WFIRST Slew/Settle Overview

(using Cycle 3 Parameters)

Cliff Jackson

Based on inputs from Eric Stoneking

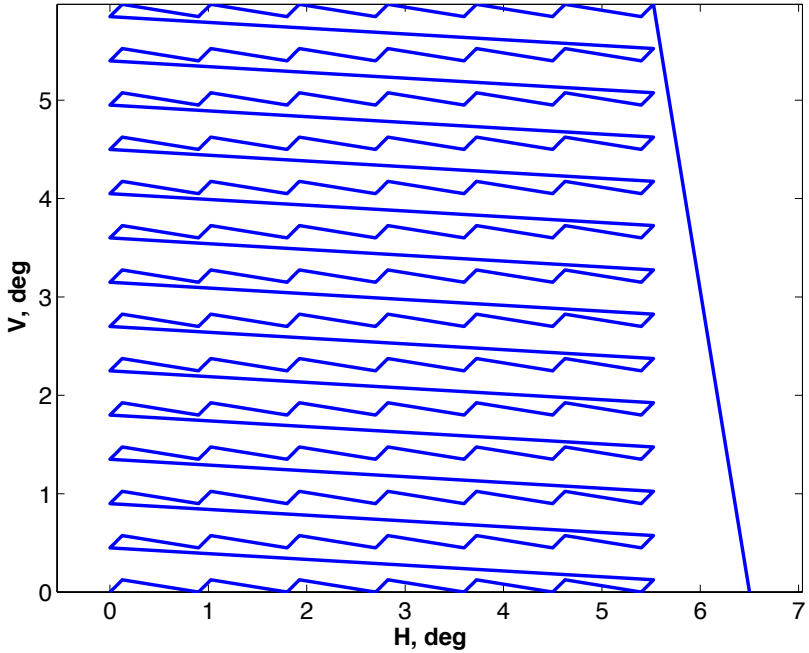
141024

Slew and Settle Estimates Overview

- Estimates from Eric Stoneking based on Cyc-3 Observatory MOI (will be updated)
- Values shown are for torque-limited slews
- There will be a trade between allocating momentum storage to minimize momentum-dump frequency vs to minimize slew times
- Currently slews <=3° will be torque-limited, and >3° will have a max slew rate of 0.05 deg/s (all TBR)

Survey Pointing Profile

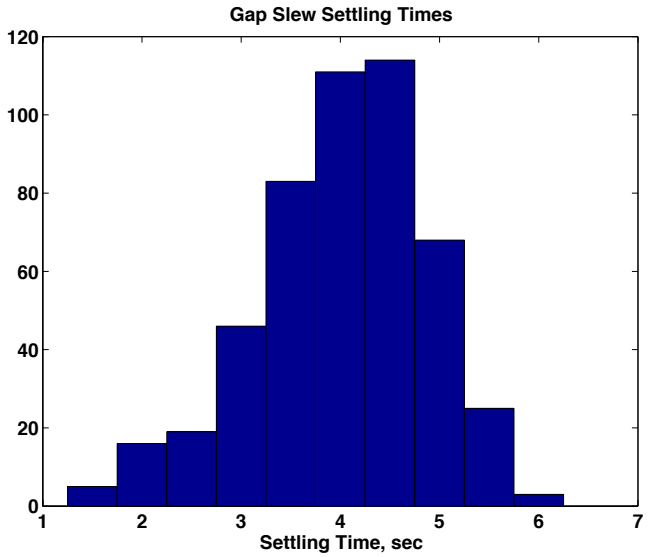
- Old strawman survey profile
  - 6x6 deg tile
  - 490 Gap filling slews
    - 0.025 deg in H and V
  - 84 FOV slews
    - 0.775 deg in H
    - 0.125 deg in V
  - 13 Row slews
    - 5.525 deg in H
    - 0.325 deg in V
  - 1 Slew to next tile
    - ~1.0 deg in H
    - ~6.0 deg in V
- Profile needs to be updated, but still gives good mix of slew sizes

