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Development of Omni-SLR System: (2) Tracking subsystem

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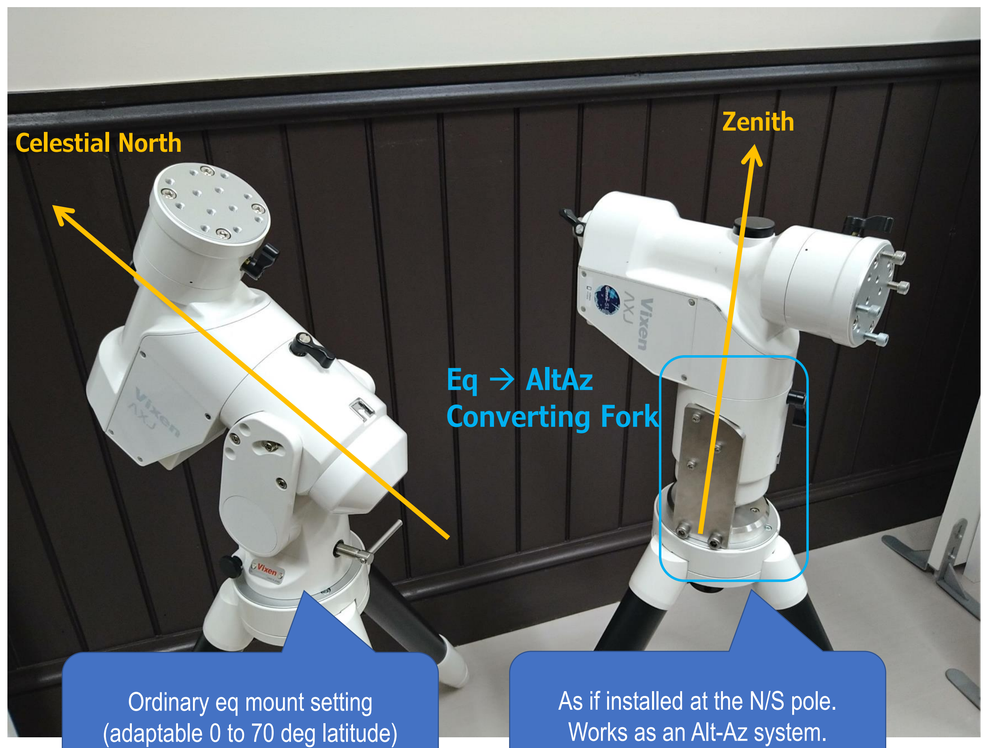
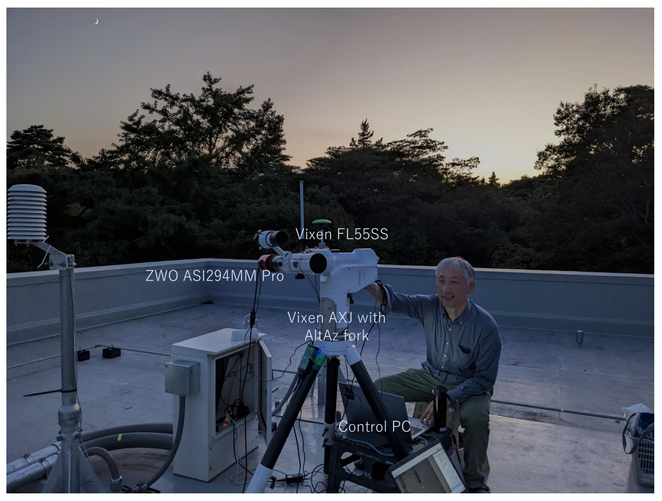
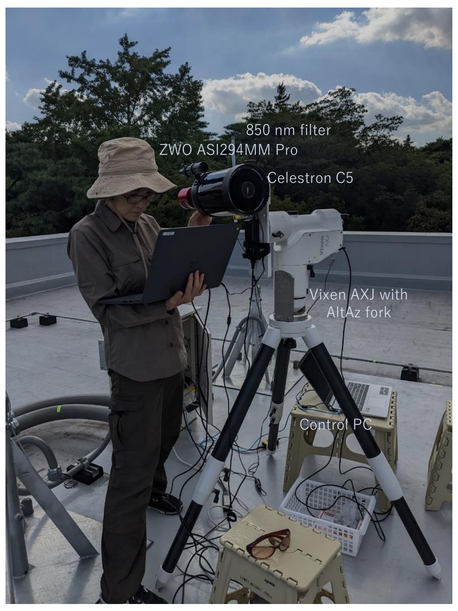
Telescope Mount under test: Vixen's AXJ in Alt-Az

