U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

SOLAR ENERGY TECHNOLOGIES OFFICE

SETO CSP Program Summit 2019

Deployment of the Aerial Distant Observer Tool to Survey Optical Performance of CSP Parabolic Trough Solar Fields

Partner: Solar Dynamics

March 19, 2019

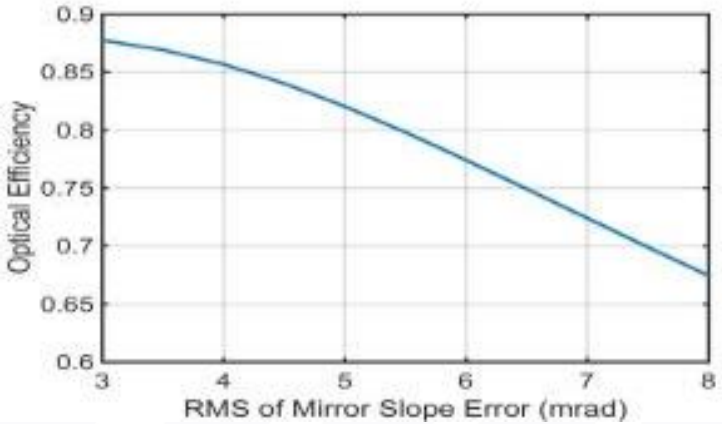
PI: Guangdong Zhu, NREL

Project Overview

- TCF FY18 Award
- Team
  - NREL: Guangdong Zhu, Devon Kesseli, Rebecca Mitchell, Josh Bauer, Mark Mehos, one TBD intern
  - Solar Dynamics (SD): Patrick Marcotte, Tim Wendelin, Hank Price
- Fund:
  - $150k to NREL and in-kind cost share of $150k from SD
- Performance period:
  - 01/01/2019 – 12/31/2019

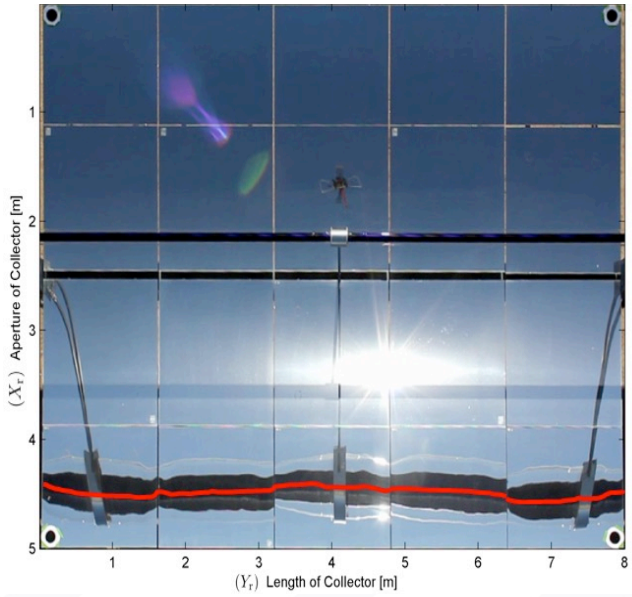
Motivation – Optics Matters!

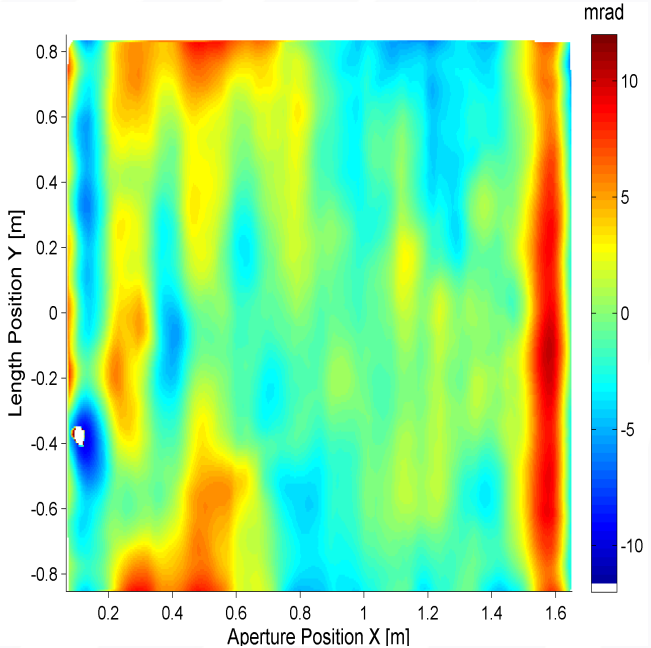
- Parabolic trough
  - A 2-mrad increase in slope error leads to a 10% efficiency loss.



