Project: Slope Error Data Processing & Reporting

Objectives

- Standardise methods for slope error data processing and reporting

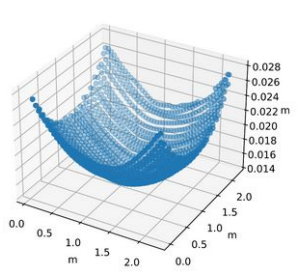
Approach

- Develop software tools for data processing and reporting
- Test against shared data sets
- Release library as open source (pending approval)

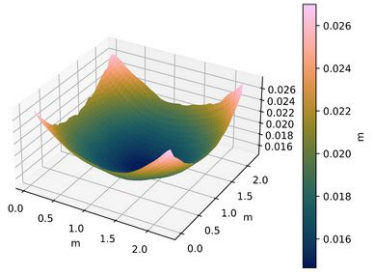
Status

- Software tools developed and tested on CSIRO point cloud surface data. Initial results shared with Heliocon

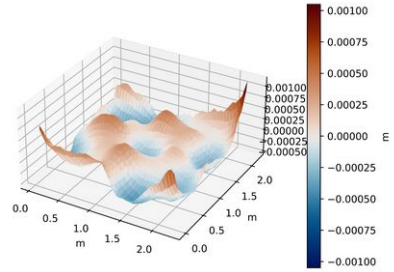
Leads: Mike Collins, Calum Acutt



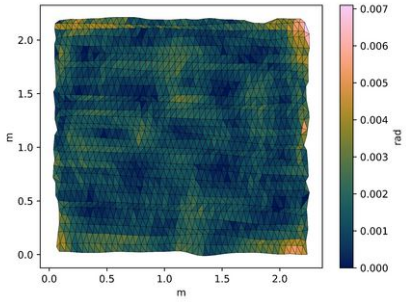
Raw Points



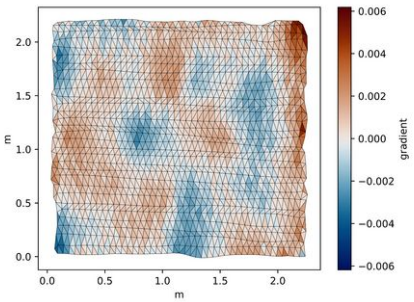
Mesh of Raw Data



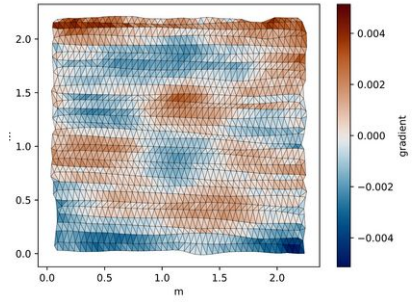
Z error (circular best fit paraboloid)



Slope error 2d



Slope error x direction



Slope error y direction

Project: Slope errors from photogrammetry

Objective

- To implement, as open source code, a method for converting photogrammetry point-cloud data to equivalent slope error values.