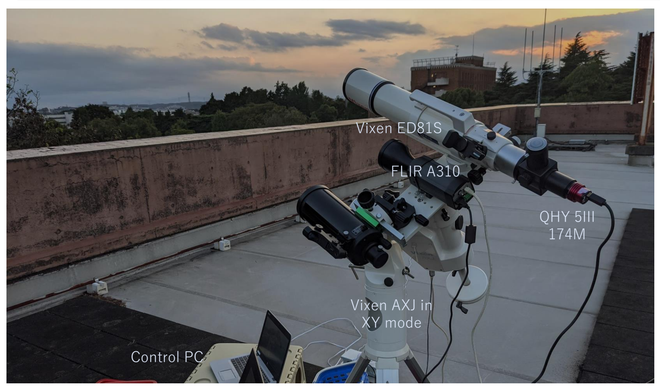
Equatorial mount, Mechanical motor, JPY 820k ~ EUR 5.8k with the tripod



Test scenes at Hitotsubashi University







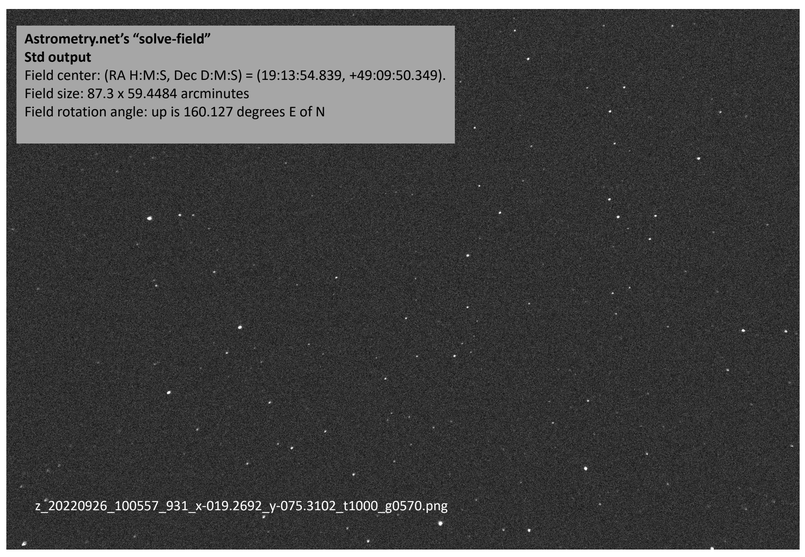
Tracking Software

Mount controller (in Julia)
- Direct communication with the mount (UART).
- Command sent every 60-70 msec.

Satellite/Aircraft tracker (in Python)
- Talking with Raspberry PIs (cpf-san and adsb-san)
- Sending realtime positions to the mount controller.

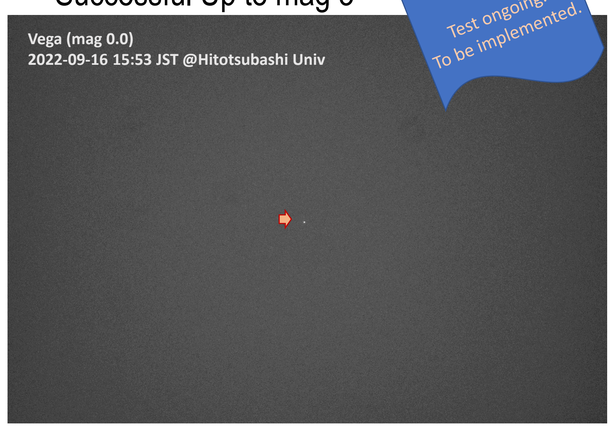
Star calibration (in Python & astometry.net's "solve-field")
- Plate-solving: no need to move a star at the centre.
- Measurement controller: Periodic motion and whole-sky mount model.
- Solver: Auto parameter optimization (typically 10 to 15 params).

