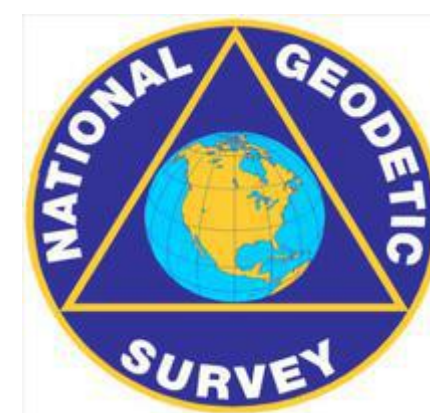


A new 6-axis robot for absolute antenna calibration at the US National Geodetic Survey



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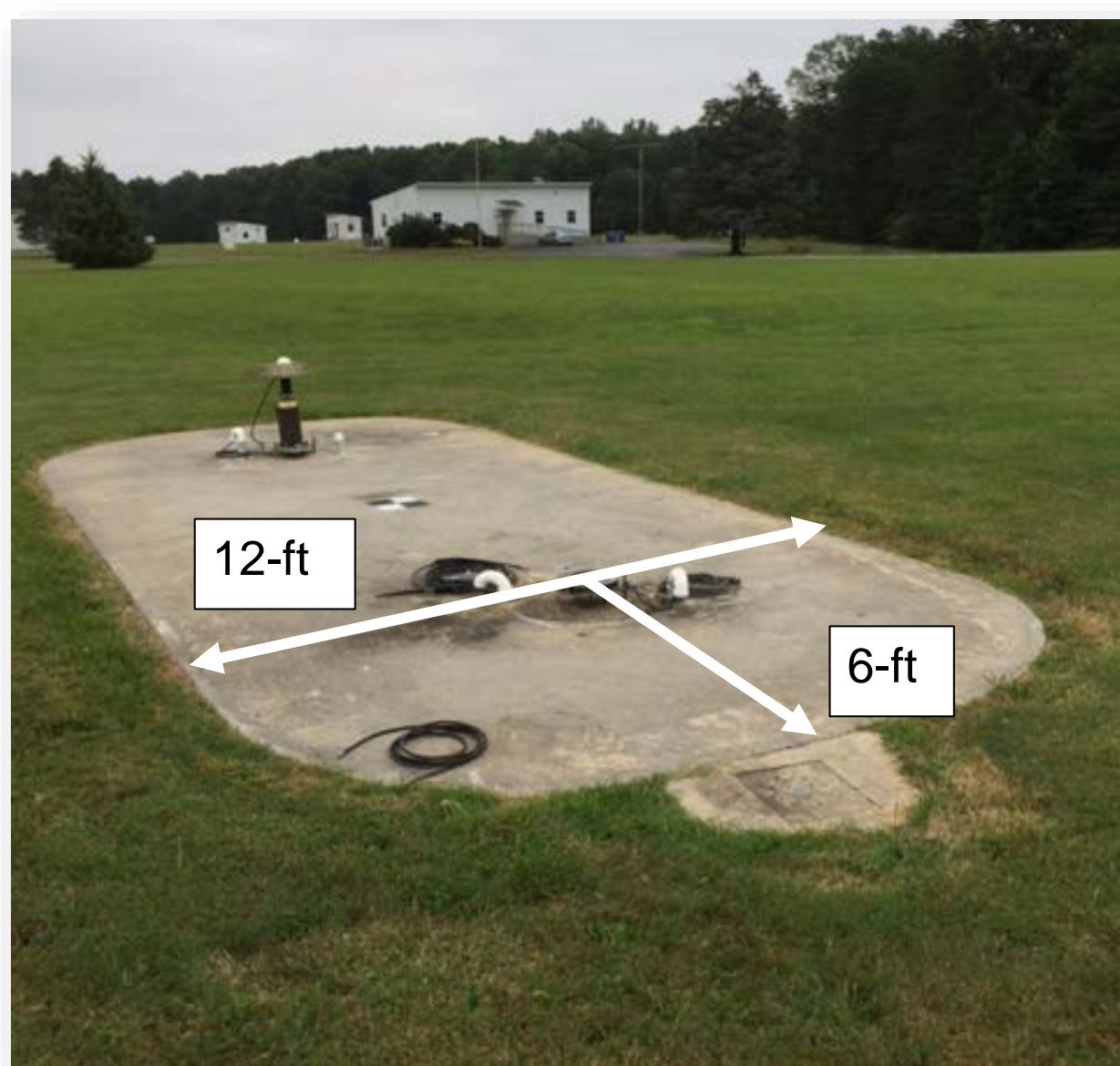


Overview

NGS has conducted calibrations of GPS antennas since 1994. Since that date, NGS has continuously offered calibrations via the historic relative calibration method, where the phase calibration is referenced to a second antenna (an AOAD/M_T choke ring antenna).

NGS briefly offered absolute antenna calibrations in 2012-2013, but the test system had continuous issues preventing reliable operation. In addition, the NGS absolute calibration system used only a 2-axis robot which lacked the degrees of freedom necessary to adequately measure the full hemisphere for each absolute calibration without requiring extra manual intervention.

