

Image Volume Registration

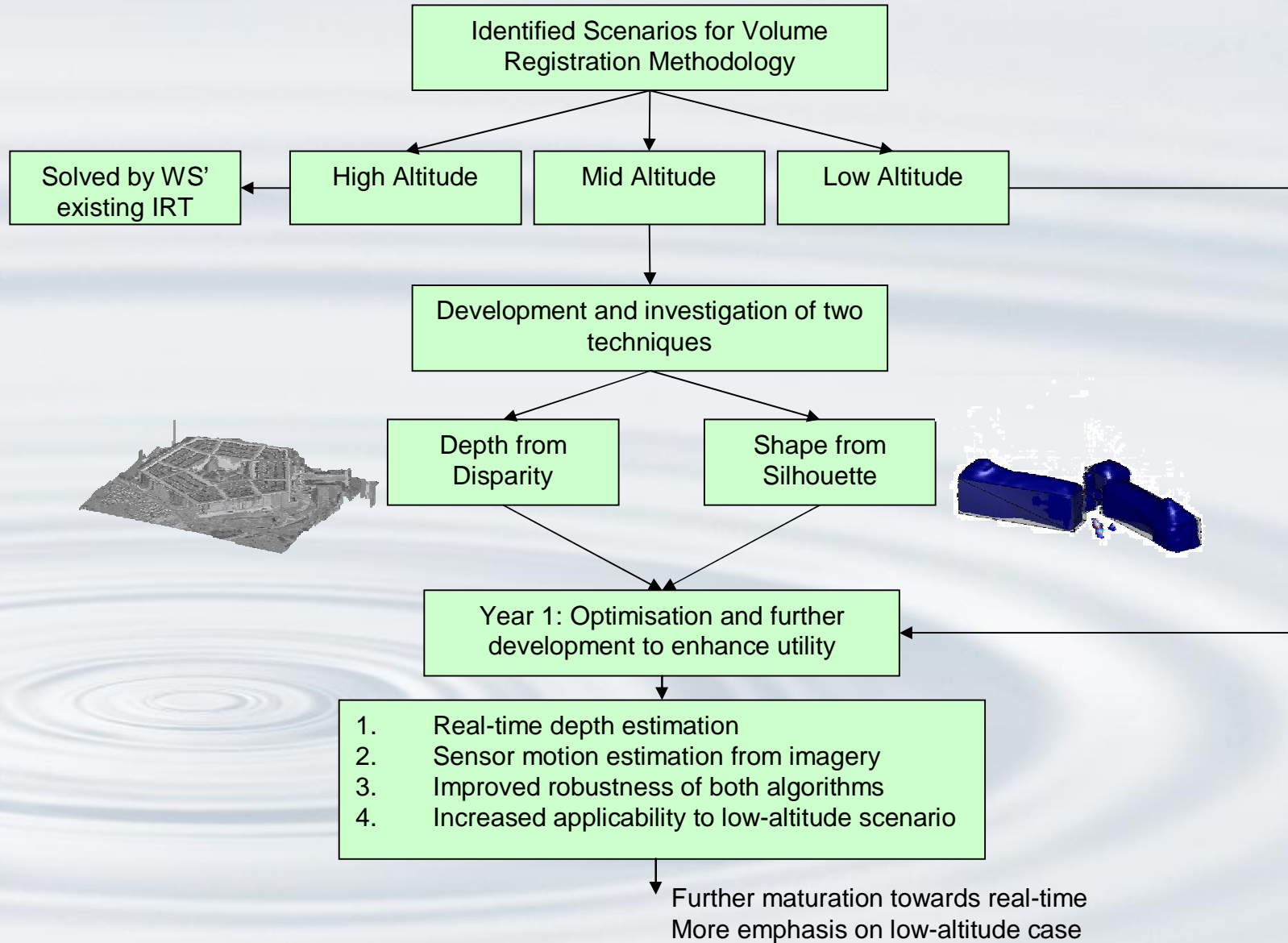
Darren Myatt & Jeremy Rogers

Waterfall Solutions Ltd

Overview

- Project Background
- Sensor Geometry Extraction
- Depth from Disparity
 - Produces a dense point cloud from two images with a relatively small baseline.
- Shape from Silhouette
 - 3D shape carved from object silhouettes over multiple frames/wide baseline.
- Summary

