

# Comparison of Stereo Photogrammetry and Structure from Motion for Modelling Soil Surfaces

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## Introduction

The surface of soil can indicate factors that influence soil quality which impact crop yield. A detailed soil surface Digital Elevation Model (DEM) provides information about the soil surface particle size, water infiltration, slope and relief and therefore provide information relating to surface run-off, soil degradation and erosion. Structure from Motion is a recently developed method for creating DEMs that could simplify the collection of imagery for this purpose.

## Objectives

1. Create soil surfaces DEMs using Stereo Photogrammetry and Structure from Motion.
2. Evaluate the accuracy, financial and time cost to produce the soil surface models using the above methods.

### Photogrammetry

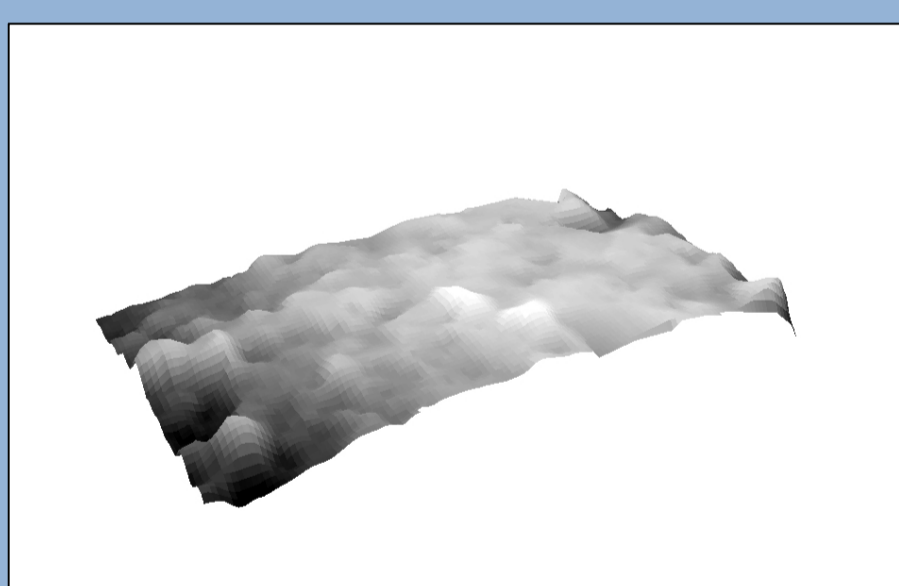
Image collection

Photogrammetry software used for triangulation

Export DEM for comparison with Structure from Motion



Original Soil Sample



DEM



Ortho-Photograph

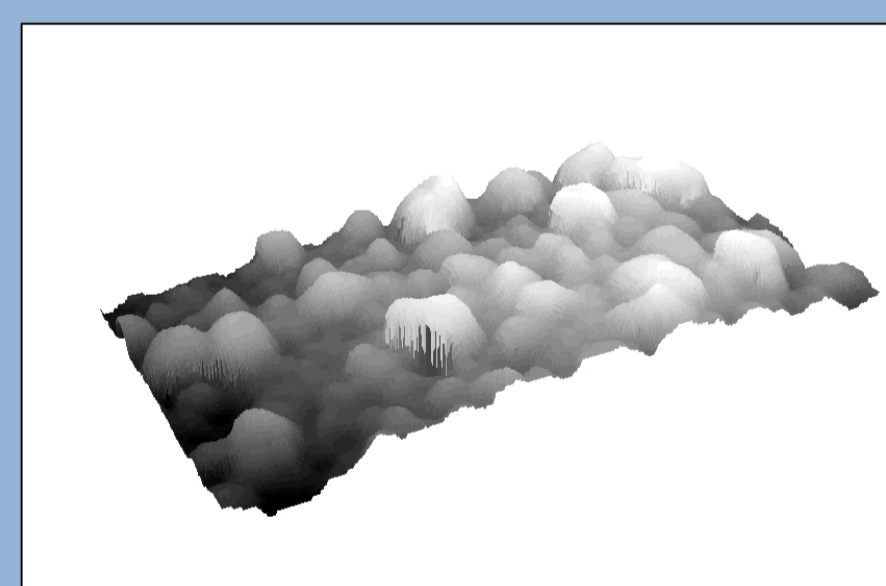
### Structure from Motion

Image collection

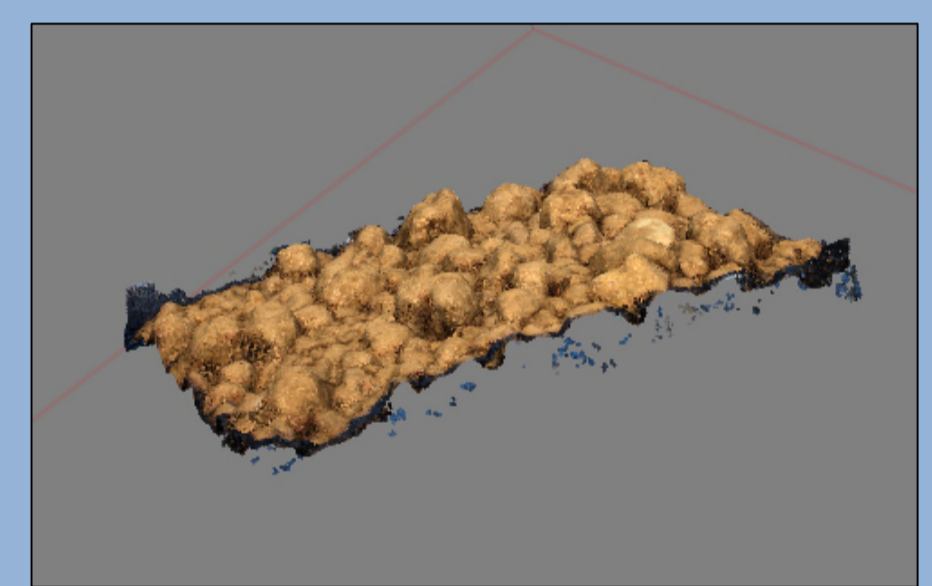
Sparse point cloud

Dense point cloud

Export DEM for comparison with Stereo Photogrammetry



DEM



Trimmed Dense point cloud

## Key Findings:

1. Visual inspection showed that Structure from Motion produced a more detailed model of the surface aggregates.
2. A comparison of the DEMs showed an average difference in elevation of 3.8mm with a standard deviation of 4mm.
3. Measurements of objects of known dimensions within the DEMs gave a RMSE of 0.9mm for structure from motion and 3.2mm for stereo photogrammetry.
4. In comparison of the practical use of the two methods: stereo photogrammetry requires the internal and external orientation of a camera pair to be measured accurately, which makes setting up time consuming; Structure from Motion uses a single camera and multiple exposures from varying angles, increasing the time needed for imagery collection.
5. As a result of matching multiple images Structure from Motion requires greater computer resources than stereo photogrammetry.