Connecting CMM Survey Data with Photogrammetry for CMS FPIXEL Alignment for Pilot Run

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Thanks to:

J. Greenwood, B. Gobbi, M. Roman

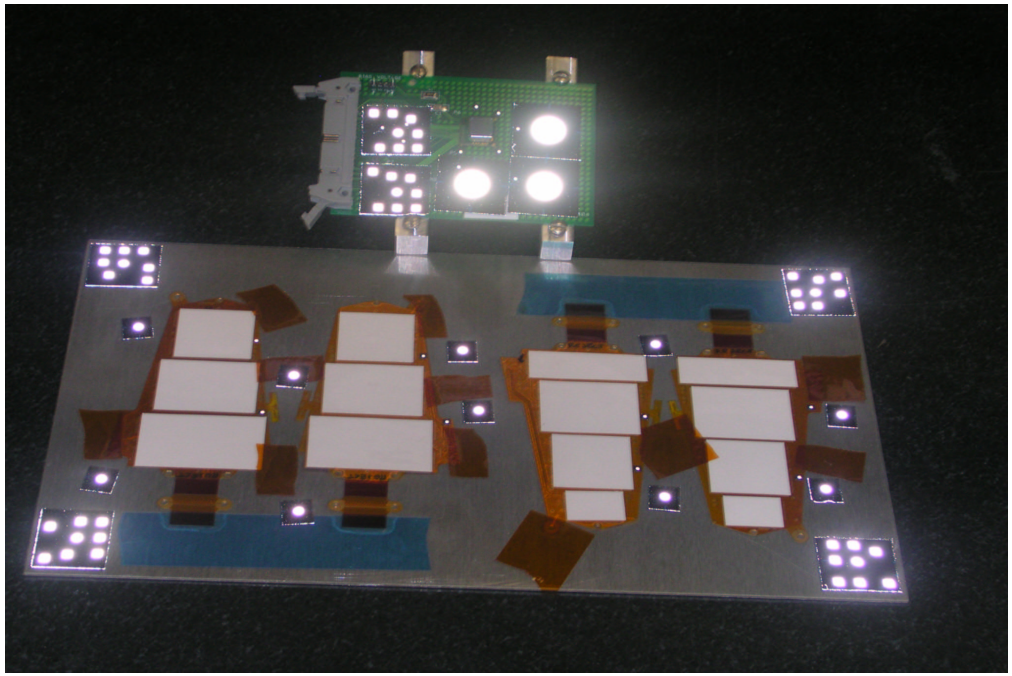
Connecting CMM measurements with Photogrammetry

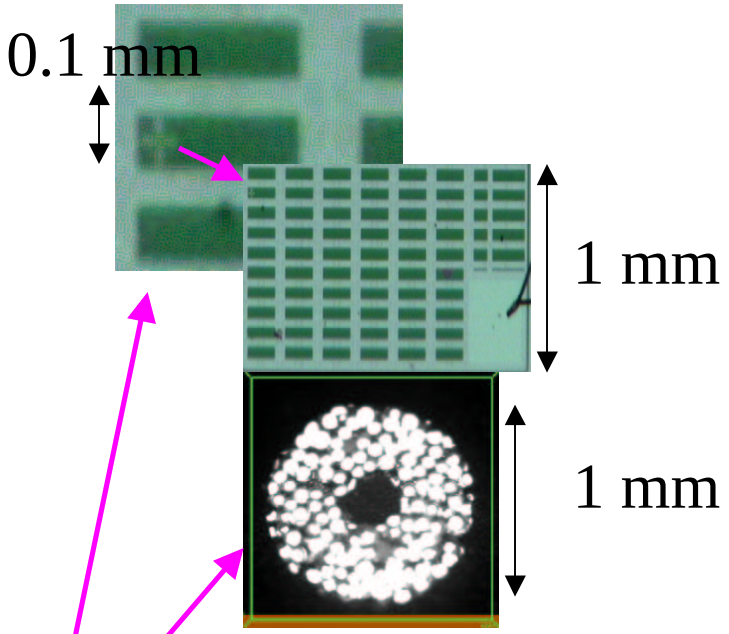
- We use **CMM** (OGP and Brown and Sharpe) with optical and touch probes to measure relative locations of silicon sensors on the panels and disks with accuracy ~1 –5 microns over dimensions of ~30 cm
- Survey of the assembly of the disks in the service cylinder of ~ 2 m long requires **a special big CMM**. Required accuracy is ~25 microns. Such measurements create additional job hazards operating in close vicinity from delicate sensors of the operational detector.
- **Photogrammetry** is well established for survey of such objects with adequate accuracy without such job hazards.
- **We need to connect CMM data with photogrammetry.**

