Investigation on Laser Scanners

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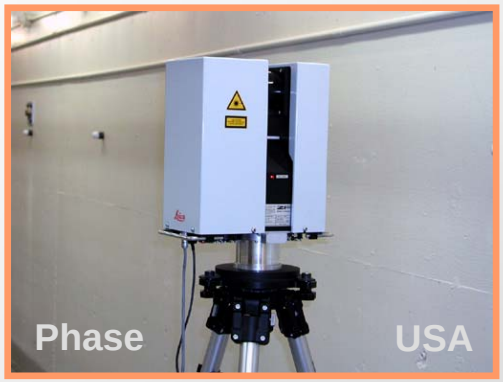
Overview

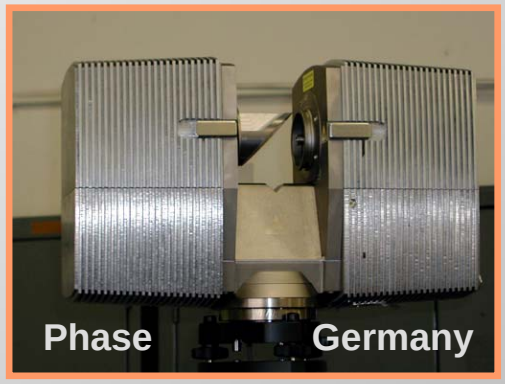
- SLAC's Metrology Department will expand its scope by purchasing a laser scanner
- Department needs are defined
- Vendors invited to SLAC to demonstrate their scanner and perform three field tests:
  - **Tunnel Test**
  - **Building Test**
  - **Accuracy and Resolution Test**

The Vendors

HDS4500
Leica Geosystems HDS



iQsun880
iQvolution



GS200
Trimble / Mensi

Imager 5003
Zoller+Fröhlich

Applications

- Geometrical record of a tunnel or similar area for retro-fitting work
  - **Full 3D “map” of area**
  - **Rapid survey (e.g., radiation or other time-limits)**
  - **Easily converted into CAD drawings**
- As-built surveys of SLAC buildings for Geographic Information System (GIS)

“ Wish We Had a Laser Scanner ! ”

- New LCLS (*Linac Coherent Light Source*) injector
- Existing tunnel
- As-built survey with total station was slow and had very limited coverage

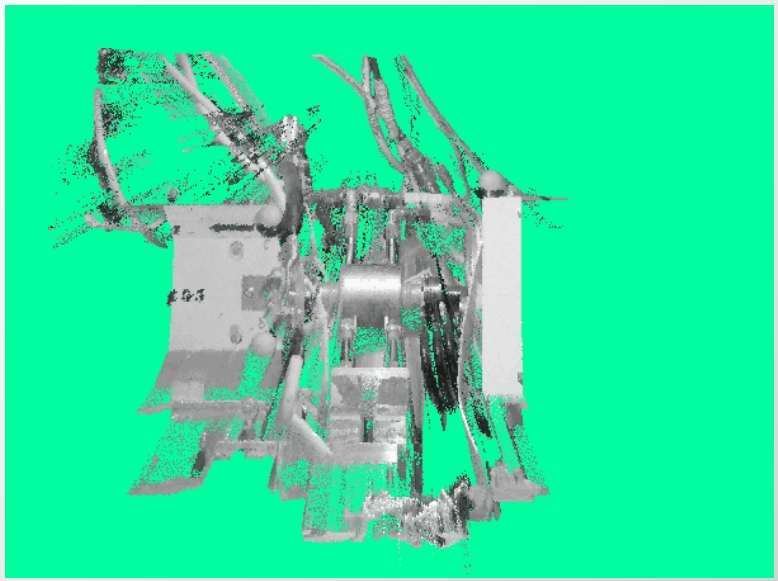
Scanner Requirements

- The scanner should have an optimal range of up to 50 m for large structures including buildings or long tunnel sections
- The minimum range of 1 m or less to capture regions that are close to the laser scanner such as accelerator magnets in a narrow tunnel
- User selectable scan density so that only regions of special interest need the highest resolution, saving time and disk space
- The resolution < 350 µrad
- Minimum accuracy of better than 5 mm at a 50 m range
- Measure minimum of 5000 points every second; significantly larger rate desired
- The field of view of 360º horizontal and at least 60º vertical; full panoramic view desired

