Angular Seed Orientation Tolerances for a Precision Corn Planter

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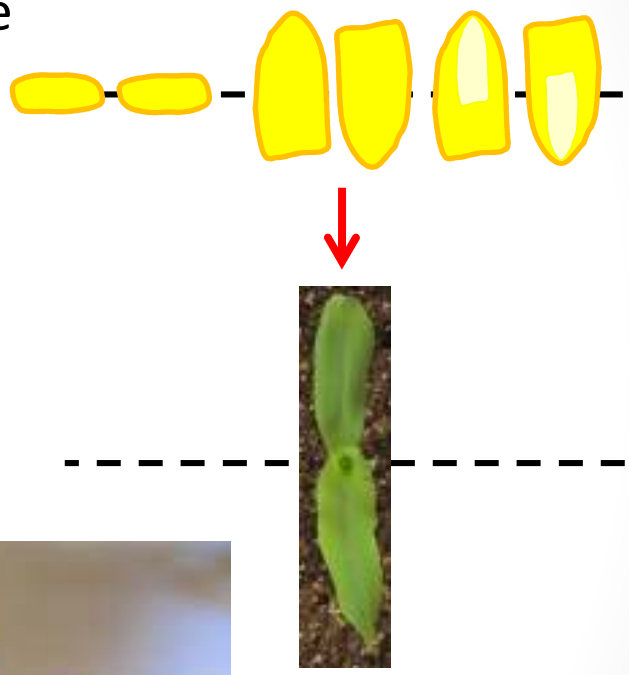
Why Seed Orientation?

- Oriented seed placement at planting influences **corn leaf azimuth***
- Prelim. data of plots with across-row leaves indicates better **light interception**, **higher yield****
- Across-row leaves may enable **by-plant management** (→GreenSeeker)
- Secondary effects may include reduced evaporation (faster canopy closure), enhanced weed repression

* Bowers & Hayden, 1972; Toler et al. , 1999; Torres et al., 2012
** Torres et al., planned 2012

Target Seed Orientation

- Caryopsis attachment point to the side
  - flat, embryo up
  - flat, embryo down
- upright (embryo left or right)
- 3-axis orientation problem



- "flats" want to lie flat!
  - Reduces 3-axis orientation problem to one axis

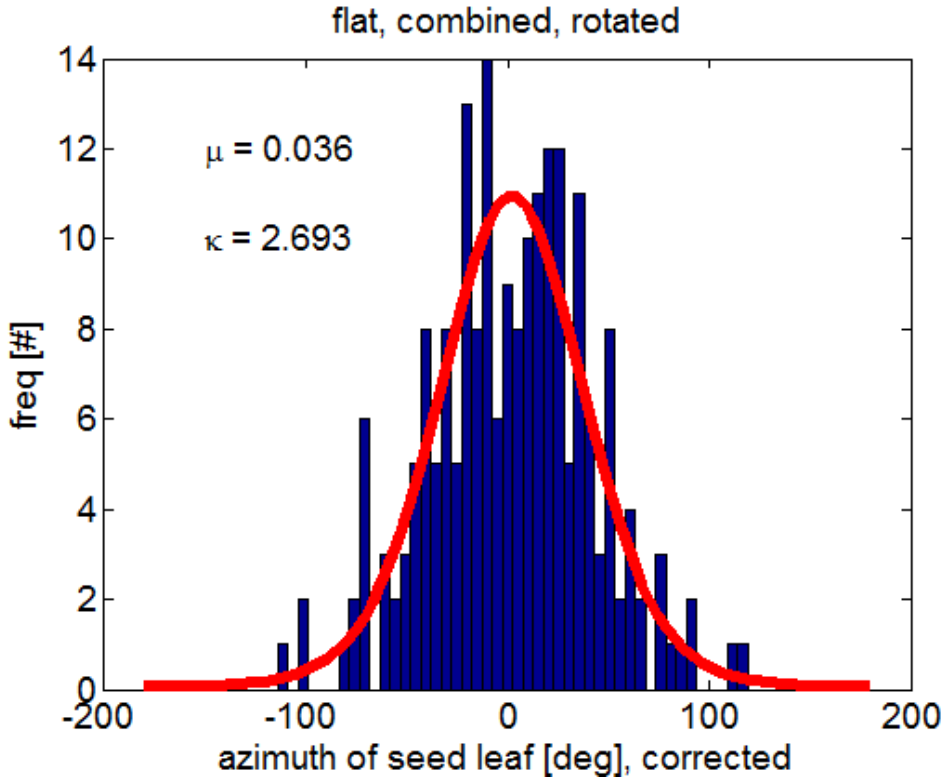
➔ Let's use "flats"

