Test Case

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I. Test Case List

(A) 1st Round Tests:

The centroid of the mirror, target and the sun vertically in one line

→ for slope error studies: collimated rays

→ for sunshape studies: perfect mirror

A1. Slope errors	**A2. Sunshapes**
A1.1 Pillbox (1, 2, 3 mrad)	A2.1 Pillbox (4 mrad)
A1.2 Normal (1, 2, 3 mrad)	A2.2 Gaussian (4 mrad)
	A2.3 Buie (CSR=0.01, 0.02, 0.03)
A3. Combine sunshape and slope error (NEW)	
A3.1 Pillbox sunshape (4.65 mrad) +Normal slope error (2 mrad)	
A3.2 Buie sunshape (CSR 0.02) + Normal slope error (2 mrad)	

(B) 2nd Round Tests:

A real sun position and a real heliostat position selected from the full field (same field as the 3rd round), combine sunshape and slope error together

B1. Pillbox sunshape (4.65 mrad) + Normal slope error (2 mrad)

B1.1 Solar noon	**B1.2 Morning**
B1.1.1 center front heliostat (P1)	B1.2.1 center front heliostat (P1)
B1.1.2 center back heliostat (P2)	B1.2.2 center back heliostat (P2)
B1.1.3 back left heliostat (P3)	B1.2.3 back left heliostat (P3)
B1.1.4 front right heliostat (P4)	B1.2.4 front right heliostat (P4)

B2. Buie sunshape (CSR 0.02) + Normal slope error (2 mrad)

B2.1 Solar noon	**B2.2 Morning**
B2.1.1 center front heliostat (P1)	B2.2.1 center front heliostat (P1)
B2.1.2 center back heliostat (P2)	B2.2.2 center back heliostat (P2)
B2.1.3 back left heliostat (P3)	B2.2.3 back left heliostat (P3)
B2.1.4 front right heliostat (P4)	B2.2.4 front right heliostat (P4)

(C) 3rd Round Tests:

Full field simulation, surface properties applied here.

C1. Pillbox sunshape (4.65 mrad) + Normal slope error (2 mrad)

C1.1 Solar noon

C1.2 Morning

C2. Buie sunshape (CSR 0.02) + Normal slope error (2 mrad)

C2.1 Solar noon

C2.2 Morning

II. Data Output Request

Please set individual folder for saving results for each case, eg. B1.1.2.

For each case, please outpout:

(1) a text file that contains:

- Q_{irr} (kW) – energy reflected/irradiated from the heliostat(s)
- Q_{abs} (kW) – energy absorbed by the target
- Q_{spil} (kW) – energy reflected from the heliostat(s) but miss the target
- Q_{refl} (kW) – energy reflected from the target

  ($Q_{irr} = Q_{abs} + Q_{spil} + Q_{refl}$)
- num of effective rays – number of rays reflected from the heliostat(s)
- Precision – leave it blank if it's not applicable
- Simulation time (min) – include post processing time

  Please also output the followings for Round C (the full field case) if you can:
- Q_{all} (kW) – energy incident on the field ($Q_{all} = AREA_{heliostats} * DNI$)
- Q_{shade} (kW) – energy losses due to shading
- Q_{block} (kW) – energy losses due to blockage
- Q_{cos} (kW) – energy losses due to cosine effect
- Q_{hstat_abs} (kW) – energy losses due to absorption of heliostats

  ($Q_{all} = Q_{cos} + Q_{shade} + Q_{hstat\_abs} + Q_{block} + Q_{spil} + Q_{abs} + Q_{refl}$)

(2) flux in x and y sampling (100x100) (.csv or .dat):

- x(m) | y(m) | flux (kW/m^2)

(3) flux in radius sampling (50) (.csv or .dat):

- r (m) | flux (kW/m^2)

*** Please record any issues when you are dealing with the tests**

III. Test Case Details

(A) 1st Round Model

The first round tests will be re-simulated by using the full scale sizes of helisotat and receiver. The parameter details can be checked in the document of parameters_list.ods.

The centroid of the mirror, target and the sun vertically in one line.

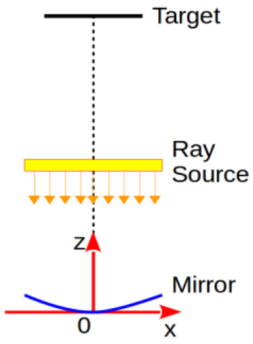

Figure 1: Round 1 Model

A1. Study of slope errors → collimated rays

A1.1 Pillbox

A1.2 Normal

A2. Study of sunshape → perfect mirror

A2.1 Pillbox

A2.2 Gaussian

A2.3 Buie

A3. Combination of sunshape and slope error (NEW)

A3.1 Pillbox sunshape (4.65 mrad) + Normal slope error (2 mrad)

A3.2 Buie sunshape (CSR 0.02) + Normal slope error (2 mrad)

Parameter details please refer to the spread sheet.