Project Background

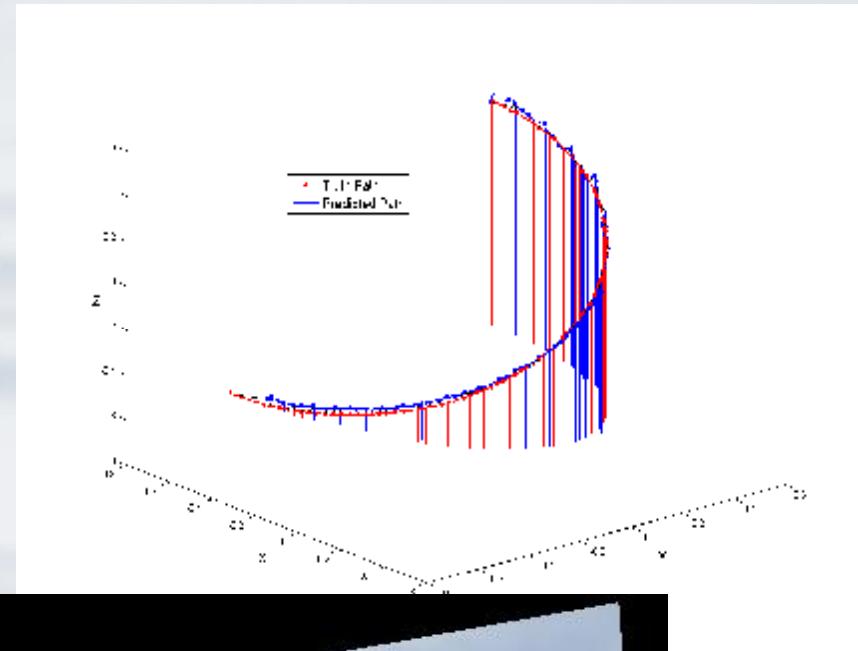


Project Background

- Objectives
 - Integration of multiple passive sensor views to form single integrated 3D model
 - Realise potential of Volume Registration methods
 - Improve accuracy and utility of model construction
 - Advance techniques towards real-time implementation
- Development of two methods
 - Depth from Disparity
 - Optimisation of speed and accuracy
 - Implementation of real-time system
 - Rectification
 - Shape from Silhouette
 - Novel methods for silhouette extraction
 - Robust geometry estimation
 - Increased speed through optimised image selection