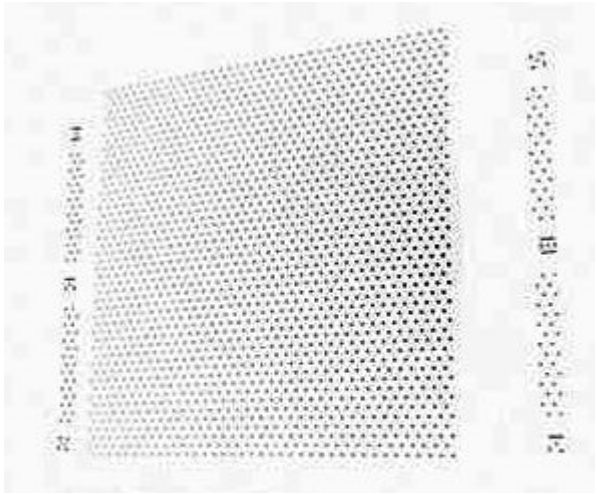
Approach

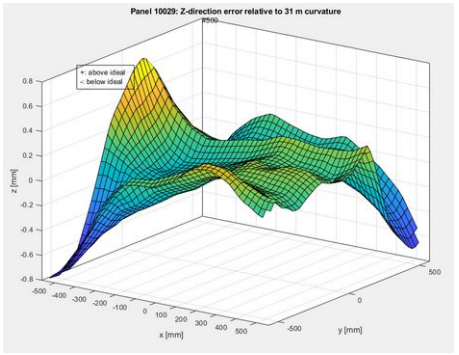
- Acquire point-clouds from images using projected or adhered dots and process using commercial “VMS” photogrammetry tool.
- Implement a new Python script based on previous IDL/Matlab ANU code: Delauney triangulation, axis alignment, paraboloid fitting, residual fitting to Rayleigh and Normal distributions.

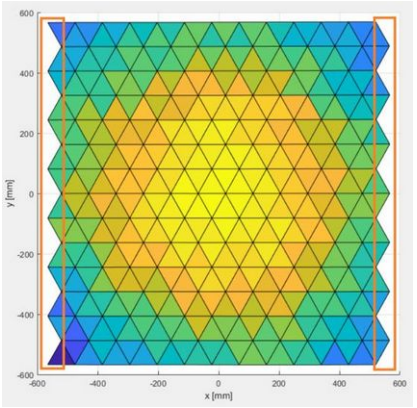
Status

- Initial code developed and shared at https://github.com/anustg/Solar_concentrator_optics.git
- Next: close the loop also by cross-checking flux mapping and ray tracing.

Leads: Johannes Pottas, Ye Wang, John Pye, Joe Coventry.