Test 1: Tunnel Test

- Laser scan of shut down SLC tunnel including 1.5 inch (3.81 cm) spherical SLAC monuments

Test 1: Sample Results

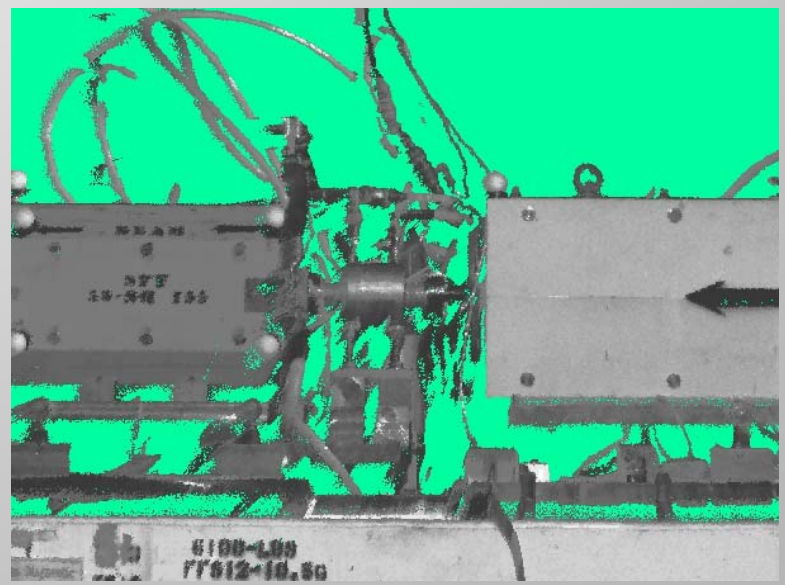


iQsun880

- note noise in image

Imager 5003

- Image is clear and noise is minimal



Test 2: Building Test

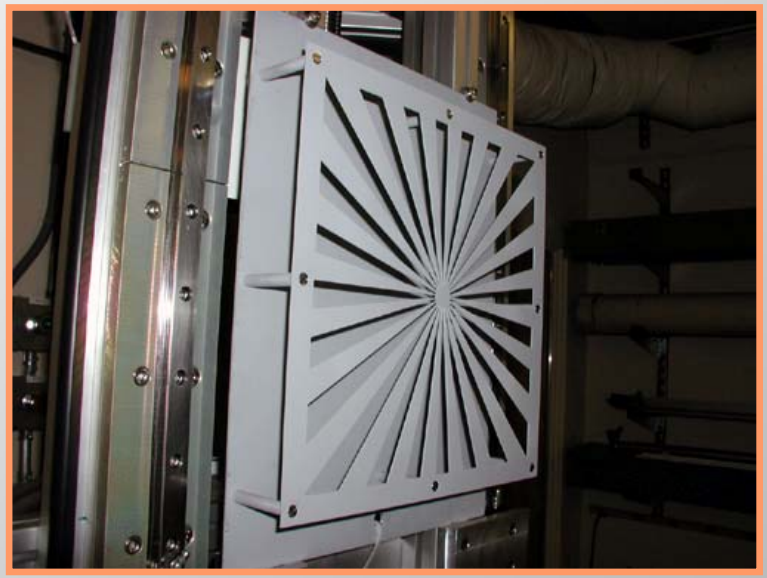
- Testing ability of laser scanner to capture building floor plan