Distant Observer by NREL

- Capability: Measure slope error and receiver alignment error of parabolic trough collectors



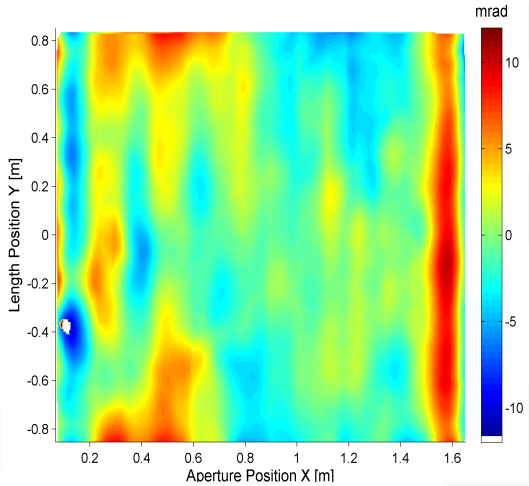


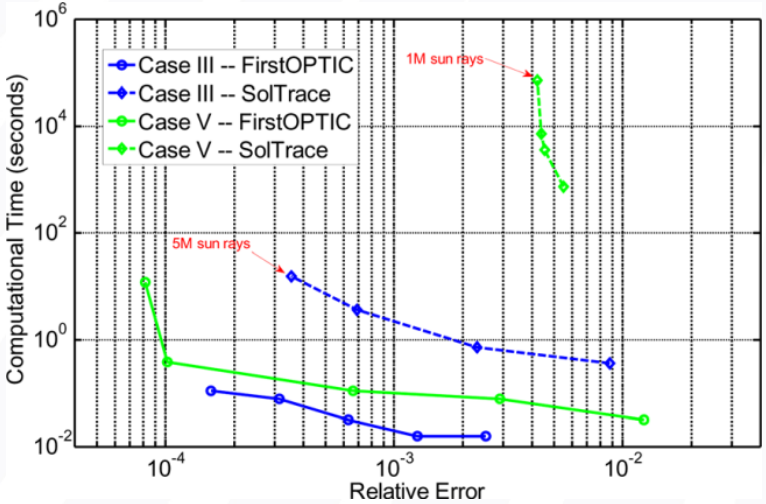
Distant Observer by NREL

- Ground-based version has been developed
- Aerial-version is not available and would be more efficient for a large-scale plant.

FirstOPTIC

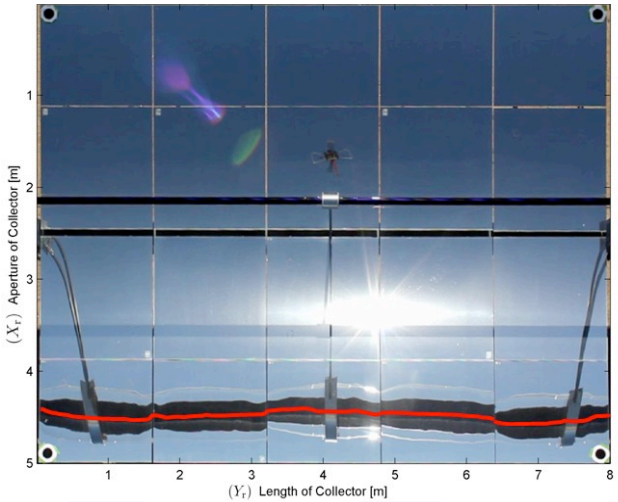
- An analytical method to calculate solar collector optical performance
- More accurate and efficient
- Take direct measurement results and calculate collector performance
- Gap: both DO and FirstOPTIC were written in matlab but are separate program





Project Objectives

- Enhance the DO's capability to directly measure a solar collector's optical error
- Validate the performance of DO with the aerial capability to perform optical characterization of a parabolic trough collector field
- Integrate FirstOPTIC to assess the solar field performance based on DO measurement results.



Project Approach

Dates (M – Month)	Milestones/Deliverables
03/31/2019 (M3)	Identify an appropriate drone and integrate with a camera.
06/30/2019 (M6)	Conduct the pilot in-field DO test at a utility-scale solar field including a drone flight.
09/30/2019 (M9)	Complete the DO software updates.
12/31/2019 (M12)	Complete integration of the improved DO and FirstOPTIC.

Conclusions

- Transfer national labs intellectual property to benefit the industry
- Provide an integrated software package for measuring and assessing solar field performance under laboratory and in-situ conditions with high-level accuracy
- Provide an alternative competing tool to the industry