(B) 2nd Round Model (same as the previous)

- Individual heliostat at four positions (P1-4) – see Figure 2 and 3
  - P1 (0, 46.5, 0)
  - P2 (0, 536.9, 0)
  - P3 (-324.3, 427.9, 0)
  - P4 (252.5, 118.1, 0)
- Two sun positions[1] (summer solstice, noon and morning)
  - **solar noon:** azimuth =180º, zenith =12º
  - **morning:** azimuth = 76º, zenith =68º

    azimuth: from North increasing towards to East (E of N)

    zenith: angle between solar vector and z axis (Figure 3)
- Combine sunshape and slope error together
  - normal slope error (2 mrad)
  - Pillbox (4.65 mrad) and Buie sunshape (CSR=0.02)

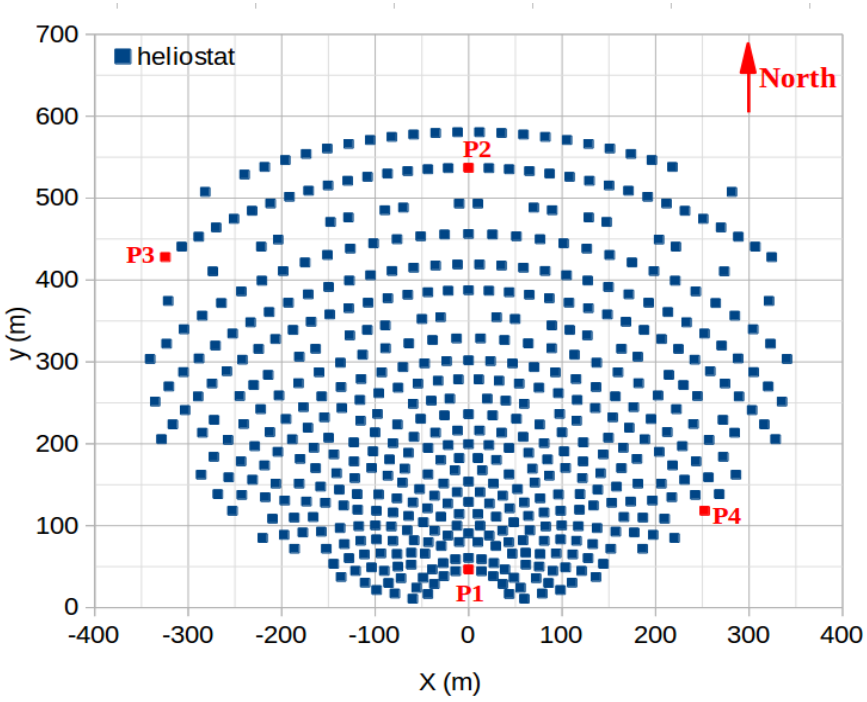

Figure 2: Selected heliostat positions

1 http://aa.usno.navy.mil/data/docs/AltAz.php

20 June, 2017, Barstow, CA (W116º56', N34º53')

- solar noon → azimuth =180º → (12:50) altitude=78.5º , zenith=90-altitude=11.5º
- sun rise → altitude =0º → (5:36)
  → morning (2h after sun rise: 7:36) → azimuth =76.2º , zenith=90-22.3=67.7º

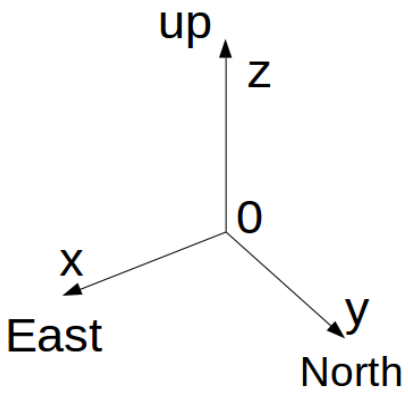

Figure 3: Coordinate definition in this study, where 0 is the center of tower bottom

B1. Pillbox sunshape (4.65 mrad) + Normal slope error (2 mrad)

B1.1 Solar noon	**B1.2 Morning**
B1.1.1 center front heliostat (P1)	B1.2.1 center front heliostat (P1)
B1.1.2 center back heliostat (P2)	B1.2.2 center back heliostat (P2)
B1.1.3 back left heliostat (P3)	B1.2.3 back left heliostat (P3)
B1.1.4 front right heliostat (P4)	B1.2.4 front right heliostat (P4)

B2. Buie sunshape (CSR 0.02) + Normal slope error (2 mrad)

B2.1 Solar noon	**B2.2 Morning**
B2.1.1 center front heliostat (P1)	B2.2.1 center front heliostat (P1)
B2.1.2 center back heliostat (P2)	B2.2.2 center back heliostat (P2)
B2.1.3 back left heliostat (P3)	B2.2.3 back left heliostat (P3)
B2.1.4 front right heliostat (P4)	B2.2.4 front right heliostat (P4)

Parameter details please refer to the spread sheet.