Few Words about Photogrammetry

Photogrammetry is used for long time for alignment:
Fermilab is using VSTARS system;
CERN is using home-developed procedure for parts of the CMS detector alignment

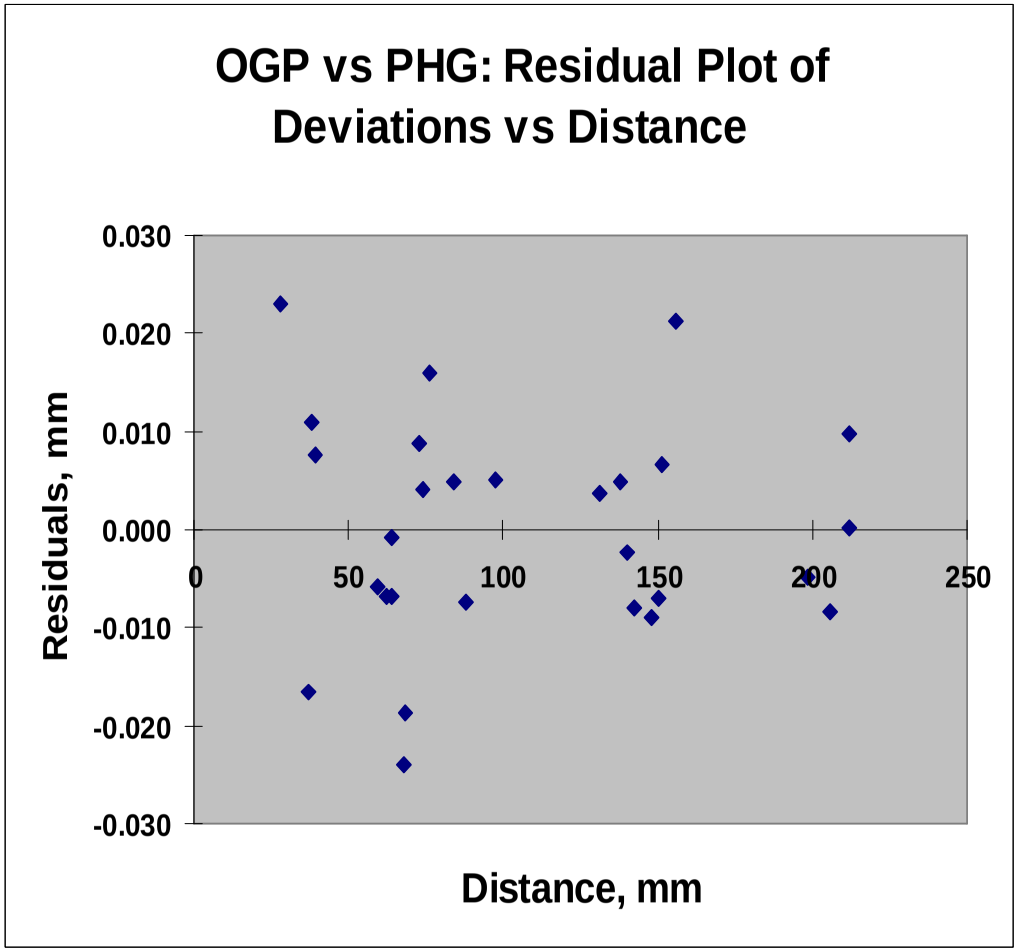
Connecting CMM survey with Photogrammetry





We are using a sample structure including **sensor fiducials** together with optical **photogrammetry targets** to develop procedure to measure these objects with CMM (both) and photogrammetry (only targets) and connect these measurements