Plate-solving

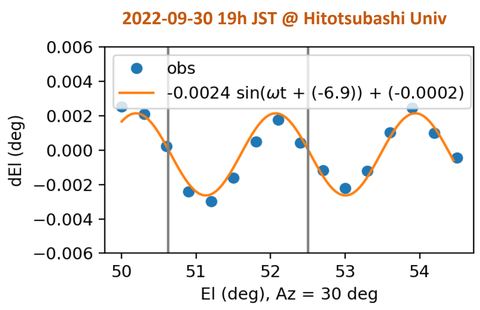


Daytime star tracking

Big problem in Antarctica.
Stars captured in daytime (↓).
- Narrow FOV. Vis-cut filter.
- Successful Up to mag 3



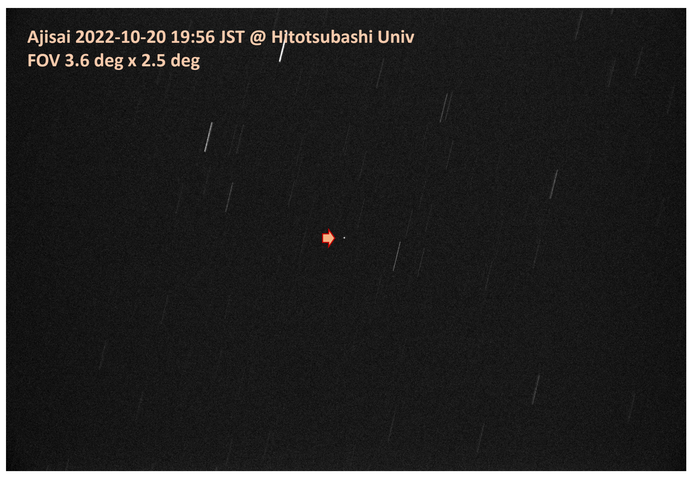
Periodic Motion (Y=El axis)



Inevitable correction for mechanical motors
- X (Az or RA) axis model embedded by Vixen before shipping.
- Y (El or Dec) axis should be corrected by ourselves.

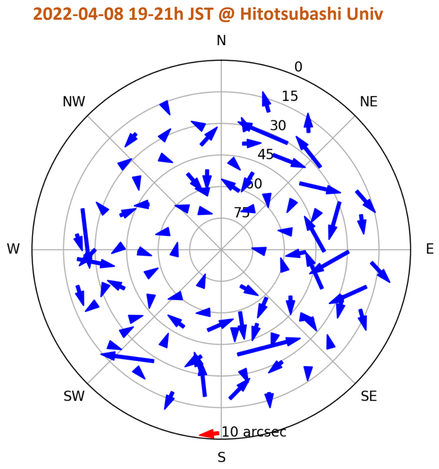
Special star calibration for periodic motion correction (←)
- "solve-field" solutions used.
- Machine-different 9 to 18 arcsec amplitude observed.

Satellite tracking

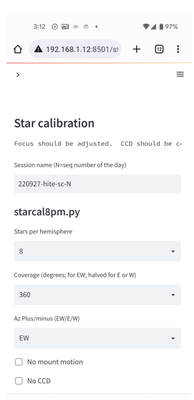


Aircraft tracking

Mount Model



Star calibration
- Post-fit residual plot of a 100-star special test (←).
- With 15 parameters fit: Post-fit (std) = Az 13 arcsec, El 9 arcsec)
- No need to move a bright star into the field centre. Easily automated.
- Executable via a web browser of a smartphone (→).



Summary / To-do's

Low-cost equatorial mount (Vixen AXJ) can
- be converted to Alt-Az system by a special fork.
- point starts at 10-15 arcsec rms with periodic motion correction.
- track SLR targets. We need to look at the precision and stability.
- track ADS-B-transmitting aircraft. ADS-B precision lower than our tracking precision.

Future works
- Daytime starcal and tracking.
- Analysis of tracking precision and stability.
- Good user interface.
- Other targets? Application to space comm.
- Other mounts?
- Idea suggestions

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