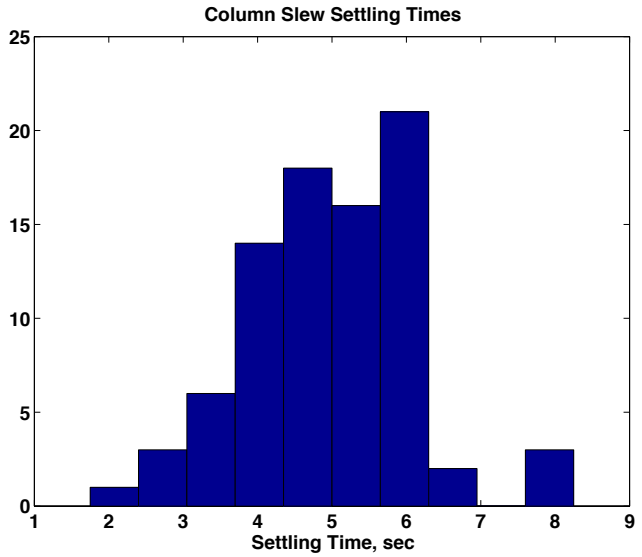


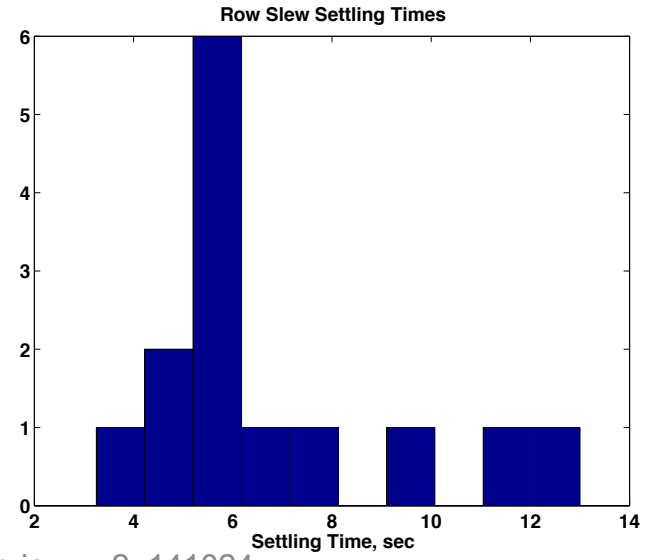
Slew Durations

- Gap-filling slews: 11.25 s
- FOV slews: 50.25 s
- Row slews: 132 s
- Add 0.25 s to each for FGS acquisition

Settling Times







- Settling times:
  - Gap-filling: < 6.25 s
  - Short FOV: < 8.25 s
  - Row: < 13.0 s

Combined Slew, Acq, Settle Times

- Gap-filling: < 11.25 + 0.25 + 6.25 = 17.75 s
- Short FOV: < 50.25 + 0.25 + 8.25 = 58.75 s
- Row: < 132 + 0.25 + 13.0 = 145.25 s

- Above are torque-limited … only the Row slew would be impacted (~5.6° vs <=3° to be torque-limited). Impact TBD.

Observations

- Settling performance is driven by attitude estimation performance during slew
  - If true attitude doesn't track slew attitude command well, it takes a long time for the linear feedback law to converge, due to error limits
  - During slews, set measurement gains to 1 to avoid lag, suspend update of gyro bias states
- Settling to "FGS" accuracy takes no longer than settling to "ST/IMU" stability
  - May be that rate residual is as important as attitude residual
  - Or may be that declaring a "home" position that has ST noise inherently in it leaves the ACS with as much attitude residual as using FGS-designated "home"
- FGS acquires in one (0.25-sec) cycle assuming a 64x64-pixel guide window
  - Stepped down to 16x16 once pointing errors below 100 mas
- Mechanical disturbances don't seem to be a driver in slew/settle performance
  - Simulation model includes slosh (and other disturbances)

Science Image and Guide Window Overview

- During Slews
  - Slews controlled by ST/Gyro
  - SCAs are readout in normal observing mode cadence, but with reset/read as each pixel is visited instead of a non-destructive read
  - One 16 x16 pixel GW per SCA is also read out, with this readout interleaved between 128 lines of science image data (no FGS use)
  - Resulting Science frame rate is 5.423 s, and the GW update rate (not used during slew) is 5.9 Hz (~ same as when observing)
- During Acq/Settle
  - Controlled by FGS using 64 x 64 pixel GWs, one per SCA
  - Acquisition takes ~0.25s
  - Same interleaving of GW readouts between 128 lines of image data
  - Science frame rate is 8.126 s, and GW update rate is 4.1 Hz
- During Observing
  - Return to 16 x 16 GWs, 5.243 s frame rate, 5.9 Hz GW update rate