Connecting CMM Survey with Photogrammetry: Preliminary Results



Differences between distances between corresponding targets measured with CMM and photogrammetry shows good agreement:

MEAN = 0.006 mm

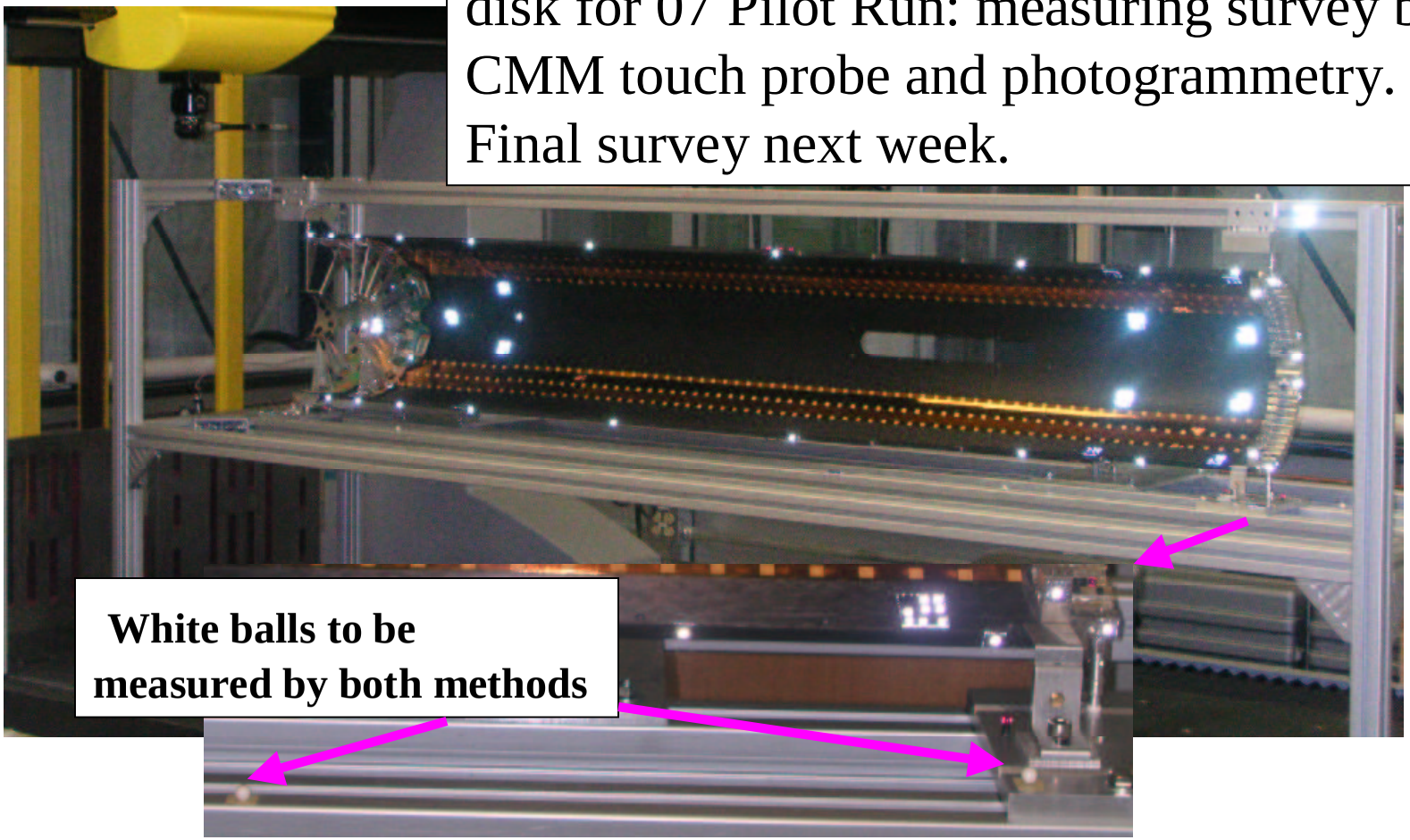
STDEV = 0.014 mm

It is expected from the error estimations for both methods.

Accuracy is adequate.