Test 3a: Accuracy

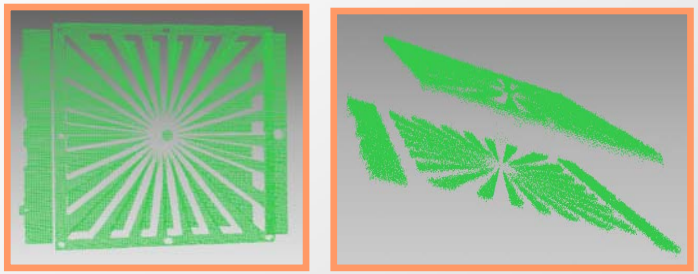
- Testing for distance and angle accuracy
  - **Horizontal and vertical measurements of standard SLAC monuments**
  - **Distance between points checked against laser *tracker***

Test 3b: Resolution

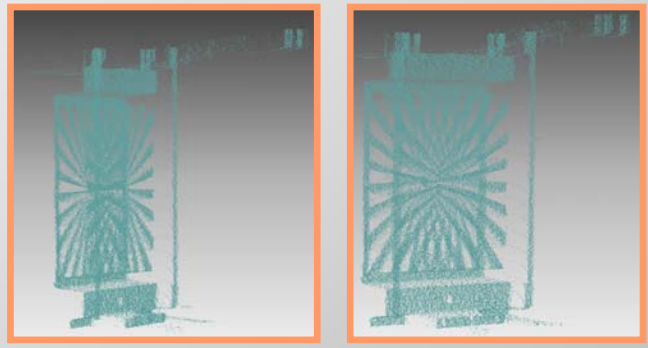
- Use Boehler's Box to test resolution
  - **Narrow slits cause false points between the planes**
  - **Less noise between the plates means higher resolution**



