are able to get high spatial resolution images which allow the deeper understanding about surface of planets. Through these images is possible to detect impact craters, and due the high resolution of images is each time more necessary efficient algorithms to detect theses structures.

In August 2004 NASA launched the MESSENGER which performed some flyby in the Earth, Venus and Mercury, and now the MESSENGER is orbing Mercury since March 2011 [4]. The MESSENGER carries a diverse suite of science instrument to characterize the planet globally, to take images there is the Mercury Dual Imaging System (MDIS) which consists of two cameras, the multispectral WAC (Wide Angle Camera) and the monochrome NAC (Narrow Angle Camera), in this paper we use images obtained by NAC. Thereby, there are hundreds of images from Mercury surface and the identification of impact craters in this surface will provide a better understanding about this planet. This paper is about the use of Mathematical Morphology and template matching to detect impact craters on Mercury surface. The images used in this paper are from Caloris basin which is one of the largest impact basins known in the Solar System and among the youngest of the large impact basins on Mercury [5]. In figure 1 is showed one image which were used as study areas. This method was applied to a set of four images from mercury surface.

Method: The method involves firstly filtering, by removal domes and basins with volume less than a given threshold. After, enhancement of target of interest, by morphological gradient with Structuring Element (SE) in the form of a semicircle, as showed in figure 1. The next step consisted in apply the morphological opening. Then, the images resulting of morphological opening were dilated conditionally (geodesic dilation)

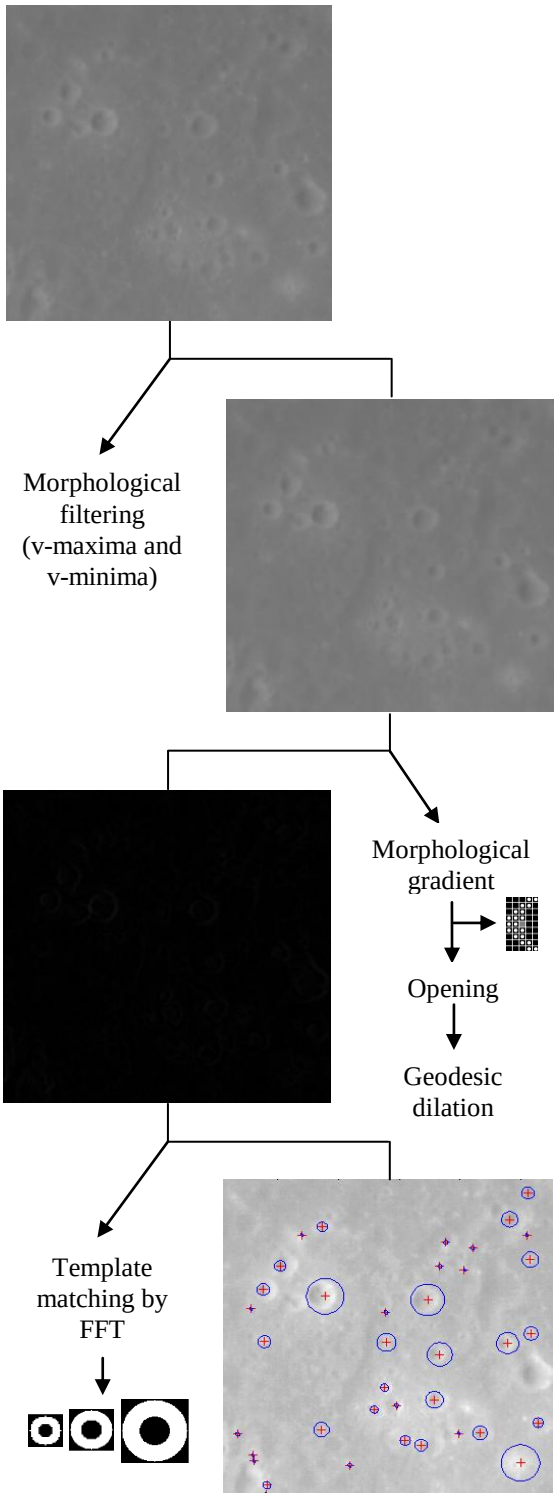

Figure 1: Sequence of method proposed to detect impact craters.

to the image obtained by application of morphological gradient. The next step was apply the template matching technique by Fast Fourier Transform (FFT). Finally, the last step consisted in the identification of the impact craters, by local maxima and calculate the circularity of the targets.

Results and discussion: The first step was to apply morphological filtering to smooth noise and bright features in the scenes. Next, the target of interest were enhanced by application of morphological gradient using SE in the form of semicircle, this application increased the difference tones of gray in the edges of the craters and the background of the image's scene. The morphological opening was applied aiming eliminate structures small structures that do not match the characteristics of craters. The images resulting of morphological opening were dilated conditionally to the image obtained by application of morphological gradient, in this stage, the goal was to highlight the targets resulting from the opening morphological according to the feature in the marker images resulting from the application of morphological gradient, this operation was applied recursively 200 times.

The second step aim to compute the similarity between the scene image and a given template. This step followed as applied in [6].

The results achieved are showed in figure 1. The evaluation of the results was done by comparing the results obtained by method developed with the ground truth. The method developed achieved the rate of approximately 79% of true detection and 27% of false detection.

To conclude, the method presented was applied to a small set of images from Mercury surface, for some images the method proved to be very efficient, however to other this was ineffective. This method is being tested and will be applied to a large number of images from Caloris basin. Additionally, will be tested other morphological operators aiming to increase the true detection rate and decrease the false detection rate.

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