

Song, Yonghak, Ph.D., Purdue University, August 2008, Automated Image Segmentation and its Applications to the Mars Exploration Rover Mission. Major Professor: Jie Shan.

As a fundamental task in image understanding, image segmentation is to partition an image into multiple regions based on certain desired properties. The traditional intensity-based segmentation methods often fail because of the heterogeneous reflectance caused by surface variation. To solve this problem, we propose a two-stage solution. In the first stage, we introduce image textures as the main cues for image segmentation. The method combines three texture analysis techniques: multi-channel, multi-resolution histogram and inter-scale decision fusion. Textures at different scales are extracted by measuring the variations between multi-resolution histograms, which are computed from the four channels of the Haar wavelet transform. Image segmentation is then performed by the adaptive k-means clustering method. In the second stage, the results from the texture-based segmentation are refined in terms of localization and topology by using the edgeflow-driven active contours. The level set method is applied to evolve such contours guided by the edgeflows towards the object boundaries to achieve a refined segmentation outcome. The stopping function computed from the edgeflows constraints the evolving curves from passing out the boundaries. The proposed image segmentation framework is applied to a number of Mars surface images collected by the Mars Exploration Rovers to test its performance. The outcome is evaluated based on a number of quality measures with reference to independently collected data. Properties and potentials of the proposed framework are also discussed