This paper describes objective technical results and analysis. Any subjective views or opinions that might be expressed in the paper do not necessarily represent the views of the U.S. Department of Energy or the United States Government.

PROJECT NAME:

LIDAR For Heliostat Optical Error Assessment

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BACKGROUND / INDUSTRY IMPACT

- ❑ No tool currently exists that directly assesses optical canting errors efficiently and accurately in commercial heliostat fields.
- ❑ Sandia is developing a LIDAR-based approach to assess optical canting and pointing errors in large commercial heliostat fields.
- ❑ System will measure canting and pointing errors, and provide feedback for making canting error corrections.

PROJECT OVERVIEW / OBJECTIVES

- Develop efficient *in-situ* methods to assess and quantify heliostat field optical errors such as canting and pointing errors.
- Develop software to drive a commercial LIDAR system automatically without user intervention for direct 3D data collections.

METHODS

- Use a commercial off the shelf LIDAR sensor for direct measurement of a dense 3D point cloud of the heliostat mirror surfaces
- Use segmentation and statistical analysis to derive heliostat optical errors
- Improve the heliostat field performance using the 3D survey results.
- Make the system usable in unmanned systems to realize autonomous survey of a commercial-scale heliostat field

KEY OUTCOMES / MILESTONES

- ✓ Procure an appropriate LIDAR sensor with software API amenable to autonomous measurement. Success metric: LIDAR sensor shall be able to power on, acquire target images and scan the surrounding area in 3D, under completely remote operation. measurement by UFACET and NIO methods.
- ✓ We have demonstrated successful data collection using LIDAR at the NSTTF and Crescent Dunes heliostat fields.
- ✓ Demonstrated 1) automatically take a scan and retrieve scan data to a computer, 2) segment the data down to individual heliostats, and then 3) automatically segment each individual heliostat into 25 separate facets which can then be analyzed for canting errors.

CONCLUSION / REMAINING RISK

- The tool was developed and validated with the field data.
- LIDAR shows promise for automating heliostat optical error assessment
- Need to identify potential commercial partners for field demonstration.

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A *LIDAR technique* has been *demonstrated to directly measure* the *canting errors of heliostat mirrors*, and can similarly be applied to *measure the pointing error of heliostats*.

Take a picture to download the full paper

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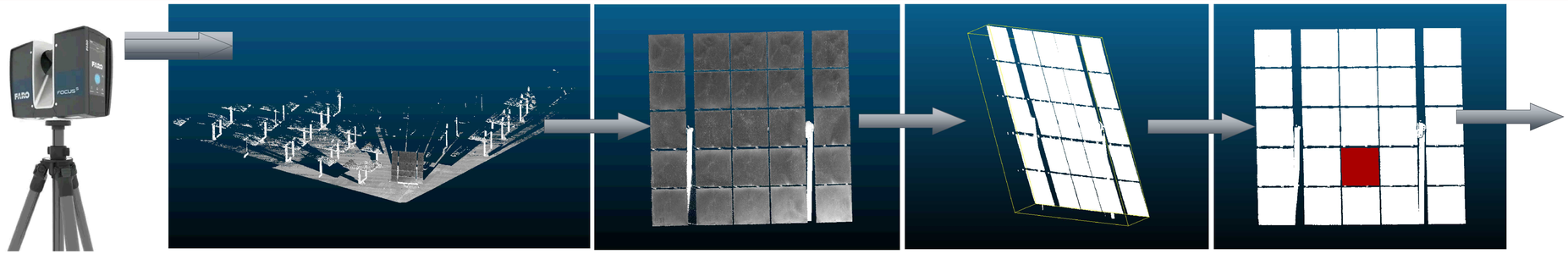
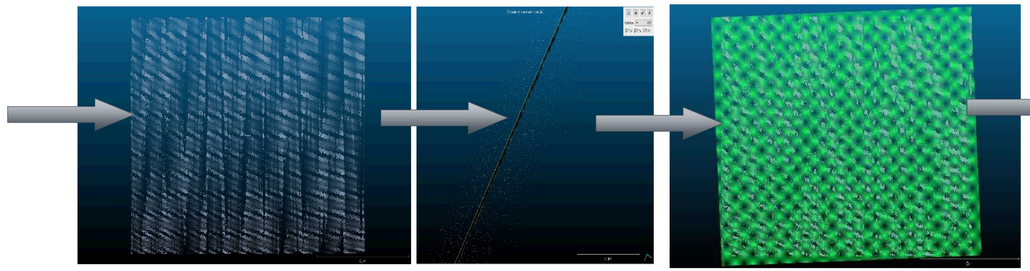


Scanner

Scan of Heliostat field

Automatic Segmentation of Heliostat into individual Point Clouds of single facets



Single facet point-cloud
Front and Side Views

Planar fit of single facet

1.14169	0.408322	0.122486	0.560779	1.21994
1.17423	0.460027	0.045571	0.485688	1.16567
1.17435	0.37967	0	0.578128	1.20949
1.21616	0.522441	0.041712	0.440738	1.24602
1.15662	0.518261	0.00400249	0.554092	1.26682

Azimuth Angle (deg) Relative to Central Boresight Mirror

1.0403	0.911666	0.95068	1.05591	1.0786
0.462568	0.482888	0.431832	0.412782	0.460116
0.00142751	0.00496555	0	0.00466502	0.0113859
0.580846	0.610093	0.486043	0.536156	0.626205
1.07751	1.09415	1.16854	1.07567	1.13388

Elecvation Angle (deg) Relative to Central Boresight Mirror

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