Testing Saliency based Techniques for Planetary Surface Scene Analysis

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Feature Detection

- Supervised Learning Techniques
  - Differences between training and real scenes – population density, lighting, hue…….

Training

Actual (image courtesy NASA)

- Local Invariant Features (SIFT)
  - Complex descriptors of objects
  - Complex tracking algorithms, high memory requirements
- Possible Solution – Saliency Based Features?
  - Shape based feature descriptors based on biologically inspired saliency models
  - Improvements to computational efficiency

Using Thematic Features

- Visual Saliency based Detection and Tracking
  - Inspired by biological visual systems
  - Generates “saliency map” showing the conspicuity of each pixel in probabilistic terms
  - Rocks described in terms of their conspicuity characteristics
    - colour, depth, orientation, curvature, size, luminance intensity, topology etc
  - Purely bottom – up, no top – down control

FASTER Project

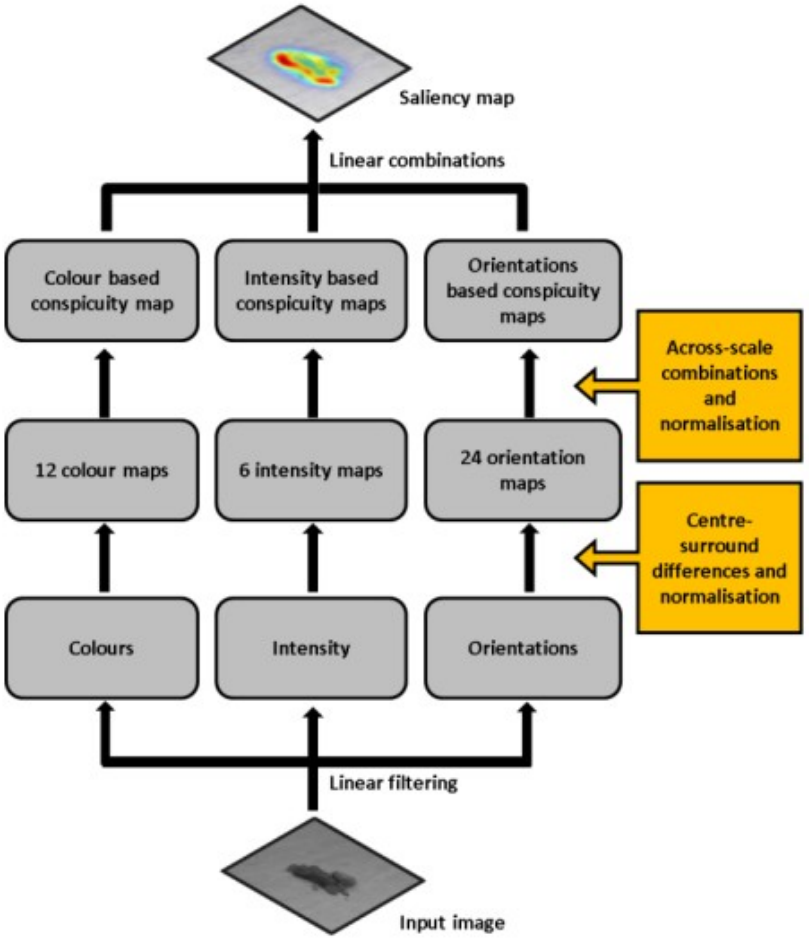
- Increase average travel velocity
- Reducing risks particularly from non geometric soil hazards
- Dual cooperative rover scenario: main rover plus lightweight, agile scout

Project Objectives

- Use saliency to identify rock hazards encountered by primary rover
- Locate hazards in 3D space
- Incorporate in cooperative rover mapping and path planning

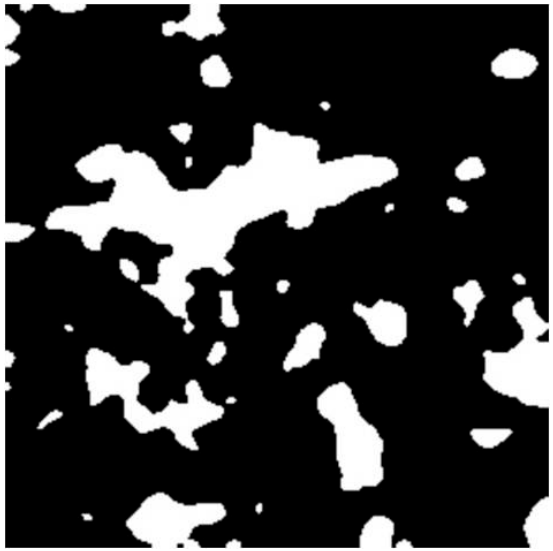
Saliency Algorithms

- Itti, Koch Niebur Model
- Well established
- Generates 42 feature maps
- Across scale / centre surround comparisons
- Combined using weighting based on local maxima
- Grey scale map threshholded to binary saliency map - Otsu's method
- Computationally quite expensive



