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Recognition based shape from shading for planetary robotics

R. O'Hara, D. Barnes

Department of computer science, University of Wales, Aberystwyth

Planetary robotics often requires the creation of a digital elevation model (DEM) of the surrounding environment for navigation and the identification of science targets. Shape from shading approaches are capable of constructing high detail DEMs at long range given a single camera image and usually a priori information about rough surface shape and/or the lighting direction. A new recognition based method for estimating surface shape from the shading information in an image is developed. Surface normals are used to label the surrounding image segments from a training set. Unknown image segments are then matched to those previously recorded to recover surface shape. This recognition based method allows it in principle to be used on surfaces with more detailed lighting models than typical shape from shading algorithms. A basic dimensionality reduction method allows the computational time to be improved and provides some gains in matching accuracy. Current results show a promising ability to recover shape given a similar training surface.