



NIST 3D Imaging Facility: An Update

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NIST 3D Imaging Workshops (1)

- **Workshops in 2003 and 2005**
- **Objectives:**
 - to provide a forum for sharing and discussing efforts in evaluation of 3D imaging systems
 - to determine the needs of the 3D imaging community
- **General consensus:**
 - neutral facility for performance evaluation
 - need for some form of standardization
 - Terminology
 - Standard evaluation protocols



3D Imaging System Performance Evaluation Facility

Why:

- A national performance evaluation facility will provide much needed means to independently evaluate performance of 3D imaging systems – a capability that does not currently exist
- Standard protocols will allow
 - Fair comparisons of instruments
 - Method to verify manufacturer's claims
- Provide the basis for secondary field calibration standards



Facility (1)

- **Purpose of facility**
 - Performance evaluation
 - Test bed for developing evaluation metrics and test protocols
- **Types of facility**
 - **Small indoor facility**
 - Evaluate short range, very accurate instruments
 - Artifact based
 - **Medium range facility**
 - Allows for longer range (~ 50 m) evaluations
 - Rail system for positioning target
 - **Outdoor facility**
 - Long range evaluations
 - Evaluation in
 - Field conditions
 - Varying environment and seasons
 - Permanent benchmarks



Indoor Artifact-Based Facility (1)

- **Facility**
 - 17 m (L) x 5 m (W)
- **Environment**
 - Not temperature controlled but monitored. Temperature $\sim 20.0\text{ }^{\circ}\text{C} \pm 0.2\text{ }^{\circ}\text{C}$
 - Humidity is monitored





Indoor Artifact-Based Facility (2)

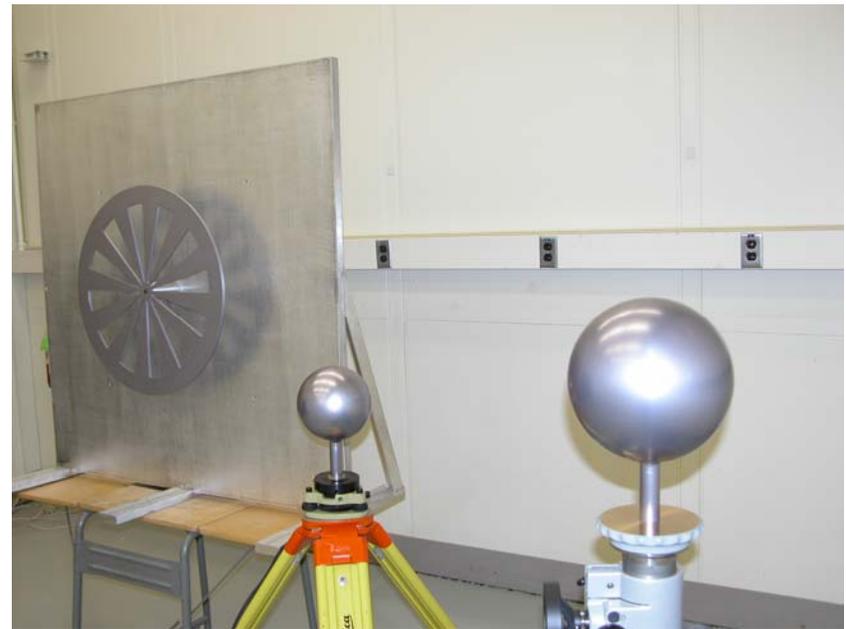
- **Hardware**
 - 4 – 3D imaging systems
 - Rotation stage
 - 1000 lbs capacity
 - 1.6 second incremental move
- **Targets**
 - 18" x 18": Multi – Step
 - ~12%, ~25%, ~50%, ~98%
 - 24" x 24":
 - ~2%
 - ~22%
 - ~45%,
 - ~75%
 - ~99%
 - 1 m x 1 m: ~98%





Indoor Artifact-Based Facility (3)

