Introduction to OSI and DFPS

Presentation at the Astronomical Instrumentation Laboratory, TAMU

16-FEB-23



Kevan Hashemi Open Source Instruments Inc. www.opensourceinstruments.com

The Company

- Founded in 2004 by employees of Brandeis University, Waltham, MA.
- All designs, software, and firmware are open-source under GPL3.
- Founded in order to provide metrology instruments for CERN.
- Diversified into laboratory animal wireless telemetry.
- Four full-time employees, two part-time employees.
- Of our \$1M revenue last year, 70% was telemetry sales.
- Another 20% was Phase I SBIR grant from NSF for fiber positioiner.
- Another 10% was Phase I SBIR grant from DoE for new metrology instrumentation.
- Relationship with Brandeis University has ended.
- Collaborate with Tufts University on the ATLAS end-cap alignment system at CERN.

Example Instrument: The BCAM



Figure: A Black H-BCAM.

- The Boston CCD Angle Monitor (BCAM)
- Sits on three-ball kinematic mount.
- Provides one or two cameras.
- Provides two or four light sources.
- Cameras measure bearing of light sources.
- Model as a pin-hole camera and point sources.
- Seven calibration constants define each camera.
- Calibrate cameras and sources in a roll cage.
- Installed thousands of these in the ATLAS detector.
- Installed hundreds more in other detectors.
- BCAM User Manual is <u>here</u>.

Data Acquisition Hardware: The LWDAQ

- Long-Wire Data Acquisition (LWDAQ) system controls and reads out our instruments.
- Communication with LWDAQ takes place over TCPIP.
- LWDAQ Software runs on Ubuntu, MacOS, Windows, and Raspberry Pi.
- User manual is <u>here</u>.
- Works well for small systems in the laboratory and large systems in detectors.
- Our Direct Fiber Positioning System test stands are LWDAQ.
- The ATLAS End-Cap Alignment System is a LWDAQ with thousands of devices.

Direct Fiber Positioning



Figure: A Direct Fiber Positioner.

- No moving parts other than bending actuator.
- Positioners can be packed on a 5-mm grid.
- Can cover 3.8-mm square with fiber tip.
- Must pack control electronics in 5-mm square.
- Permits construction of Stage 5 Spectrograph.

NSF Support

- Received \$240k SBIR Phase I grant from NSF in January 2022.
- Award period ends 30-MAR-23.
- Have achieved all important milestons.
- Controllers fit in available space.
- Creep and hysteresis mitigation strategies successful.
- Ready to apply for Phase II \$1M grant.
- Need to collaborate with spectograph maker and telescope.