Connecting CMM measurements with Photogrammetry: 07 Pilot Run

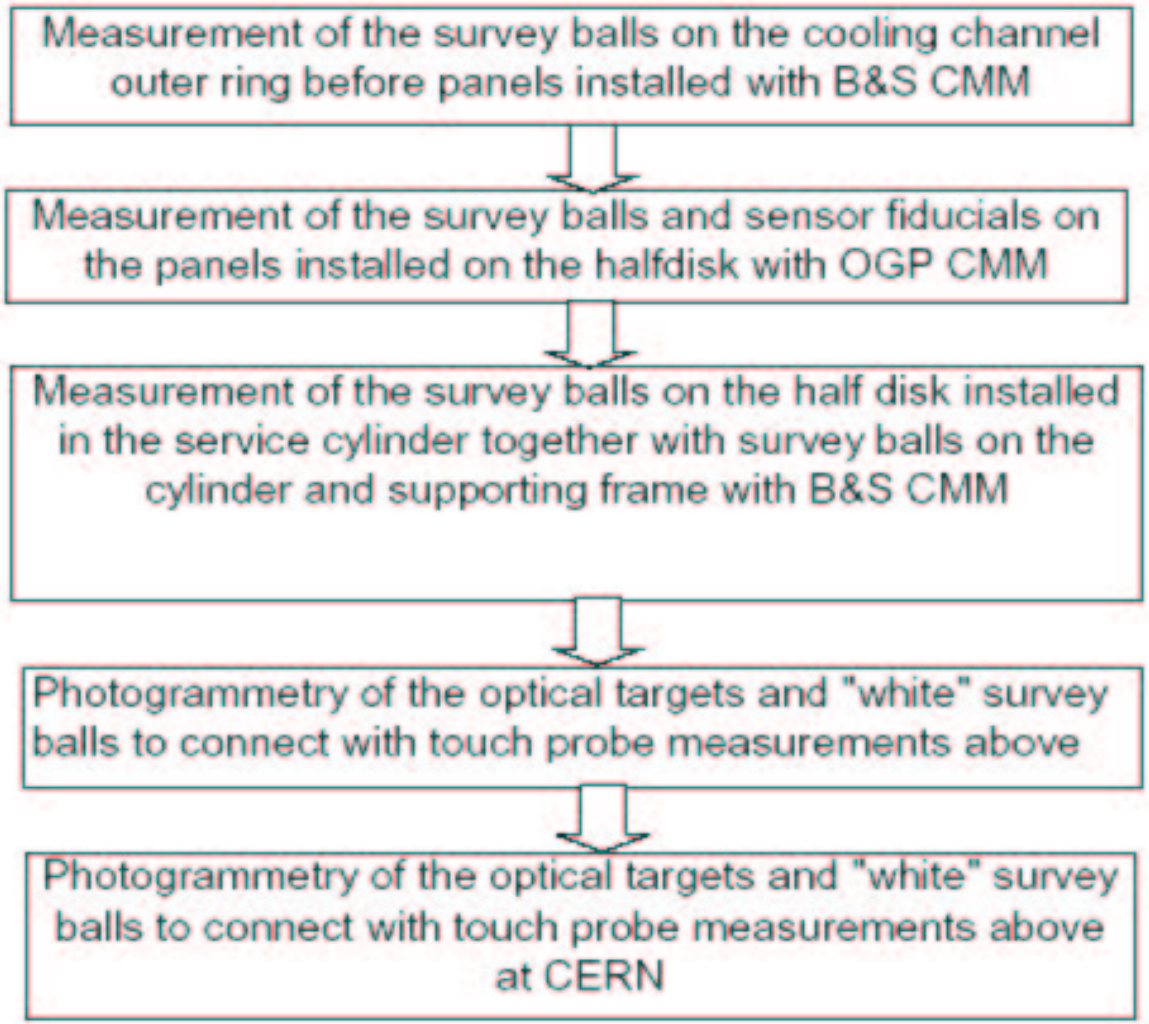
Programming survey of the half-cylinder with half disk for 07 Pilot Run: measuring survey balls with CMM touch probe and photogrammetry.
Final survey next week.