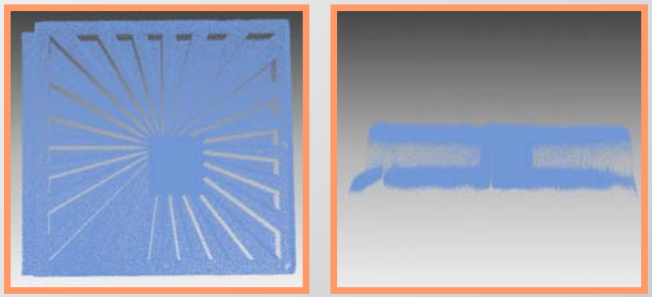
Test 3b: Results



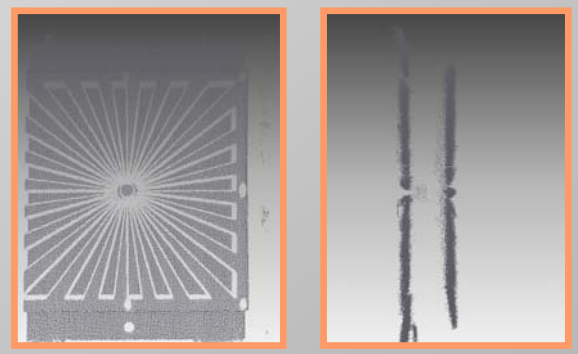
HDS 4500



iQsun 880

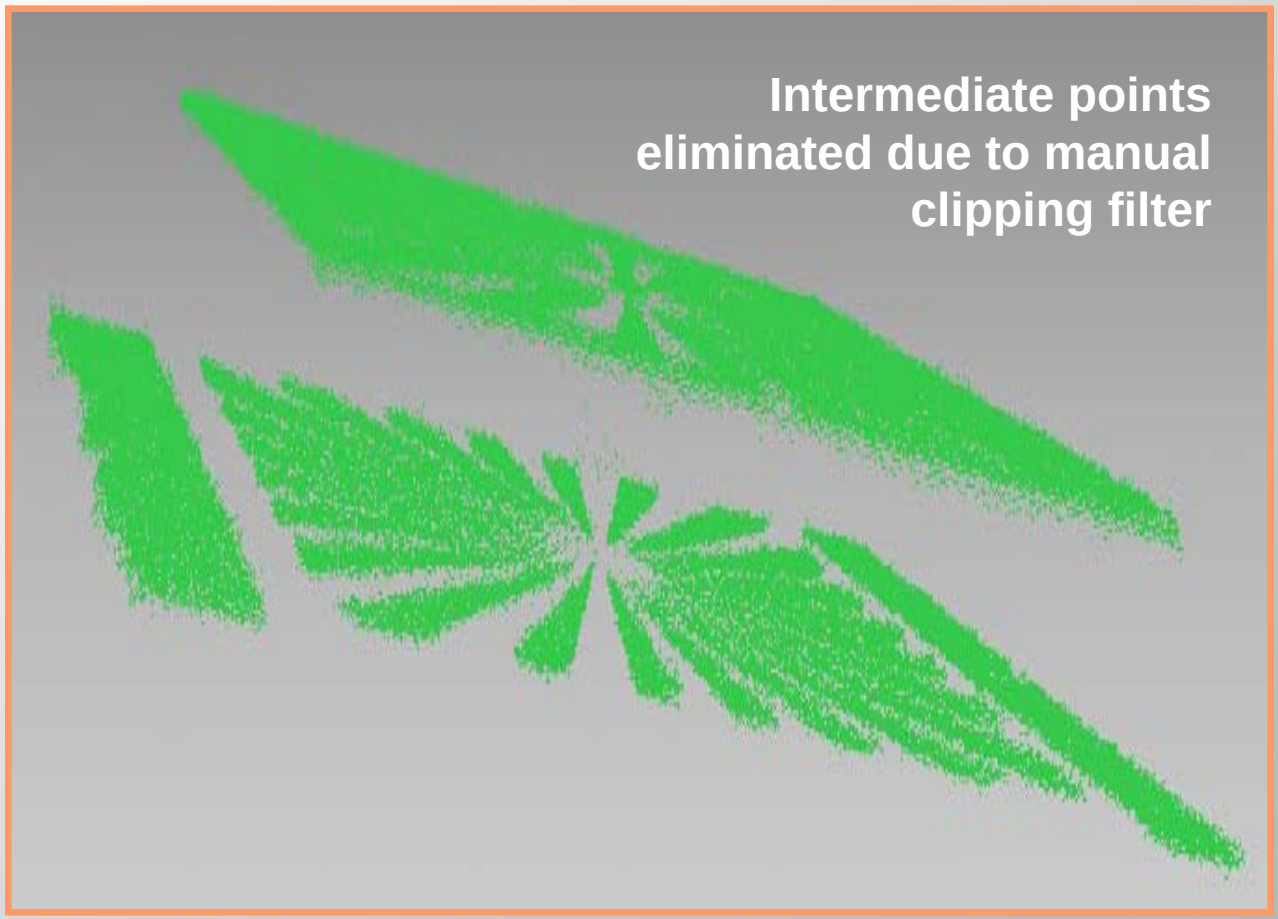


GS 200

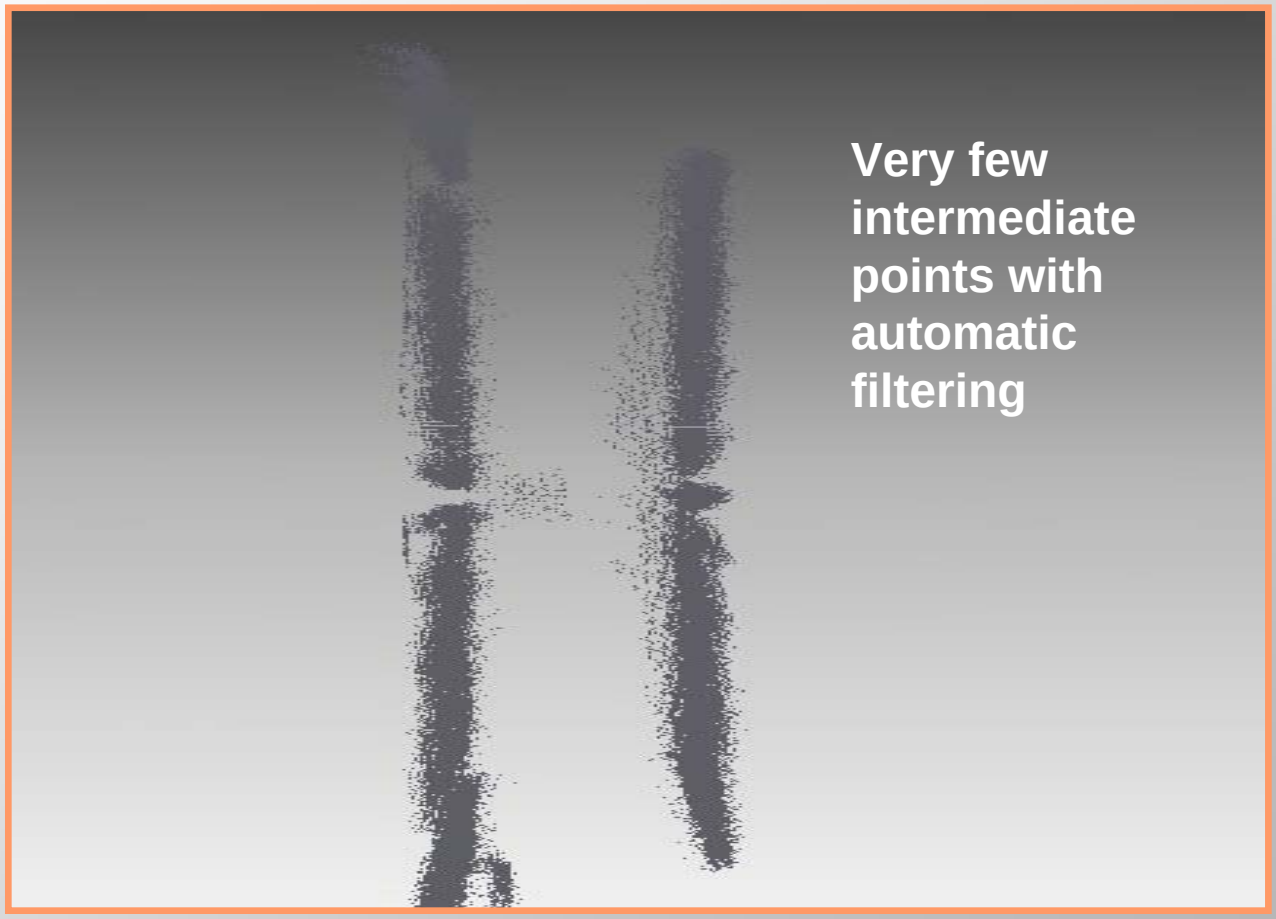


Imager 5003

Leica's HDS 4500



Z+F's Imager 5003

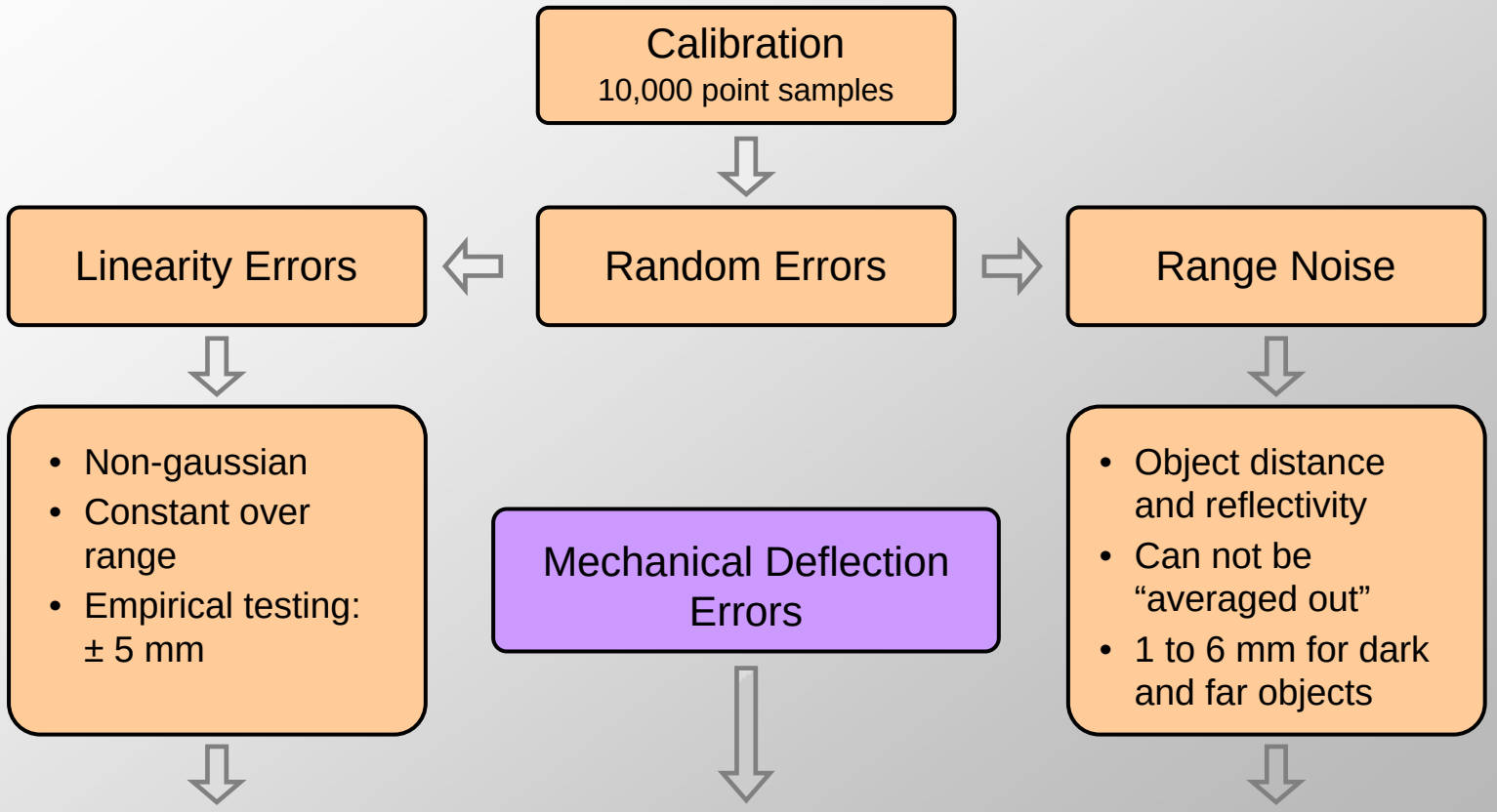


Very few intermediate points with automatic filtering

The Selection

- Zoller+Fröhlich's Imager 5003
  - **Meets SLAC's specifications**
  - **Open to future hardware upgrades**
- Decision weighting:
  - **Accuracy (15%)**
  - **Data acquisition speed (15%)**
  - **Price (15%)**
    - **Initial Acquisition**
    - **Hardware Upgrades**
  - **Customer References (15%)**
  - **Field evaluation results (40%)**
    - **Software**
    - **Test 1: Tunnel Test**
    - **Test 2: Building Test**
    - **Test 3: Accuracy Test**

Imager 5003 Ranging Errors



Distance (m)	50	30	20	10	Practical (registered)	SLAC Testing
Abs. Error (mm rms)	25.2	15.7	11.1	7.0	~ 3 mm (Z+F)	~ 0.6 to 1.3 mm

“I Scan, You Scan”

- Should receive the scanner in a few months
- Training for field personnel in January
- Another practical instrument in our toolbox
- For further details see our lovely IWAA2004 poster “*Laser Scanner Demonstration*”