Itti Algorithm - Results

- Identifies feature
- A lot of false positives
- A little slow



Binary saliency map

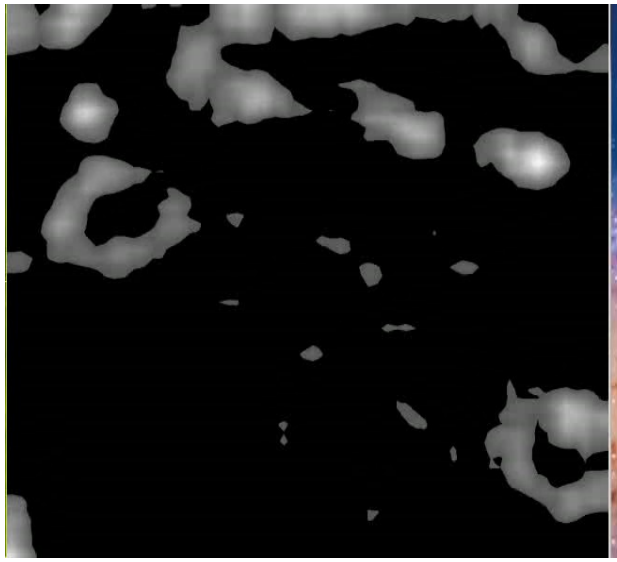
Mars image courtesy NASA

Hou Algorithm

- Different, faster approach to spatial feature identification
- Uses spectral residual
- No weighting, uses single grey scale image as source

Hou Algorithm - Results

- Faster
- Identifies features well
- Some false positives from textures



Saliency map

Airbus Mars Yard

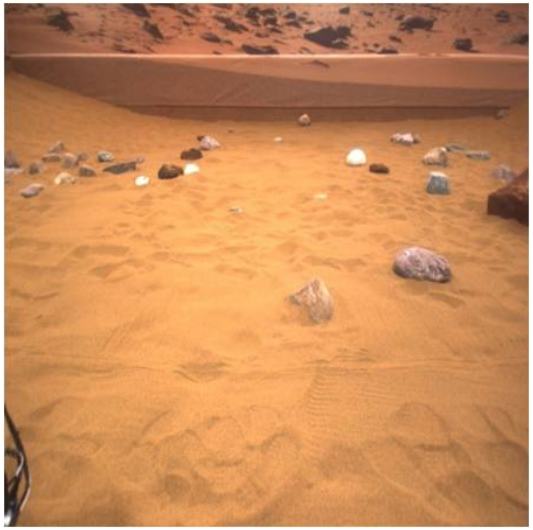
Rudinac Algorithm

- Similar to Hou and uses same spectral residual approach to spatial features
- Adds colour information
- Weighting required as per Itti