07 Pilot Run

MK 01/02/07

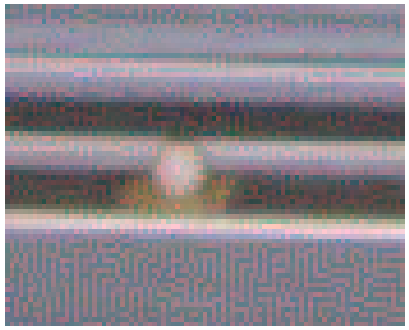
07 Pilot Run Survey Flow Chart

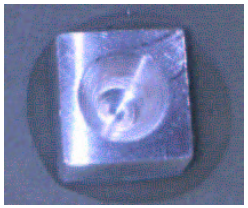


Spare Slides

Connecting CMM measurements with Photogrammetry

Universal method to connect photogrammetry with touch probe:
feature target block





Survey ball is capped with an Al block
with cone with glued coded target

Physics Run

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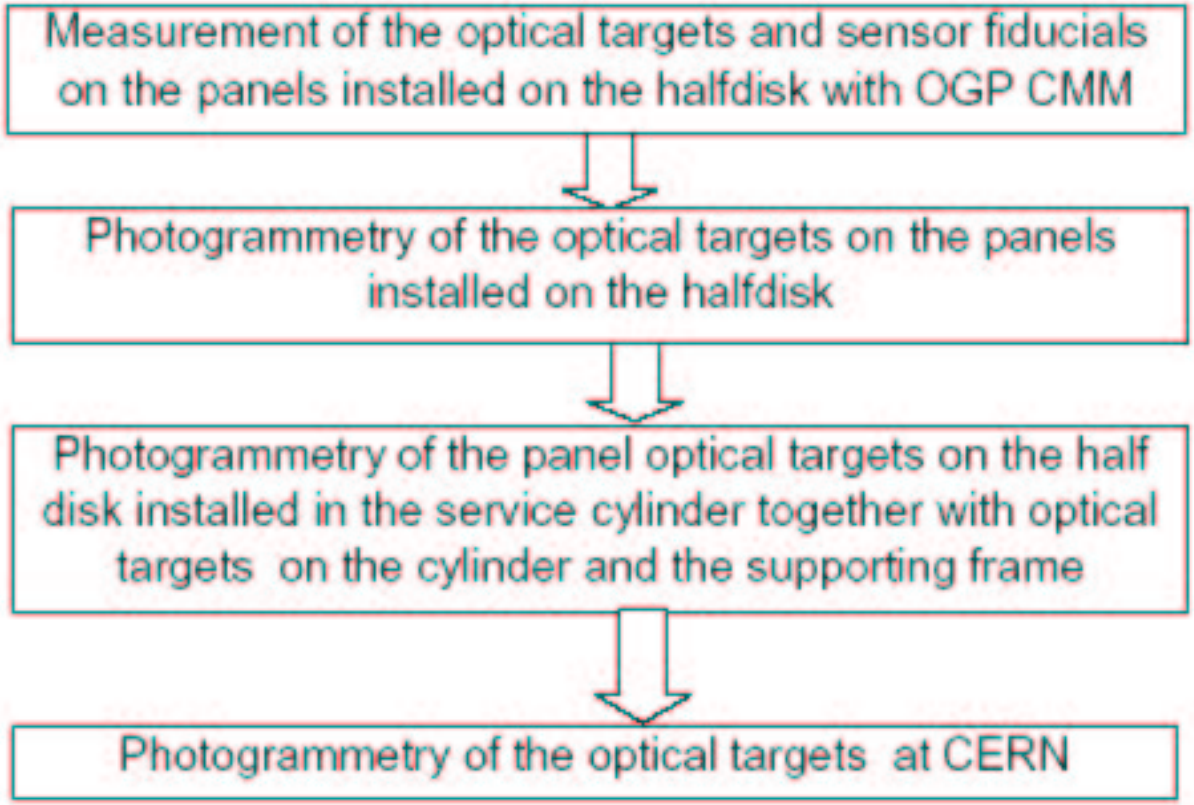
Physics Run Survey Flow Chart