Seed-to-Leaf Correlation

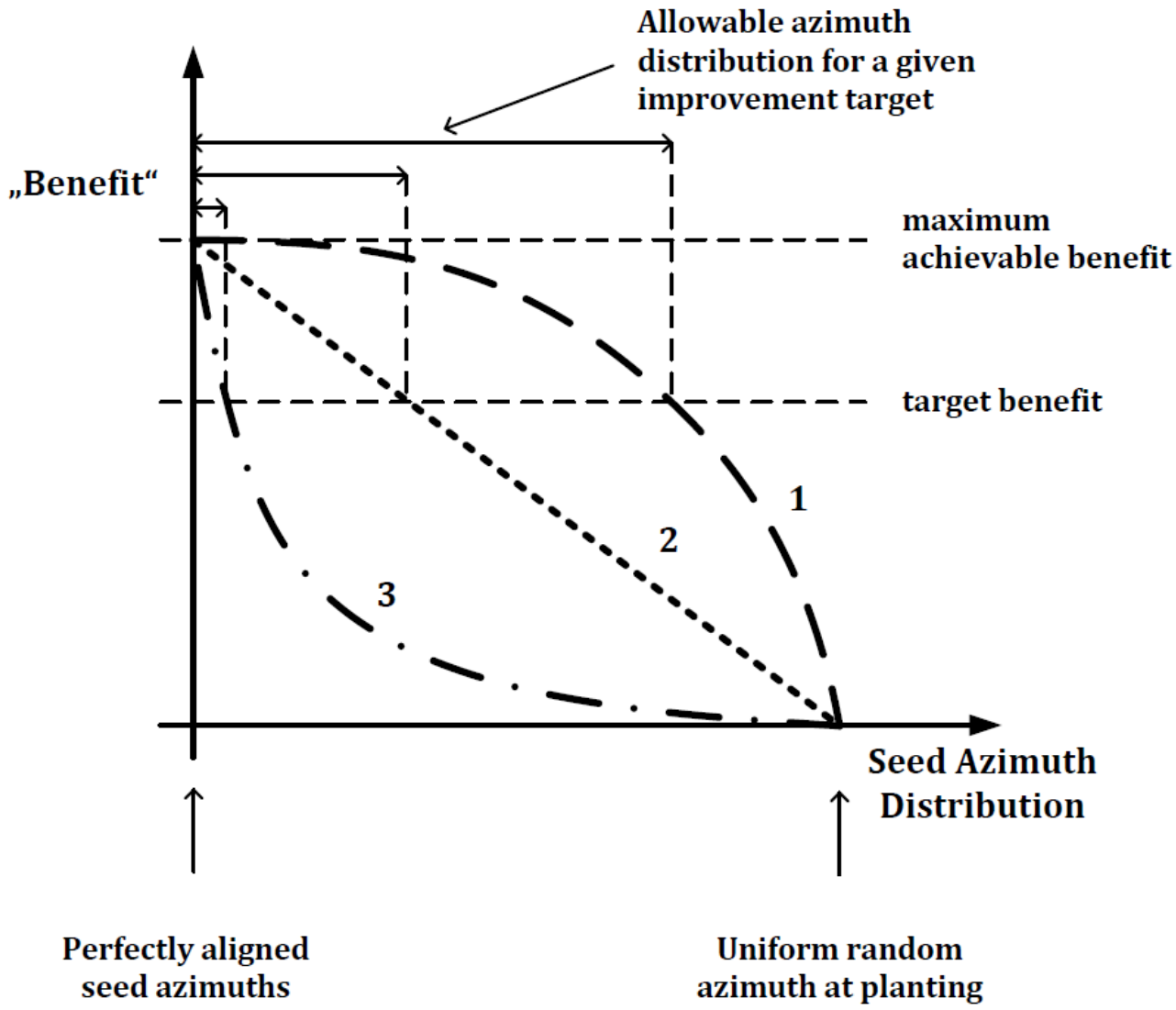
Model for Seed Leaf Orientation

- Hybrid DKC-6346RR2, combined ‘flat, embryo up’, ‘flat, embryo down’