To restore reliable operations, **NGS will be purchasing a 6-axis robot** which is capable of moving the antenna under test through the full range of angles and motions necessary for calibration. We discuss the advantages and disadvantages of the 6-axis robotic arm for the antenna calibration application. We present this information as a way to **foster open discussion with our IGS colleagues about absolute antenna calibration equipment and techniques.**



Existing concrete pad surrounds two piers going to 6' depth

Existing Site



0.640 m diameter concrete pier



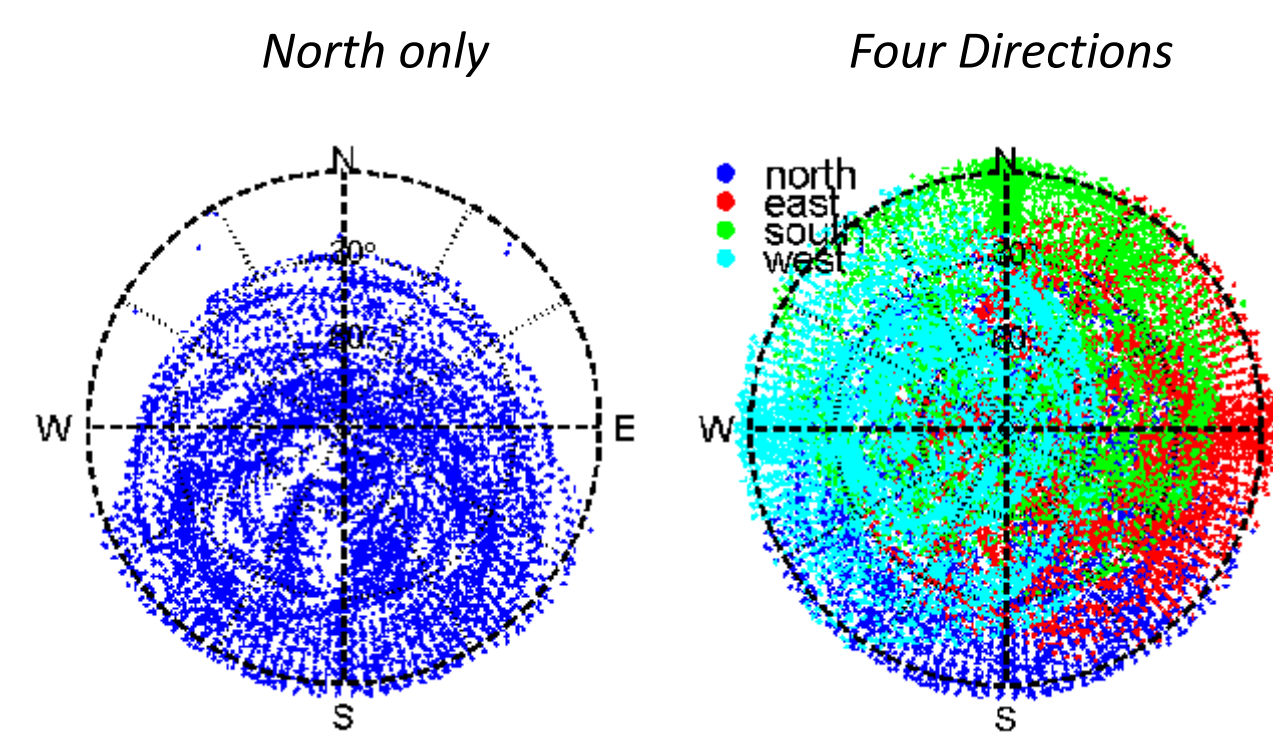
Field site in Corbin, VA, USA



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Previous 2-axis System

Data Collection



Four-orientation Antenna Mount: Mounting the antenna in one orientation (North) on robot cannot sample all directions. Instead, data were collected with antenna mounted in four different positions (N,S,E,W).



Robot

Directed Perception / FLIR

- 2-axis pan + tilt unit
- coincident origins for pan and tilt systems

Advantages:

- Inexpensive
- Software already written

Disadvantages:

- Only 2 degrees of freedom
- Cannot keep PCO stable during test
- Light payloads
- Remount antenna for full coverage