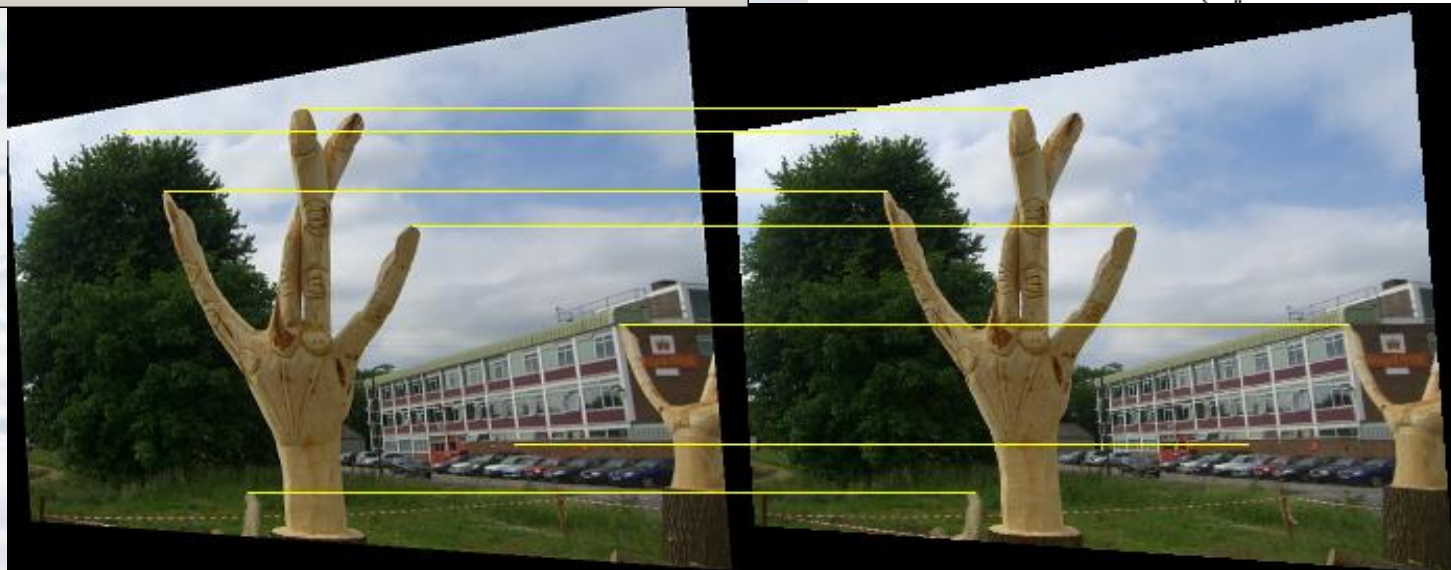
Automatic Extraction of Sensor Geometry

Feature Tracking



Sensor Position Estimation

Rectification

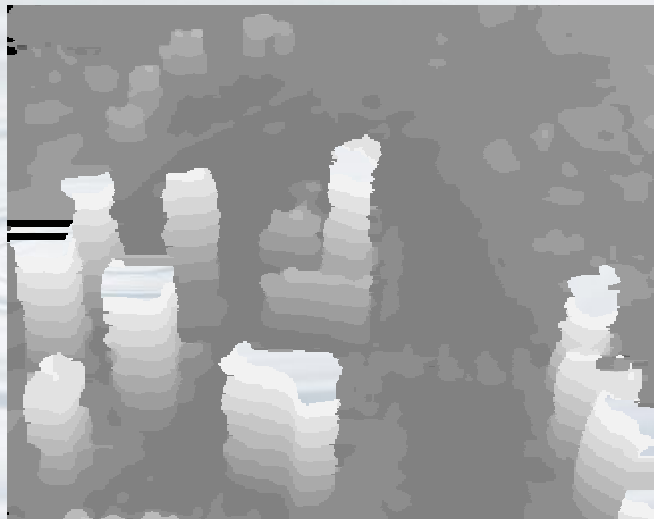


Depth From Disparity

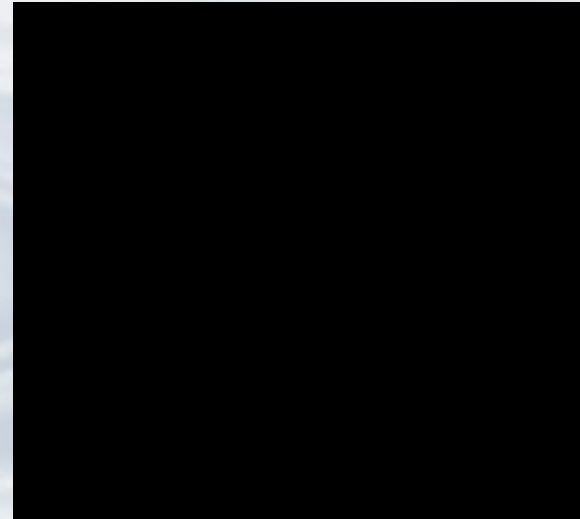
Input
Images



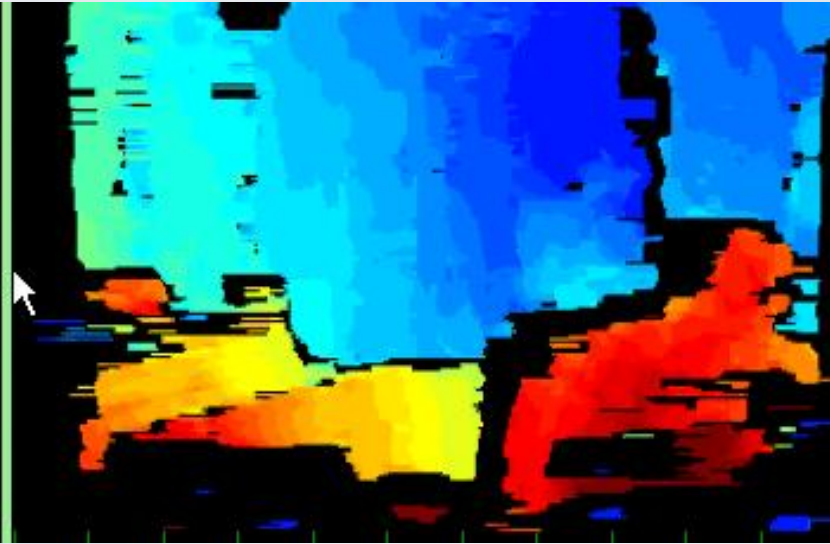
Disparity
Map



3D Model



Depth from Disparity



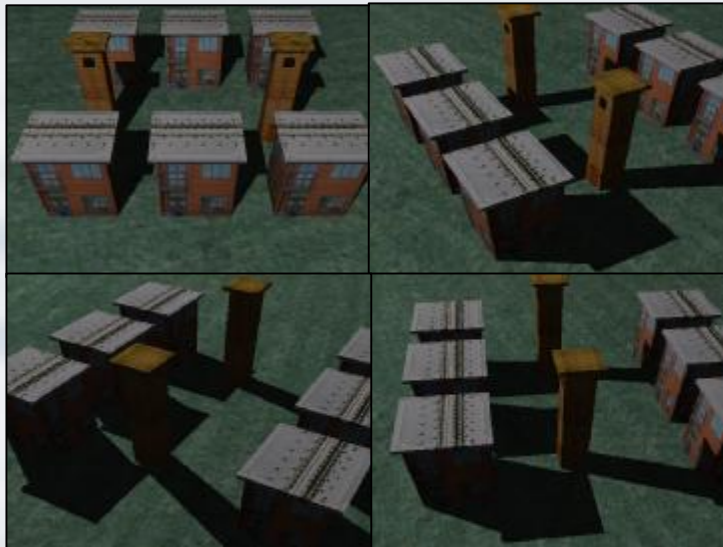
Depth Map Construction

3D Reconstruction