Rudinac Algorithm - Results

- False positive rejection improved

Enhancements

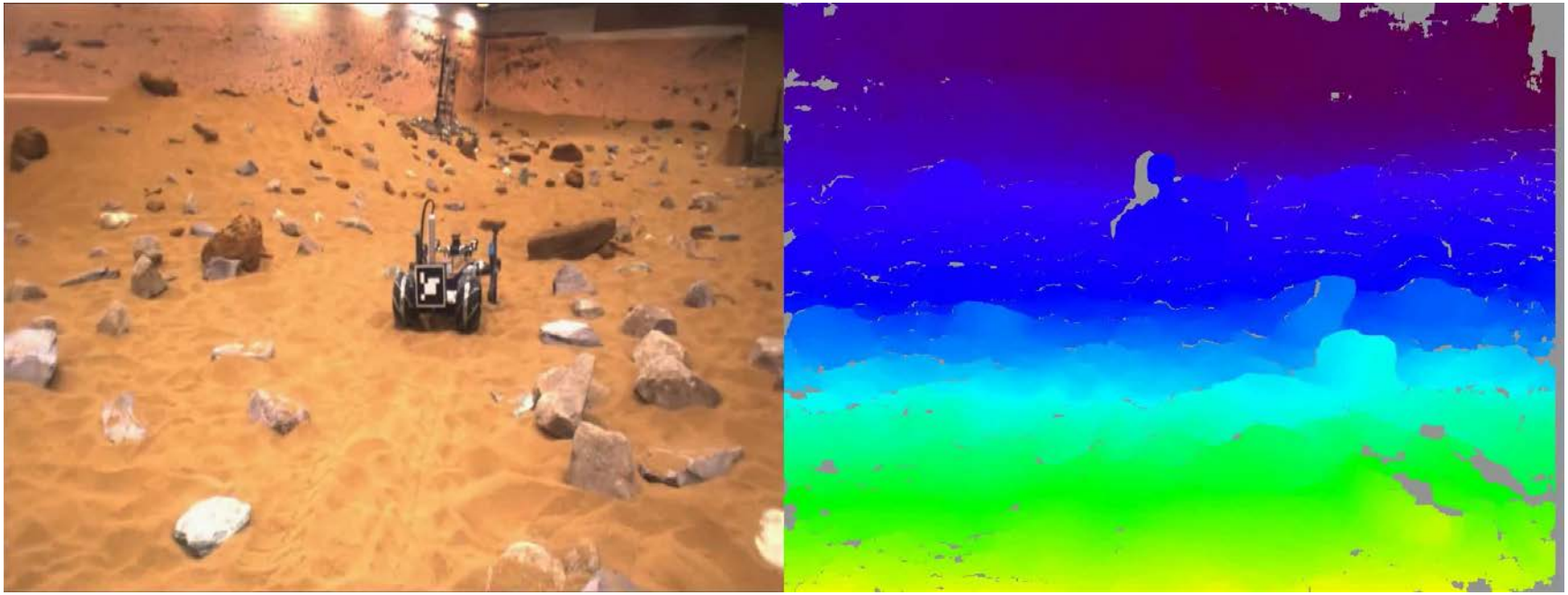


- Colour Information
- Histogram equalisation

without *with*

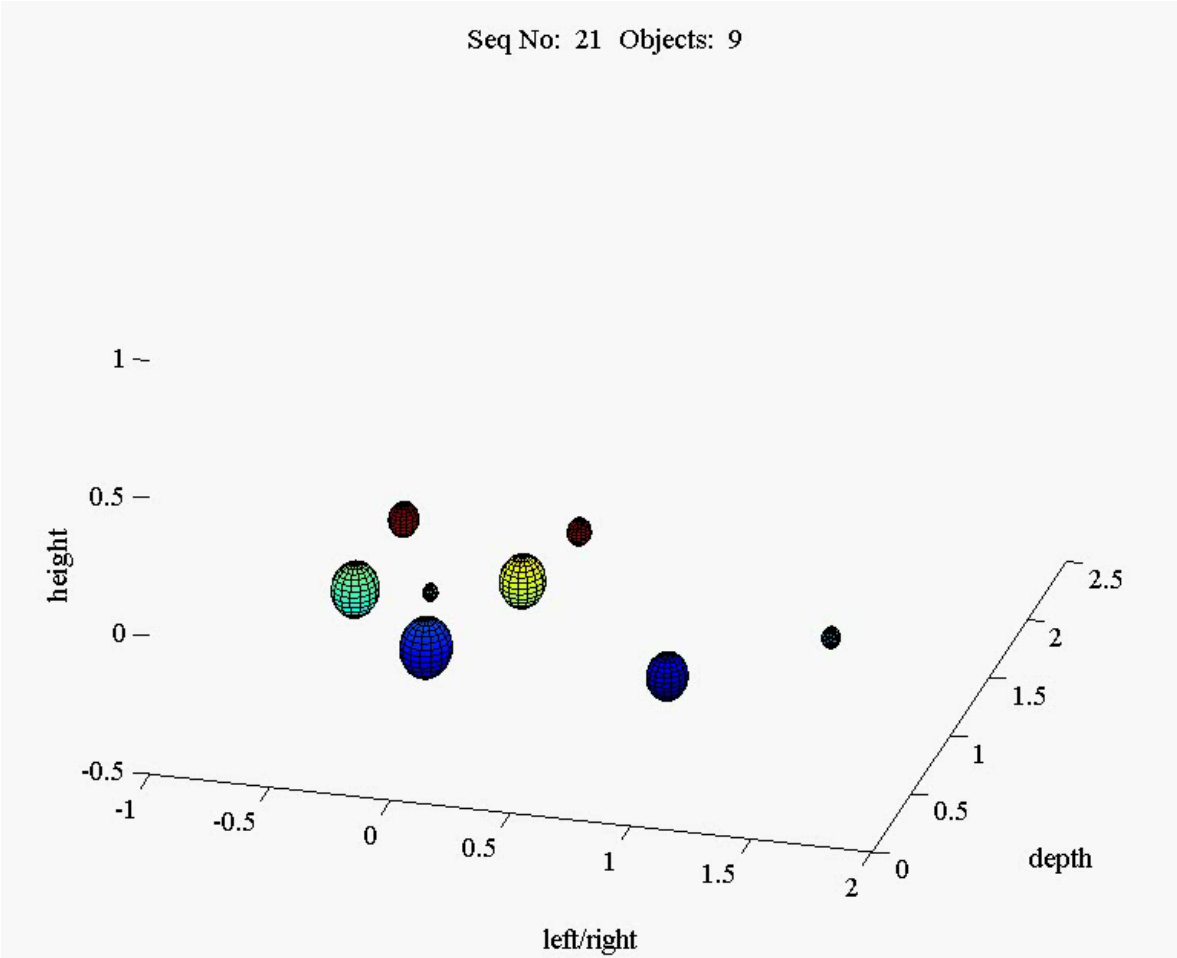
Hazard Localisation

- Correlate salient objects with stereo camera disparity data



Hazard Detection Data

- Generates rock centroid locations and sizes – heights based on Golombek model
- Aim for smooth flow through scene



Saliency Based Feature Detection

- Questions?