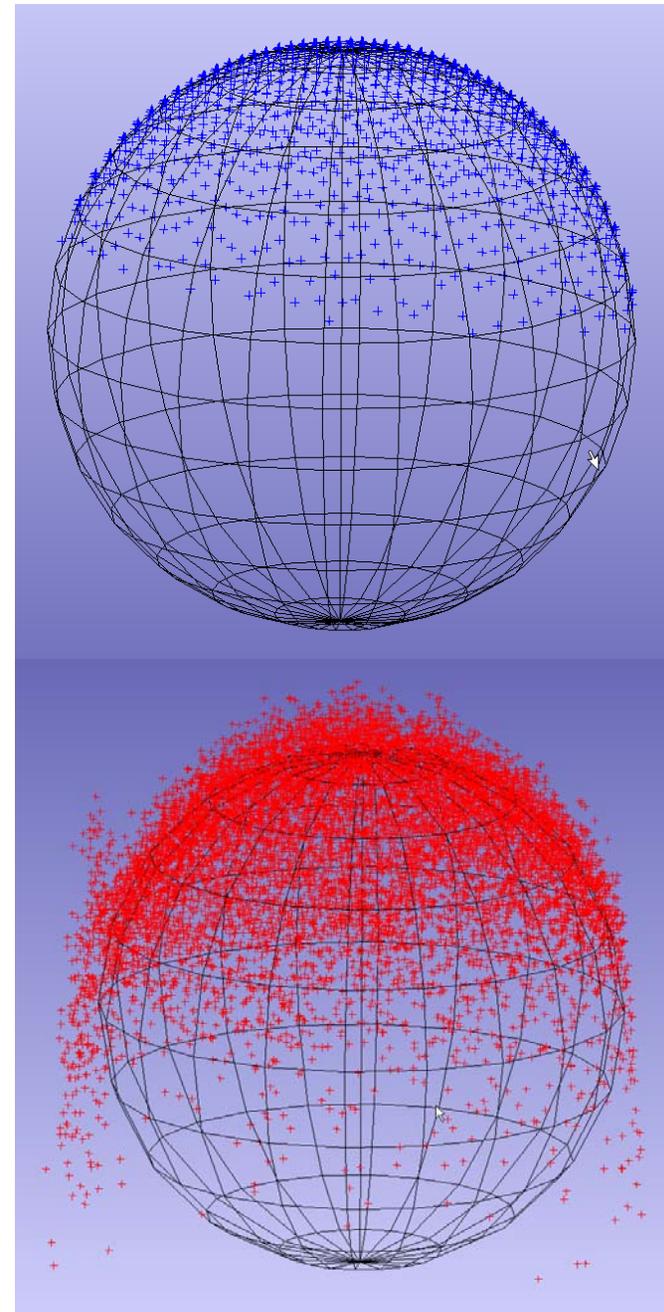
- **Prototype artifacts**
 - 6" and 8" diameter spheres
 - Slotted disc
 - Stair
 - Ball bar





Artifact: 8 in. Sphere

- Anodized aluminum
- Registration
- Evaluate fitting algorithms

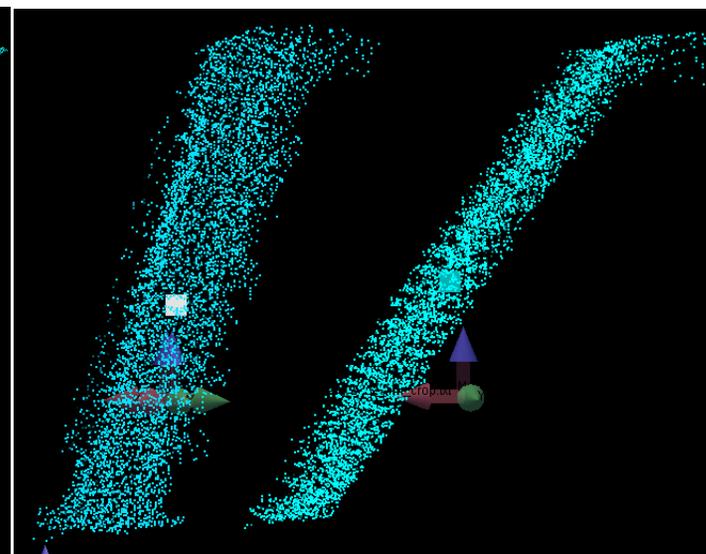
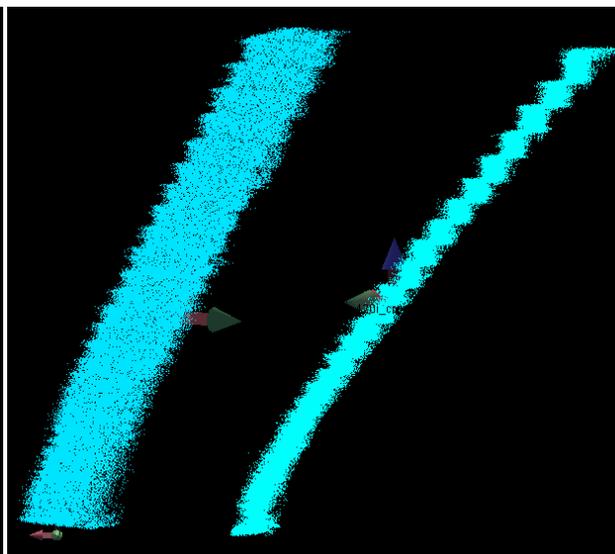
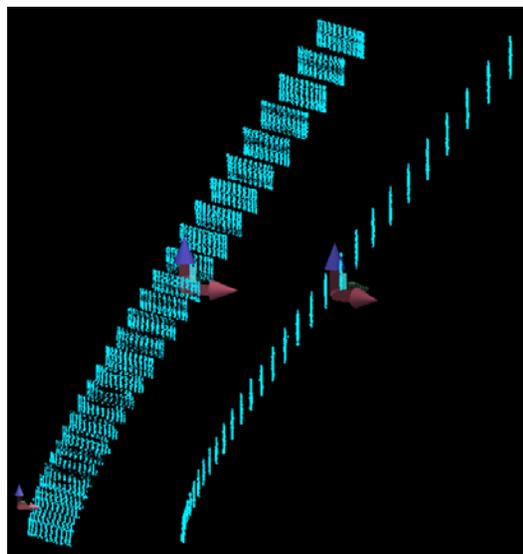