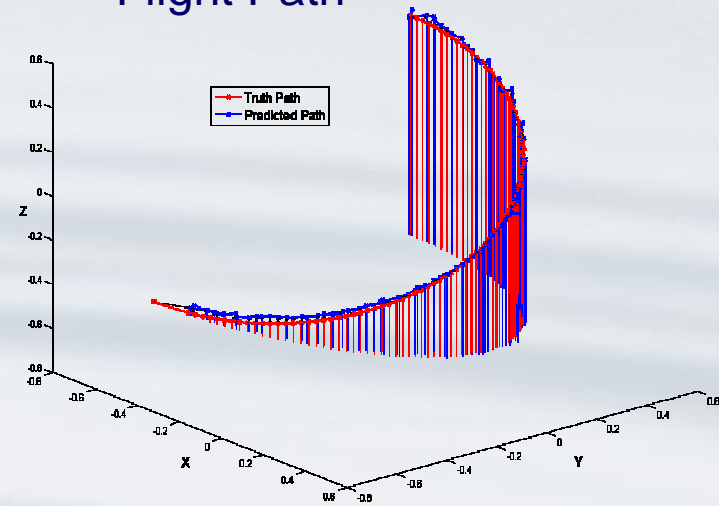


TankGrass.avi

Shape From Silhouette



Flight Path



Shape From Silhouette

Input Images



Silhouette



Intermediate Model

Shape From Silhouette

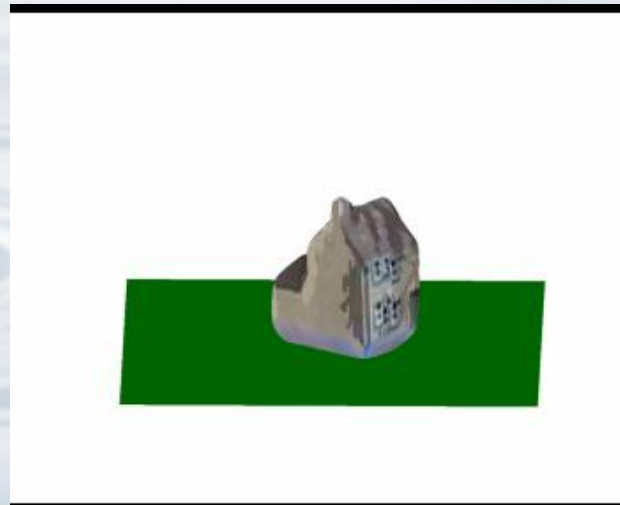


Shape From Silhouette

Input Imagery



3D model



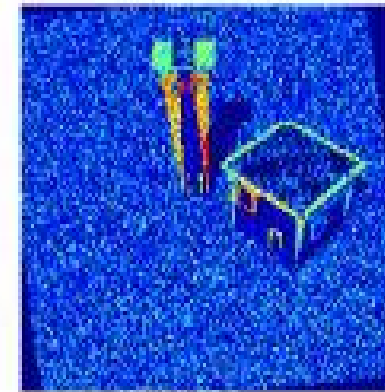
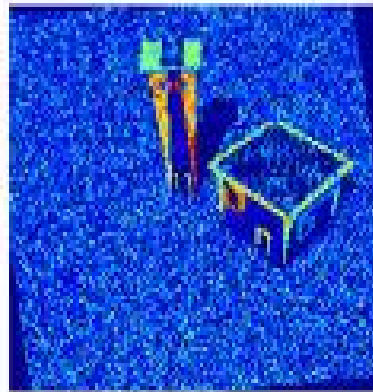
Silhouette Generation

- Ground Plane Homography
 - Projection of different views onto ground plane