$$f_{v.M.}(\theta; 0.036, 2.693) = \frac{e^{2.693\cos(\theta)}}{2\pi\, I_o(2.693)}$$

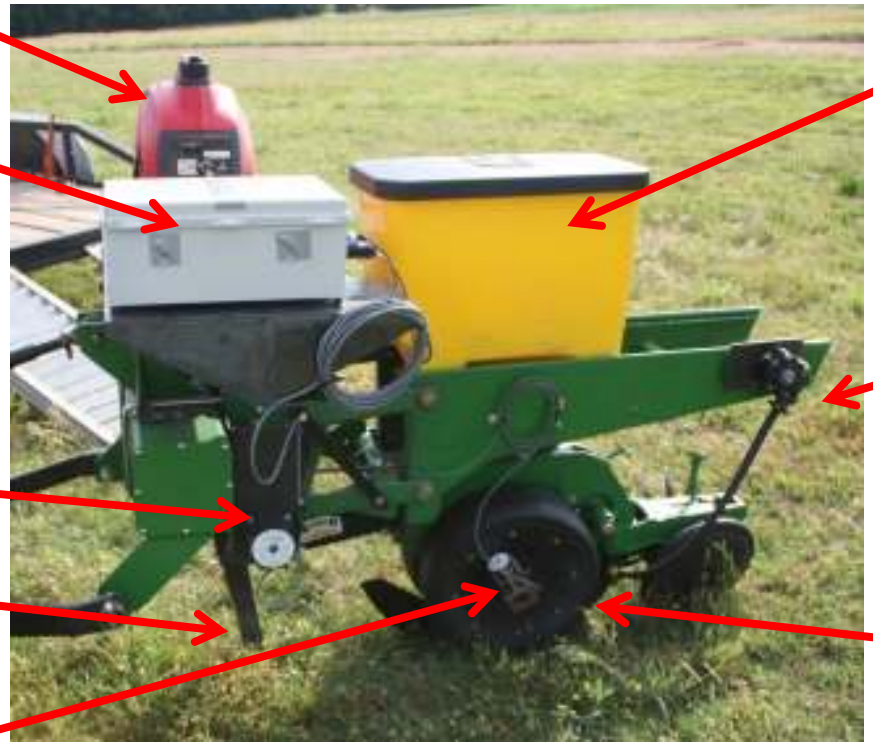


Accuracy Requirement?