Artifact: Stair



- Aluminum
- Step height 1 mm difference
- Resolution

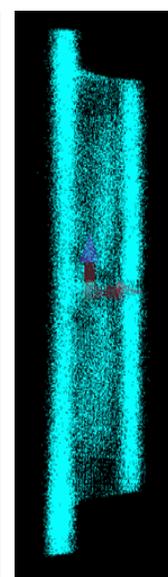
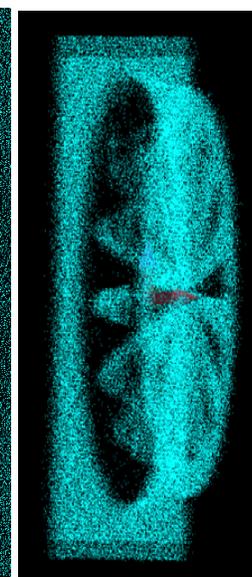
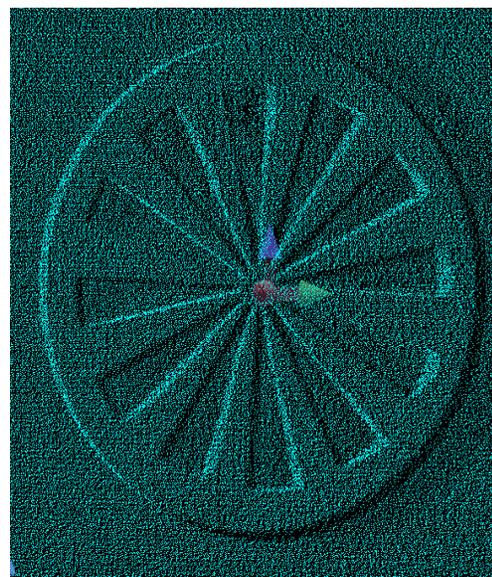
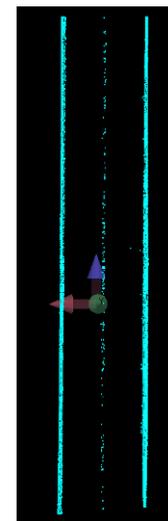
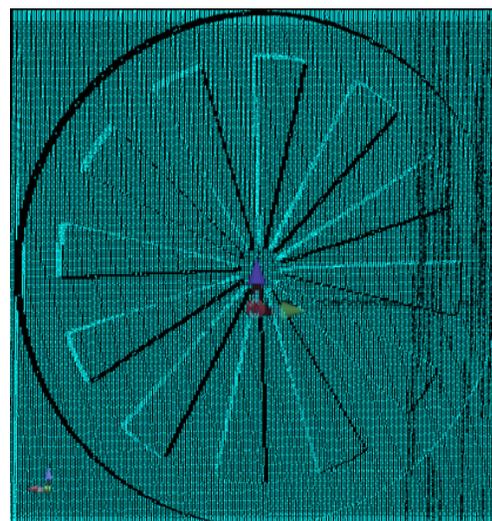