 - Aggregation of these different projections is employed to identify objects above this plane

Input Imagery



Difference Image

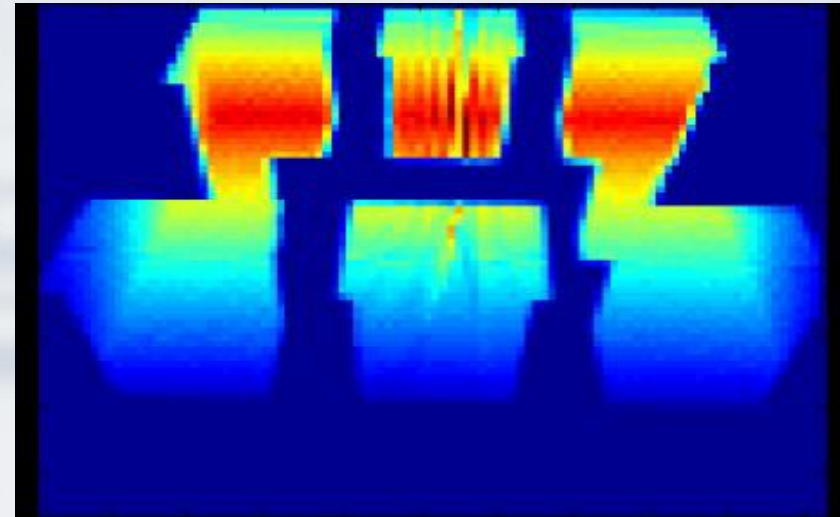


Homography Projection

Aggregated Differences

Optimised Image Selection

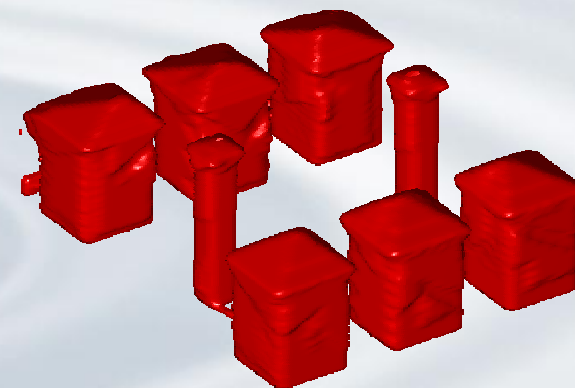
- Optimal selection of imagery enables faster model construction.
- Can also be used to guide the platform and acquire more useful imagery.
- Model created from first 20 selected frames.