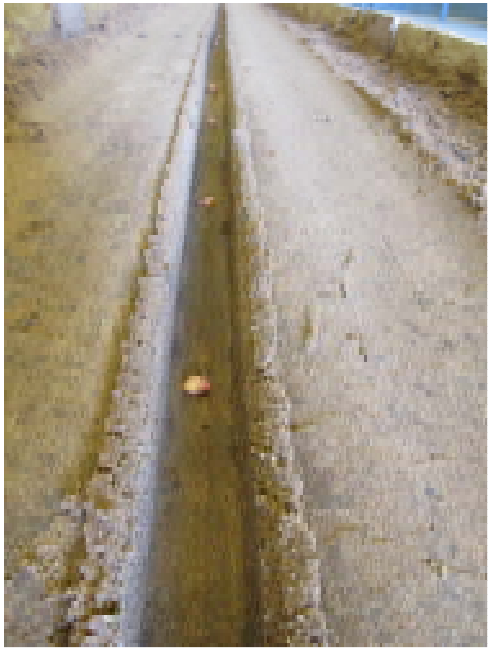


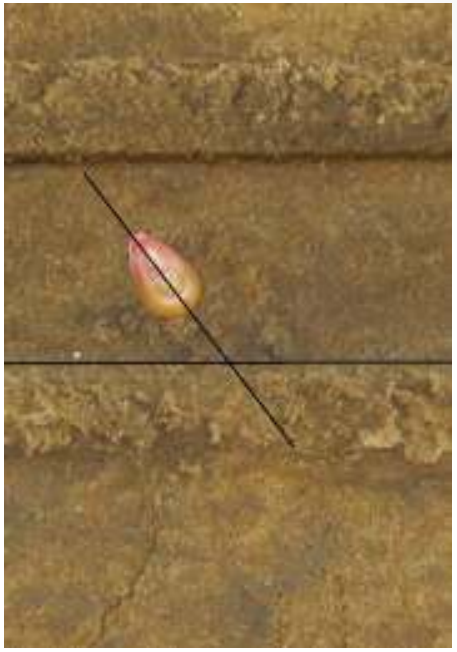
Planter Test Bed

- standard John Deere MaxEmerge row unit
- integrated orientation mechanism



Soil Bin Tests

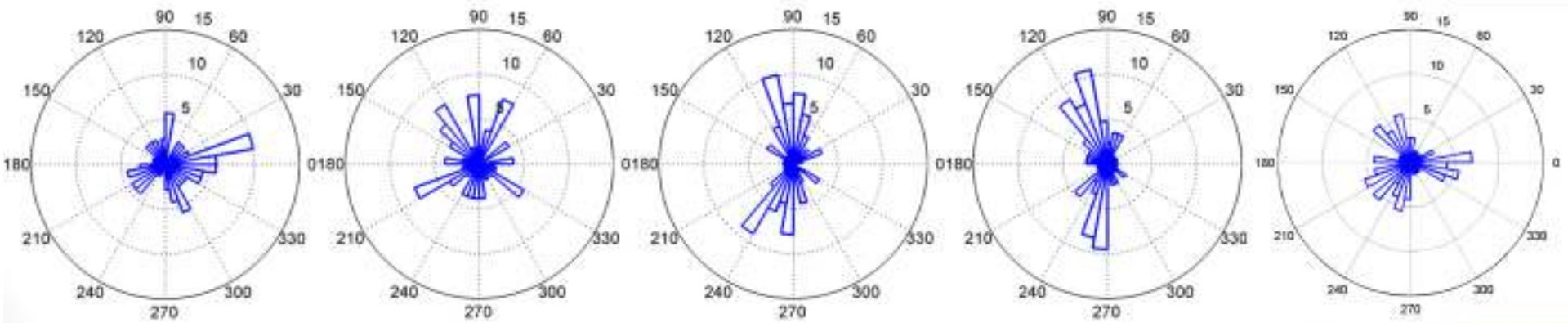