Artifact: Slotted Disc

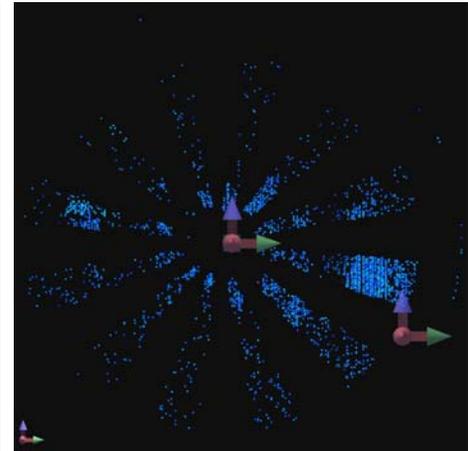
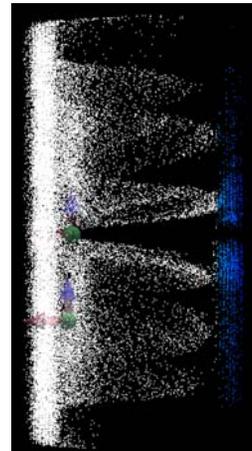
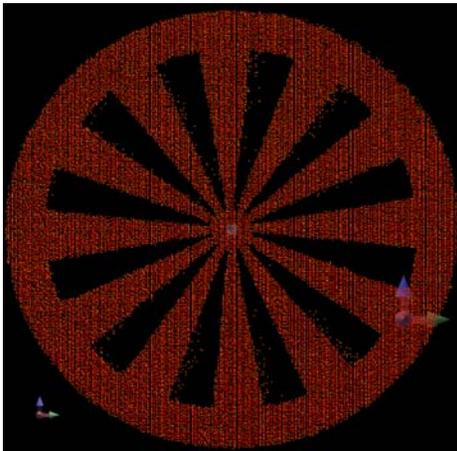
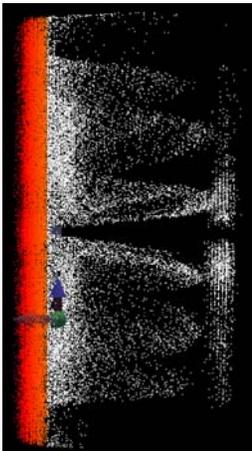
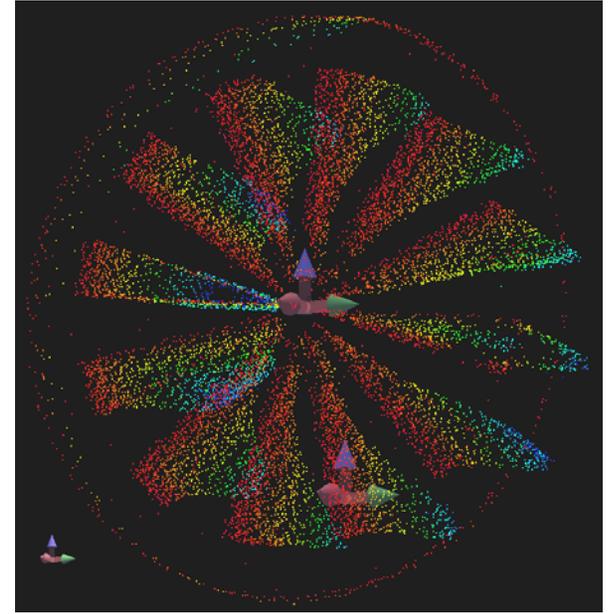
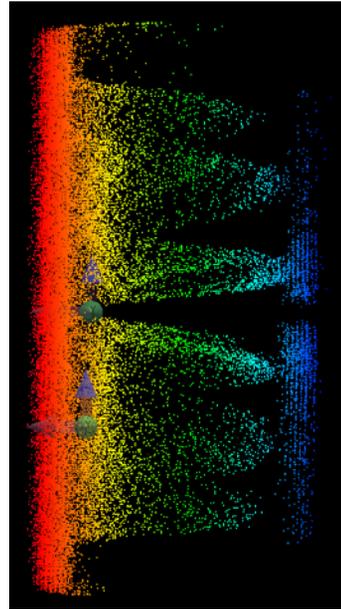
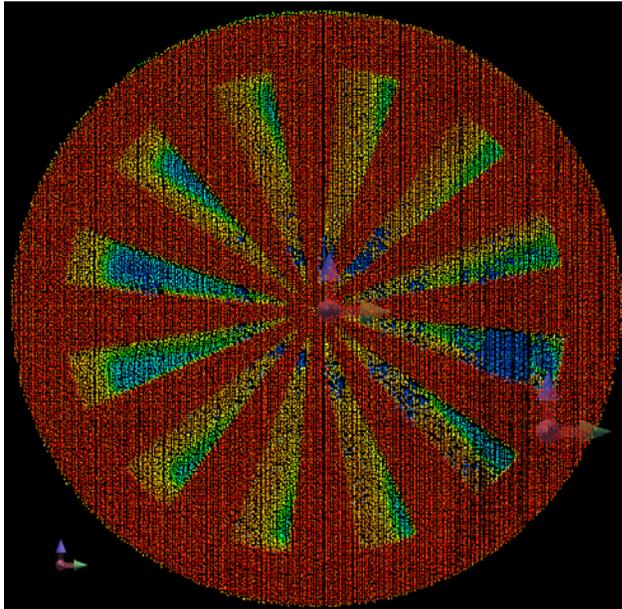


- Disc anodized aluminum
- Resolution
- Vary slot angles 0° to 15°
- Vary distance betw'n disc and back plane



