Elevation Retrieval Routine Documentation

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**Overview – Usage Instructions**

The elevation retrieval routine is accessible through a simple interface script titled “*SurfaceSolve*”. Running this script in the command window of MATLAB will prompt the user for either an input directory or an input variable and will crunch through the necessary calculations.

REQUIREMENTS:

- Proper system constants set in “*system\_constants*”

- A flat surface image (preferably time-averaged)

- A flat cap image

- A data image as a local variable, or a data directory

OUTPUTS

- A surface normal matrix and a surface vector (elevation) matrix

- if processing a directory: to a .mat file in \data\_dir\Outputs

- if processing a single variable: to the workspace

**Theory and Underlying Routines**

The elevation routine is based on a two part solution; the surface normals are solved first, and the elevations that are required to match those normals are solved second. In order to be able to use the data images, it is necessary to process the flat surface image from the data set prior to the routine.

System Scripts

*SurfaceSolve* – A user interface to the system

*ElevationRetrieval* – The processing script which runs all of the necessary routines on a data image

*ElevationBatch* – A batch processing script to manage ElevationRetrieval for a directory of data

**System Preparation – Flat surface Processing**

*system\_constants*

Set system constants (such as nadir point, resolution, etc) in this script.

*flat\_fit*

This script prepares a model of the flat surface that can be used in the processing of data images. A flat surface image and system constants are taken as an input. A flat surface vector matrix is created through ray tracing from the camera to the focal plane of the image (focused at the calm surface height of the water). Rays are then traced down to the bottom of the tank, and their points of intersection are given color values based on the input flat surface color image. A quadratic surface is fit through these color values using *polyfitn* for each color. This fitted surface is then solved using *polyvaln* for a plaid grid of about 100 points which span an area larger than the actual input image. Points outside the area of the input image are extrapolated using the model.

**Step 1 – Surface Normal Processing**