Orientation Performance

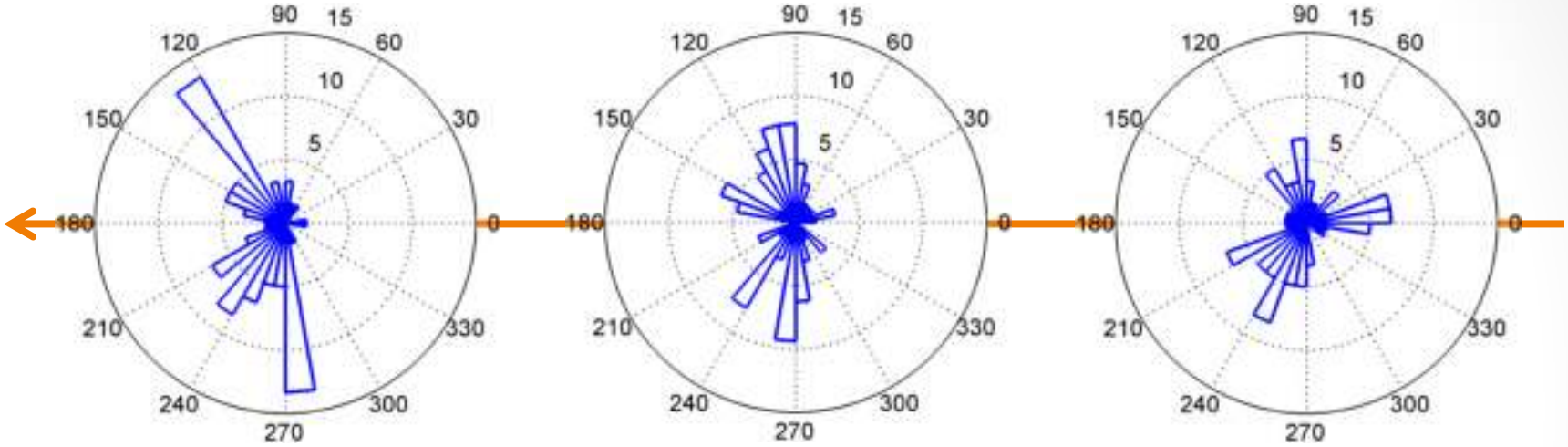
- release seeds as close to the ground as possible
  - cannot drop oriented seed 18" through seed tube
- relative velocity between seed and ground is a challenge
  - match ground speed?