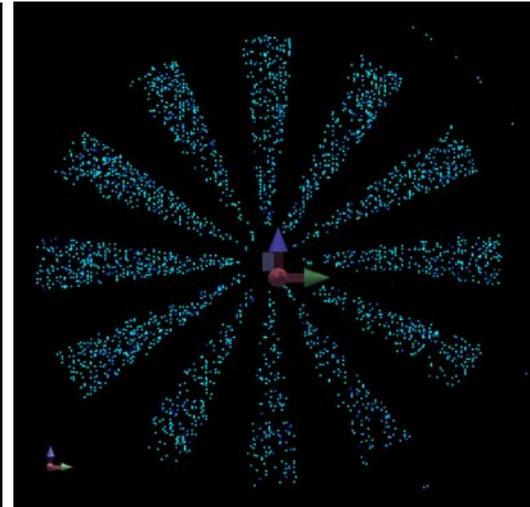
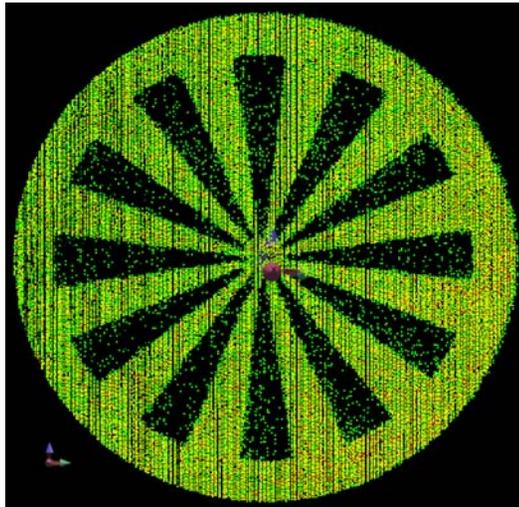
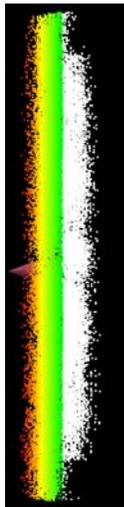
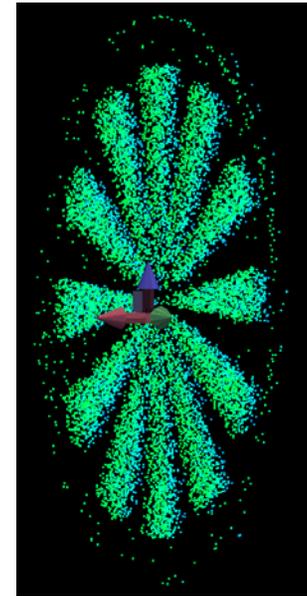
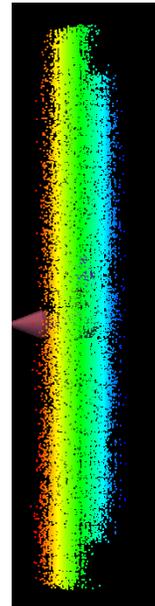
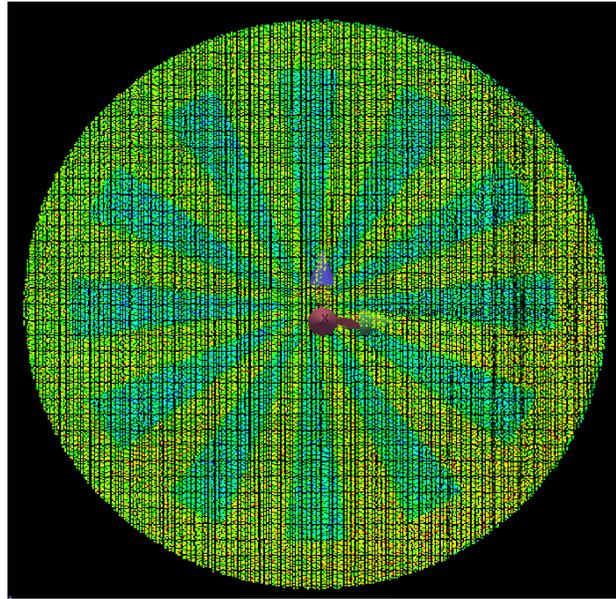