(C) 3rd Round Model (same as the previous)

Full field simulation with two sun positions, and surface properties applied here.

- Field information is presented in Figure 4.
- Sun position in the morning is presented in Figure 5.
- Parameter details please refer to the spread sheet.

C1. Pillbox sunshape (4.65 mrad) + Normal slope error (2 mrad)

C1.1 Solar noon

C1.2 Morning

C2. Buie sunshape (CSR 0.02) + Normal slope error (2 mrad)

C2.1 Solar noon

C2.2 Morning

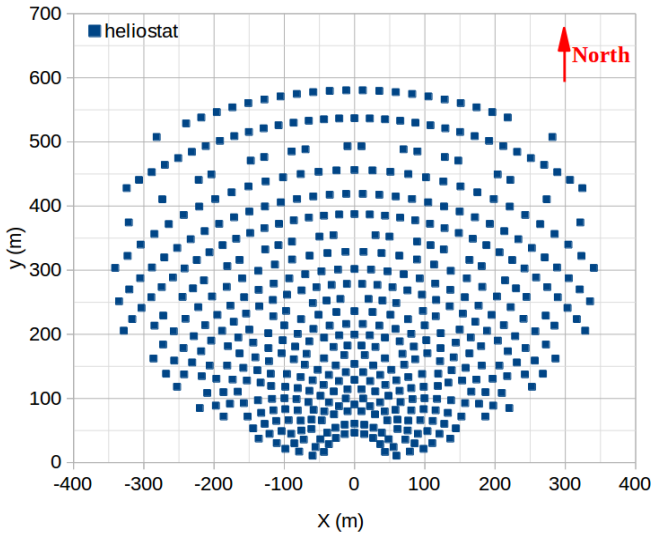

Figure 4: Heliostat field: 522 heliostats, 10x10m single facet mirror, ideally focused with no canting, 62m tower height, 30 MWth with 6 m height x8 m width billboard receiver

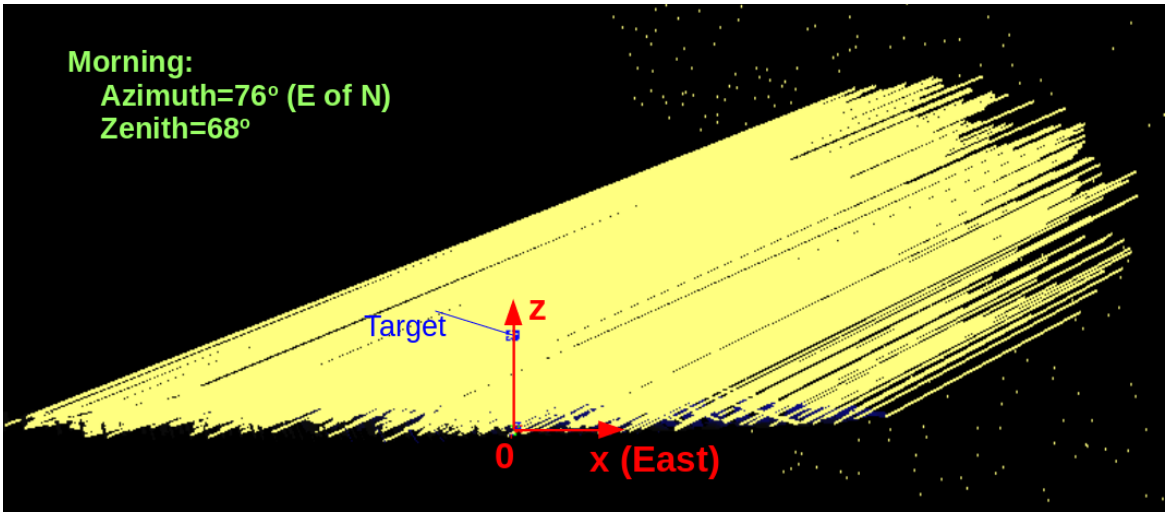

Figure 5: Sun position in the morning (2h after sun rise)