planting directing



0.6 GS | 0.8 GS | 1.0 GS | 1.2 GS | 1.4 GS

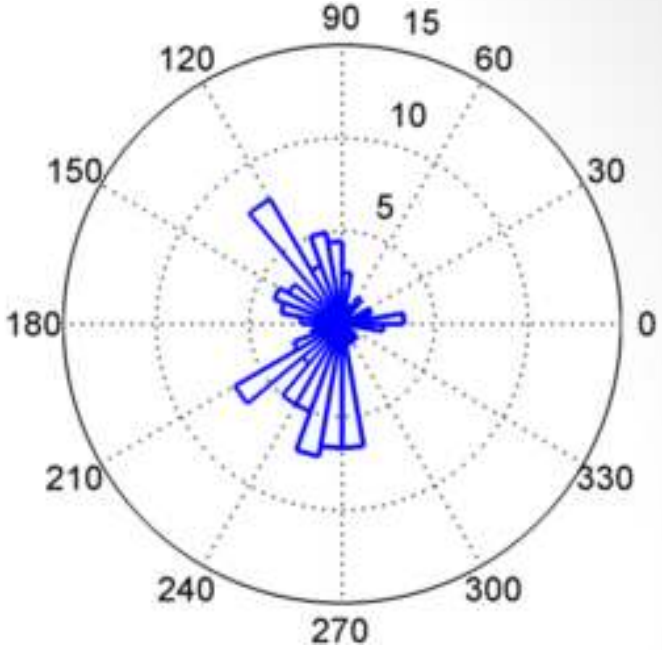
Hybrid Dependence

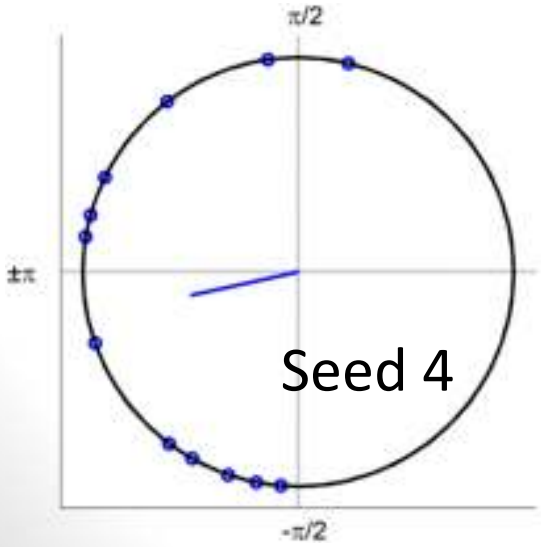


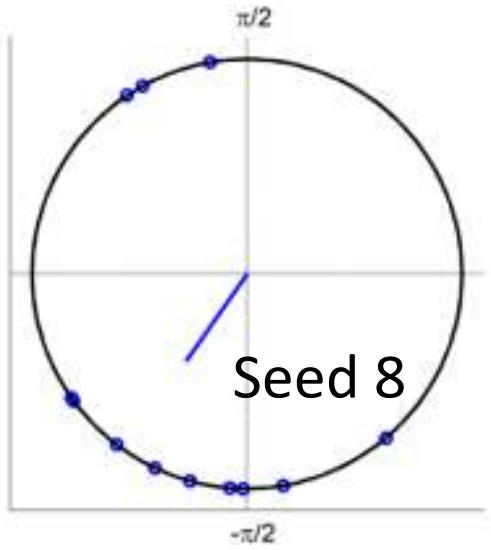
- Performance dependent on seed shape (hybrid, grading)

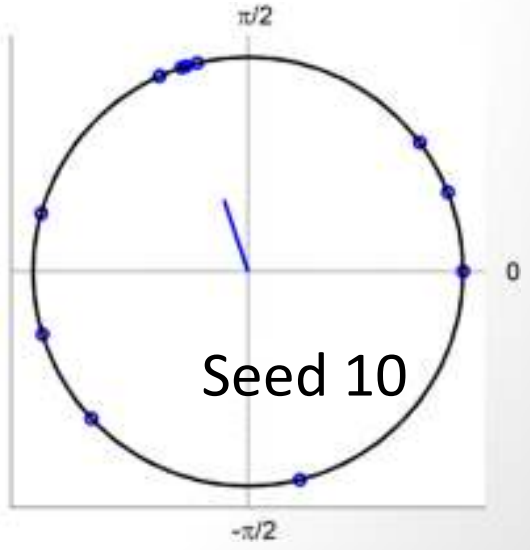
Repeatability

12 runs, 1.2GS
all seeds, all runs



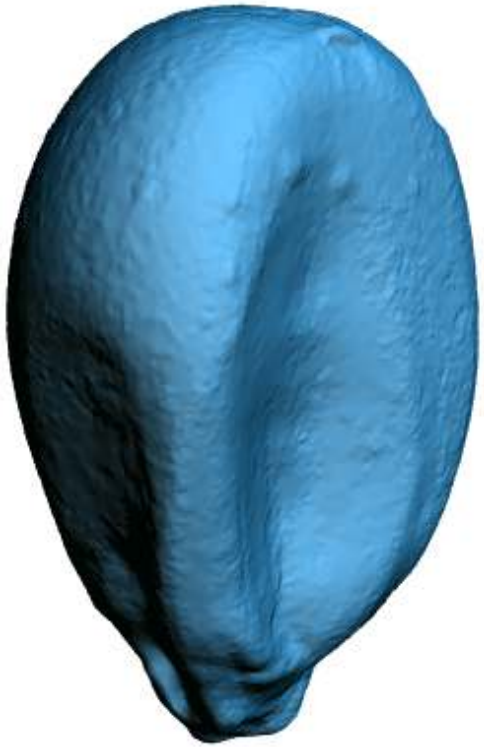






Future Work

- examine 3D laser sans of seeds for features that explain orientation performance
- develop orientation model
- correlate measured orientation results with predicted orientation



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Field Testing

Collection of Field Data