Fan: 14 m, 0.01 deg, 10 in back plane



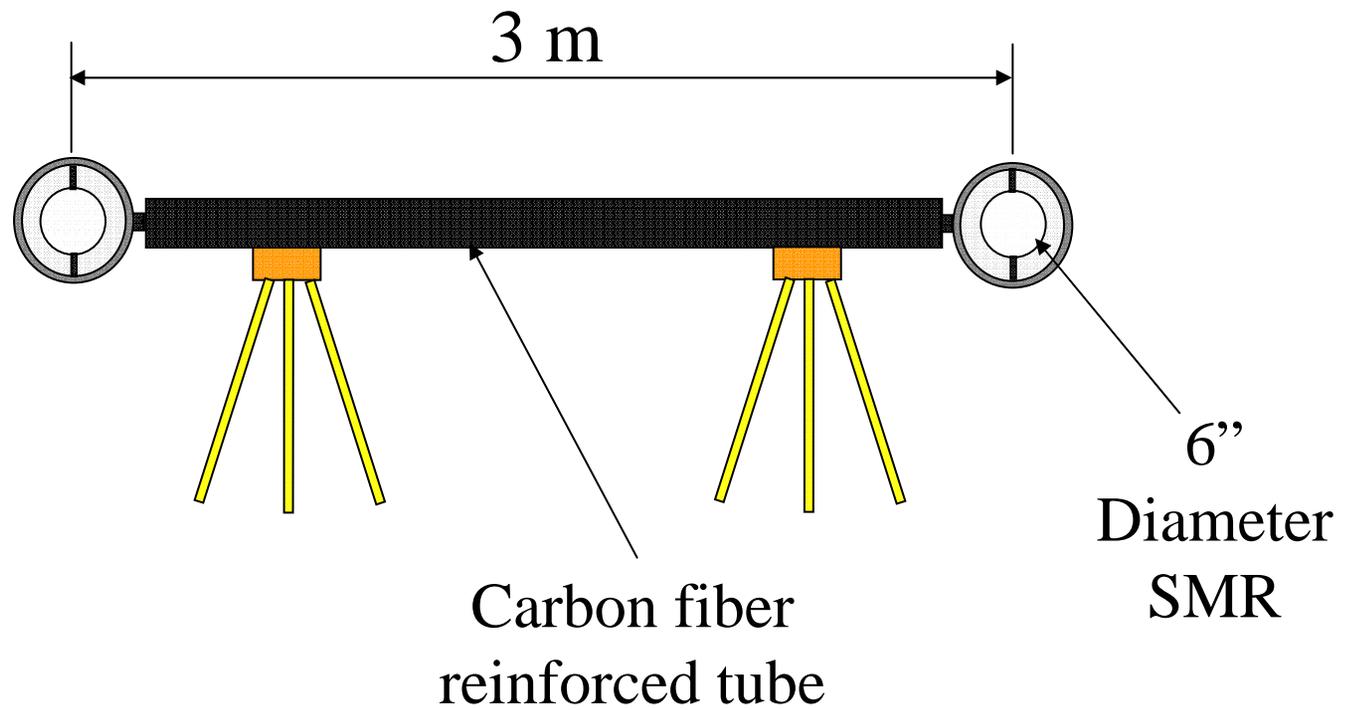


Fan: 14 m, 0.01 deg, 1 in back plane



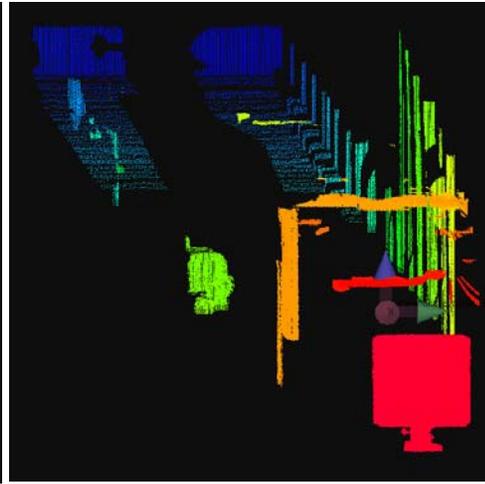
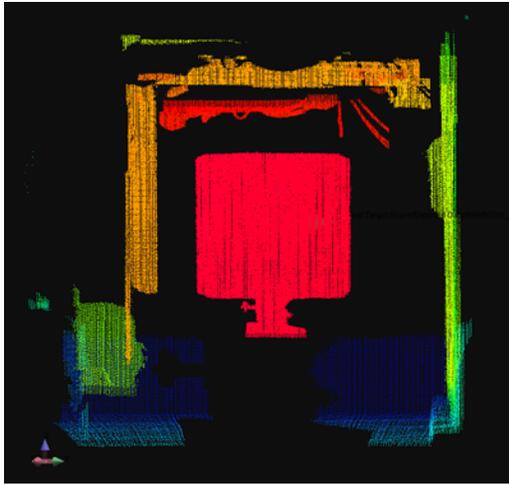