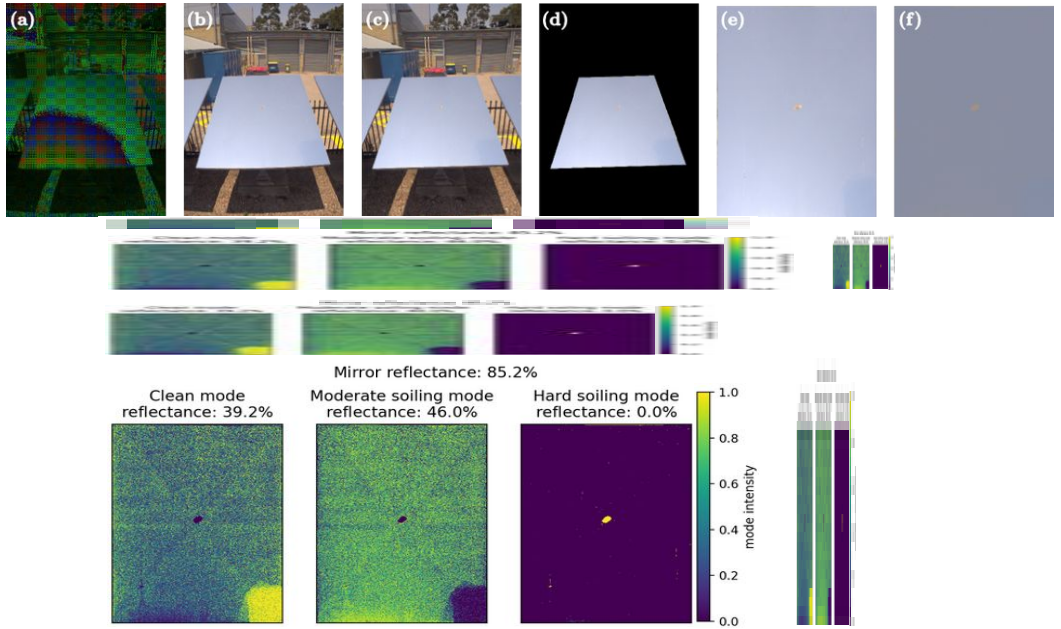


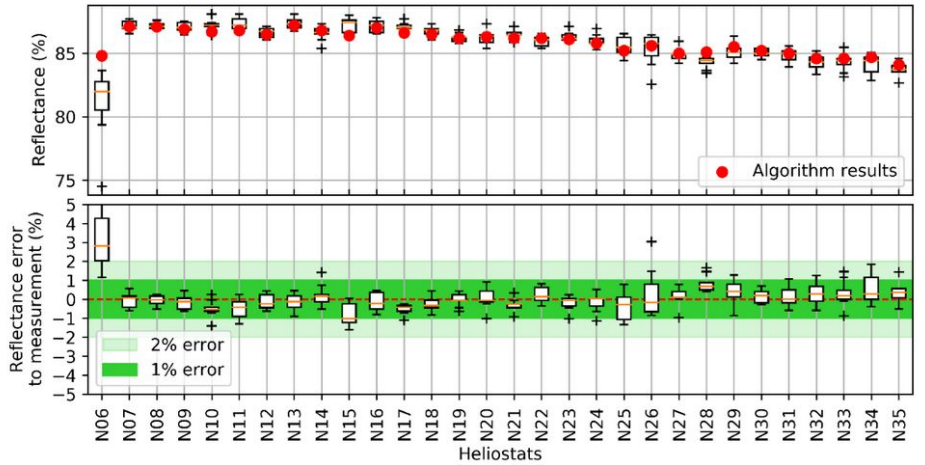




Project: Soiling estimation from DSLR images

- **Objectives:**
  - Develop a cost-effective way to significantly improve the spatial and temporal resolution of soiling loss estimation.
- **Approach:**
  - Use an original color-space processing method to estimate mirror reflectance and soiling loss.
  - Gather camera images and reflectometer-based soiling measurements from multiple heliostat technologies and sites to test the method.
- **Status:**
  - Controlled conditions result in <1% error in reflectance estimation.
  - Currently evaluating the impact of the image acquisition parameters on the accuracy of the method.
- **Leads:** Charles-Alexis Asselineau & Joe Coventry





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Project: Using BCS for Heliostat Shape Estimation

Objective

- To us images from a beam characterisation system (BCS) for in-situ heliostat shape and slope error measurements and spillage quantification

Approach

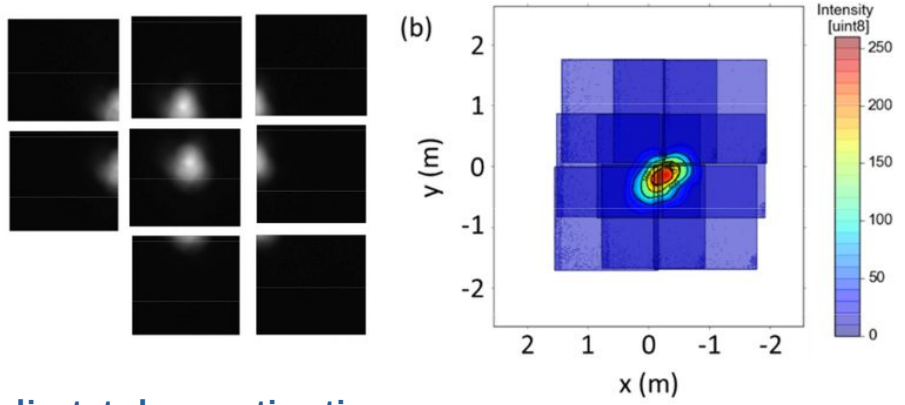
- Acquire beam images of a heliostat at different times of a day using BCS
- Matching the flux distributions from ray-tracing and image data by optimising the shape of the heliostat that is governed by coefficients of a quadric equation

Status

- Streamlined software process has been developed and applied to flux image data previously acquired at Vast Solar (Australia)
- New image data were acquired at IMDEA (Madrid, Spain) and are being processed to validate against deflectometry data