Projection Density

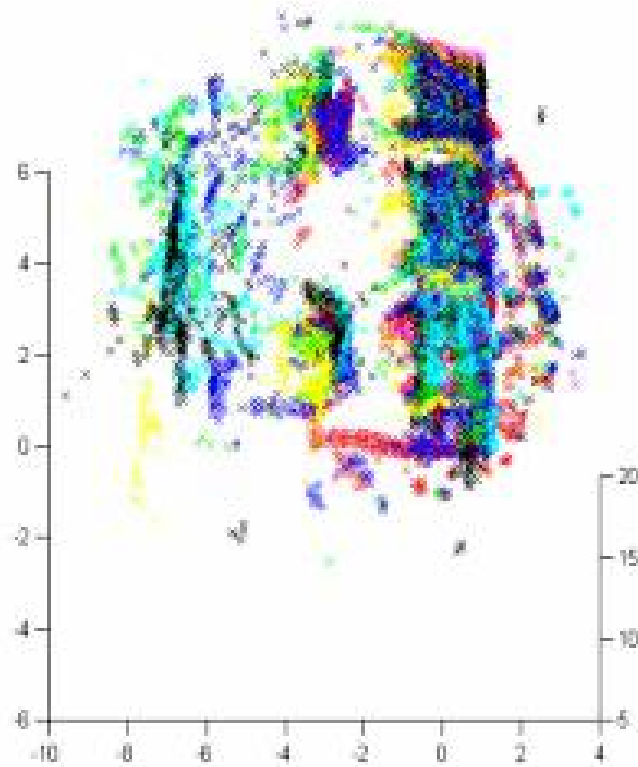


Frame Order



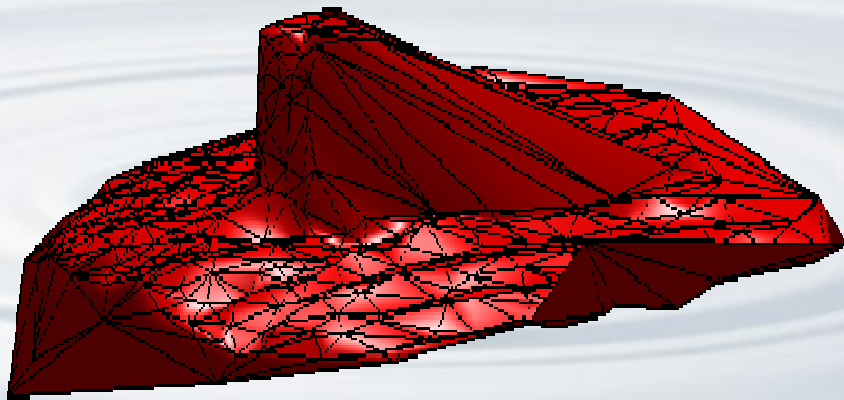
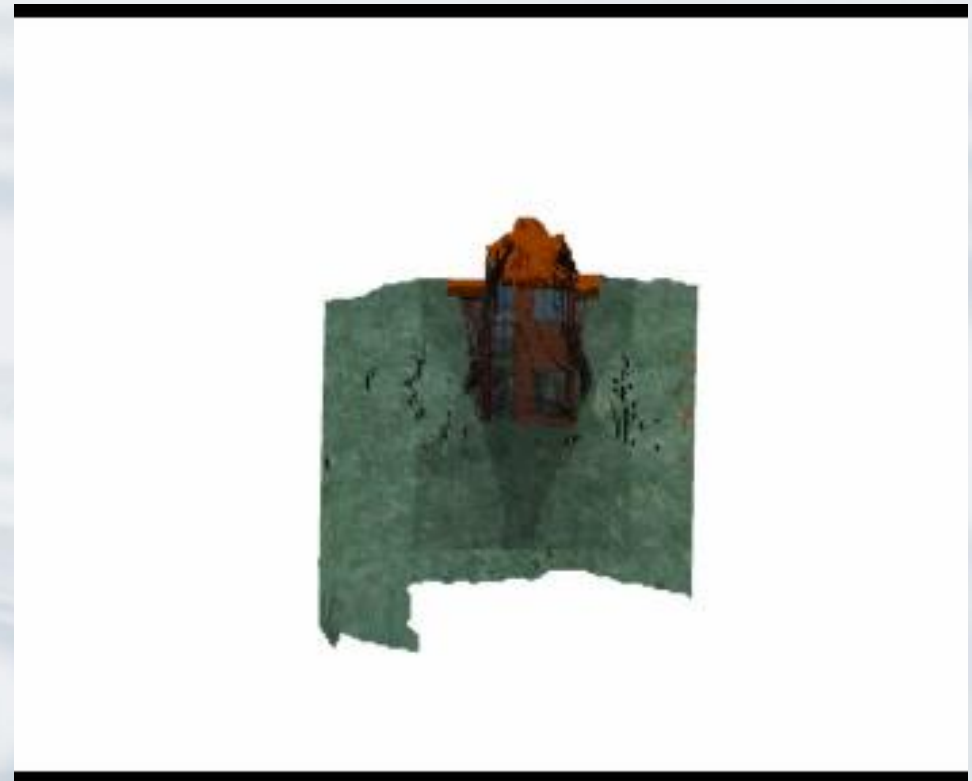
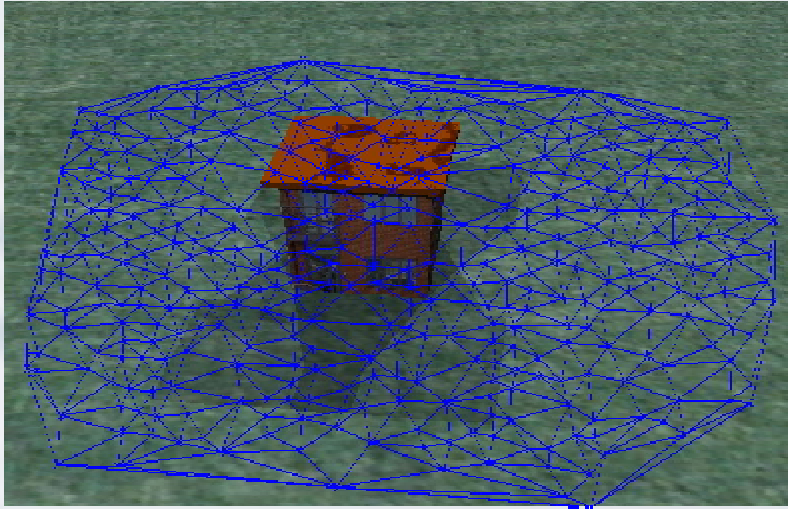
Guided Selection

Sparse Triangulation



Extension of disparity estimation to wide
baseline triangulation

Mesh Carving



Surveillance Applications



Summary

- WS has an ongoing development programme investigating novel 3D imaging from passive sensors
- Within current programme:
 - Depth from Disparity has been demonstrated in a real-time system.
 - Shape-from-Silhouette has been shown to produce very good results in the more challenging low-altitude case.
 - Preliminary investigation of sparse techniques has demonstrated its potential.
- Work is now focussing on low-altitude case and is examining the potential of merging the two techniques
 - Technology from Depth from Disparity can be exploited in low-altitude case through sparse method.
 - Extending the military utility through different forms of voxel carving.
 - Integration of different aspects offers significant potential for practical systems.
- Ongoing design activities are evolving and maturing these ideas and concepts.