Ball Bar



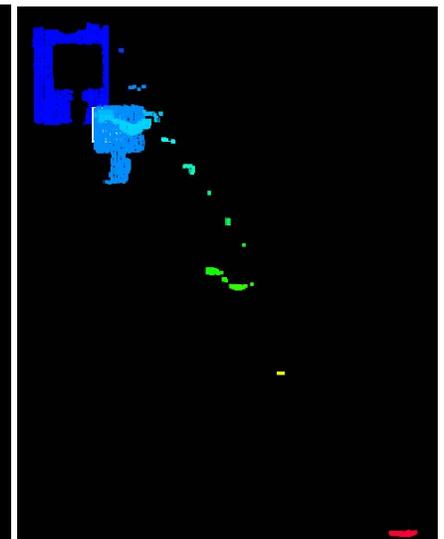
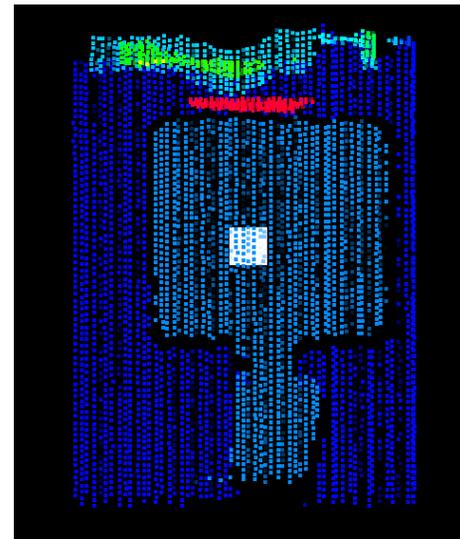


Ranging Protocol (1) - Initial Data Filtering



30 m

100 m

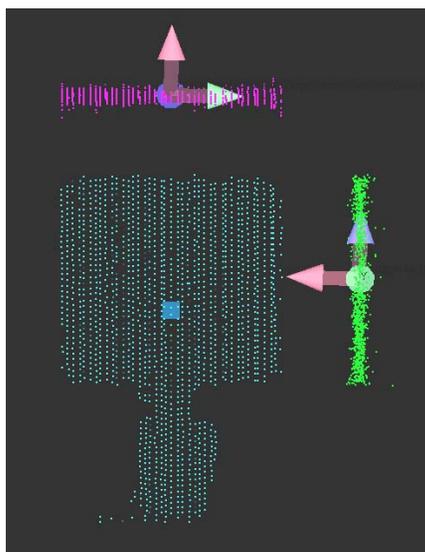




Ranging Protocol (1)

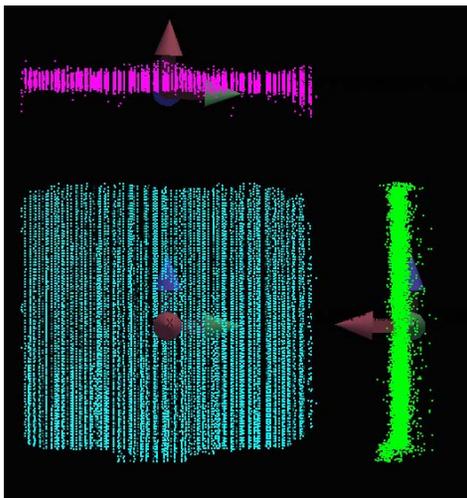
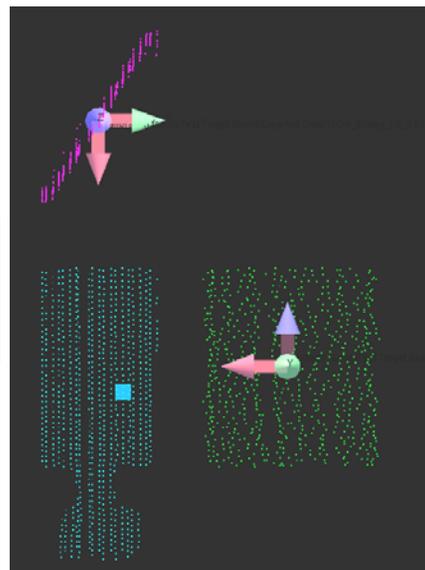
Distance = 100 m

Target reflectivity = 99 %



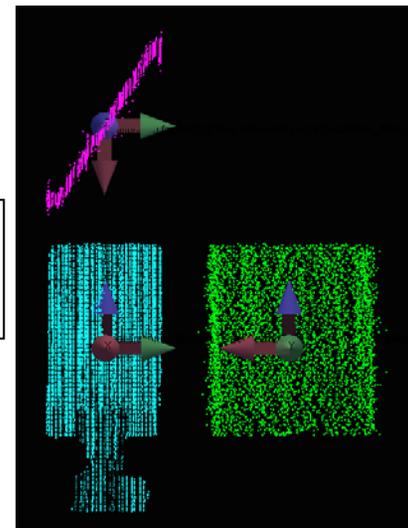
Rotation: 0°
Ang. incr.: 0.01°
No. pts: 1,800