Leads: Ye Wang, Charles-Alexis Asselineau, Joe Coventry and John Pye

1. Image acquisition using BCS (with stitching if necessary)



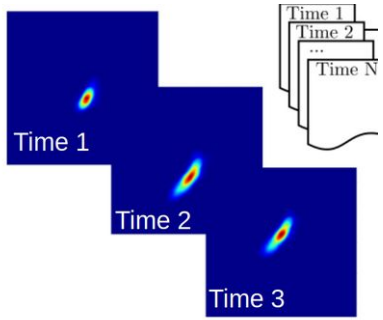
2. Heliostat shape estimation

$$z = ax^2 + by^2 + cxy$$

$$\begin{bmatrix} x^2y^2 & x^2y & x^2 \\ xy^2 & xy & x \\ y^2 & y & 1 \end{bmatrix}$$

Image data

ray tracing flux maps



Obtain the optimal *a*, *b*, *c* that minimise the difference in flux distributions

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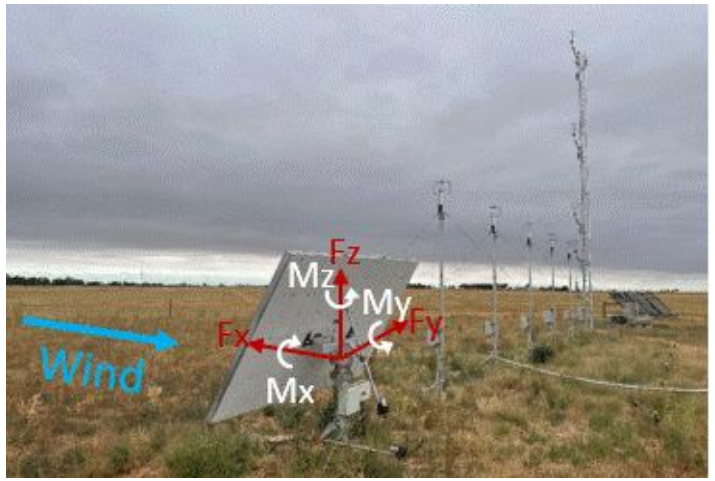
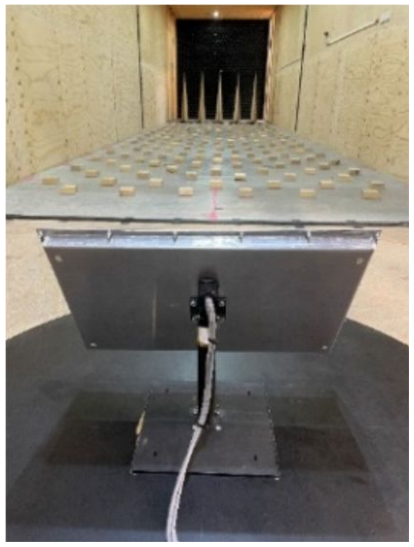
3. Optical performance of the entire field

N heliostats (*N* sets of {a,b,c}) → Randomly distributed in the field → Annual optical performance → Equivalent slope error

Project: Heliostat Wind Load Field Measurements

- **Objectives**
  - Develop detailed measurement procedure to reconcile single heliostat load field measurements with wind tunnel experiments
  - Investigate loads in low- and high-density arrays of heliostats for wind load prediction in a heliostat field at different elevation angles
- **Approach**
  - Field measurements at UoA Atmospheric Boundary Layer Facility (ABLRF) Roseworthy campus to verify single heliostat loads with wind tunnel data
  - Heliostat field array load and flow measurements in different rows of linear staggered field array
- **Status**
  - Single heliostat load field measurements consistent with wind tunnel data for prevailing wind direction, other wind directions to be analyzed
  - Increasing load reduction in downstream rows of heliostat array for increasing elevation angle and increasing field density
- **Lead**: Matthew Emes





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conceptual design • components • integration • mass production • heliostat field