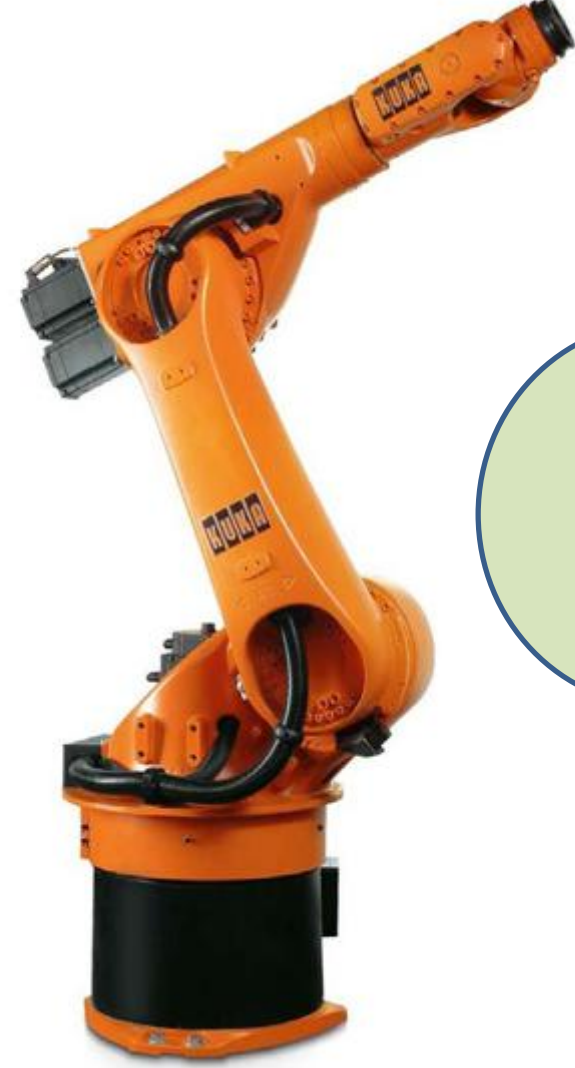
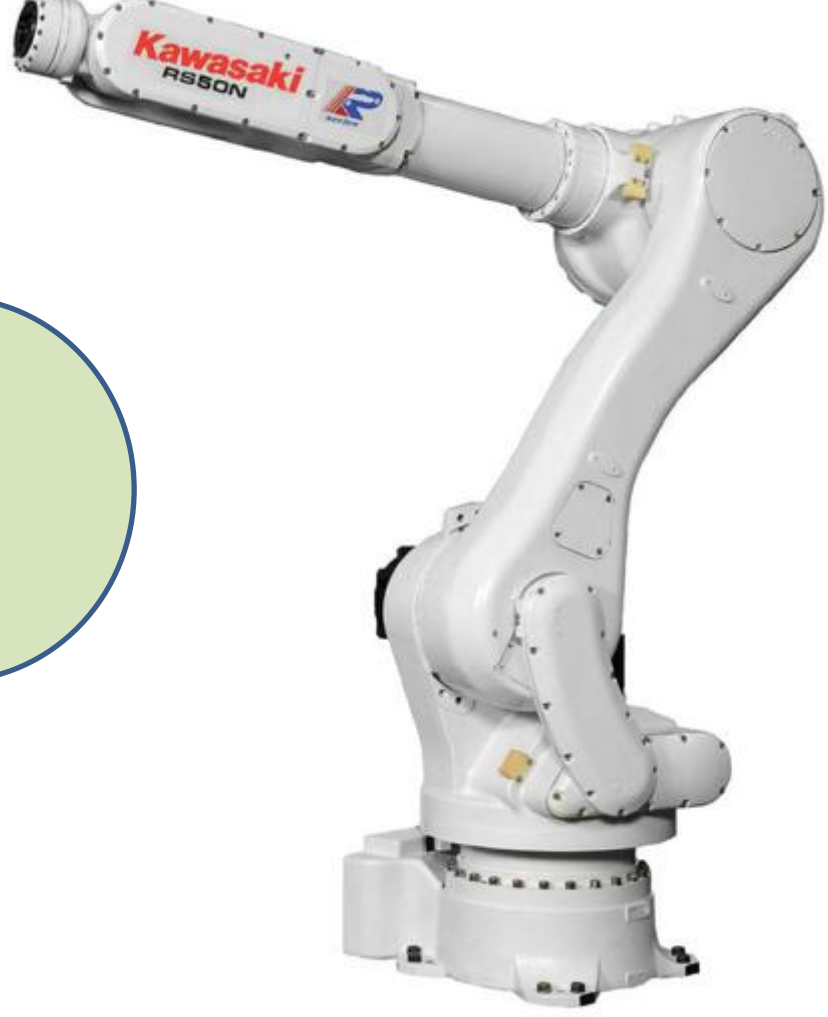
New 6-axis System

Advantages:

- 6 degrees of freedom
- High position accuracy
- PCO can be kept stationary during test
- Can support heavy payloads, even with extension

Disadvantages:

- New software development
- May not operate at lower temperatures

Robot	Kuka KR60HA	Kawasaki RS50N
		
Max payload weight (kg)	60	50
Operational range (°C)	10-55	0-45
Repeatability (mm)	0.05	0.07
Max reach (m)	2.03	3.70

Calibration

Leica Laser Tracker

- Micrometer-level accuracy
- Leverage NGS experience from IERS site surveys
- Will design protocol that could be used to calibrate other absolute calibration robots



Enclosure



Protection from the elements:

- Dome fully retracts
- Circular shape when open for low multipath
- Fully protects robot when not in use
- Adds safety and security

Questions and Comments?

Please post a sticky note in this section