Rotation: 60°
Ang. incr.: 0.01°
No. pts: 800



Rotation: 0°
Ang. incr.: 0.004°
No. pts: 11,000

Rotation: 60°
Ang. incr.: 0.004°
No. pts: 5,500

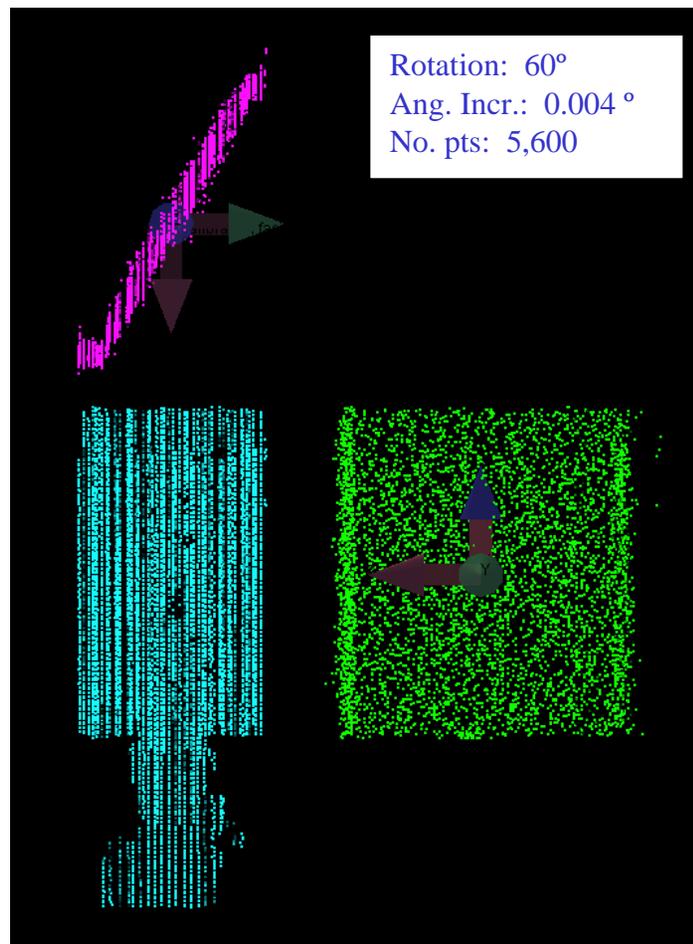
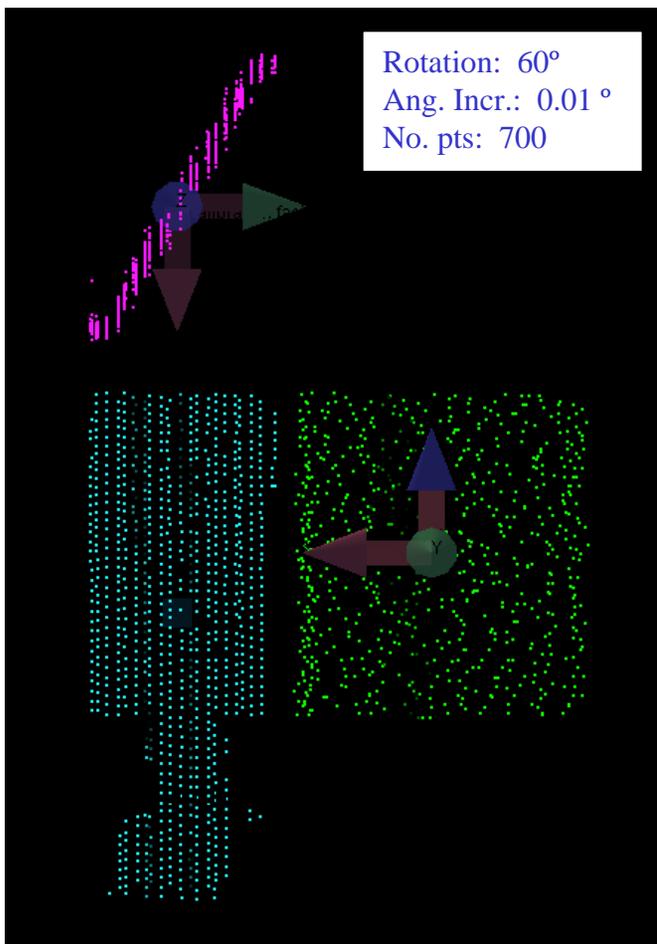




Ranging Protocol (2)

Distance = 100 m

Target reflectivity = 2 %





Future Tasks

- **Test the ranging protocol**
- **Conduct experiments to determine registration uncertainty**
 - Experiments using 6” SMRs and “box”
 - Test sphere fitting algorithm
- **Conduct experiments using the slotted disc and stair artifacts**
- **Acquire linear stage for resolution**
- **Determine benchmarks for outdoor facility**