System 1 Tracking Modifications

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Agenda

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- Current Tracking Approach
- Modified Tracking Approach
- Performance Analysis
  - Tracking Signal Loss
  - Target Rates
  - Step-Drift Interval
  - Signal Loss versus Step-Drift IntervalTrade
- Plan

Current Tracking Approach

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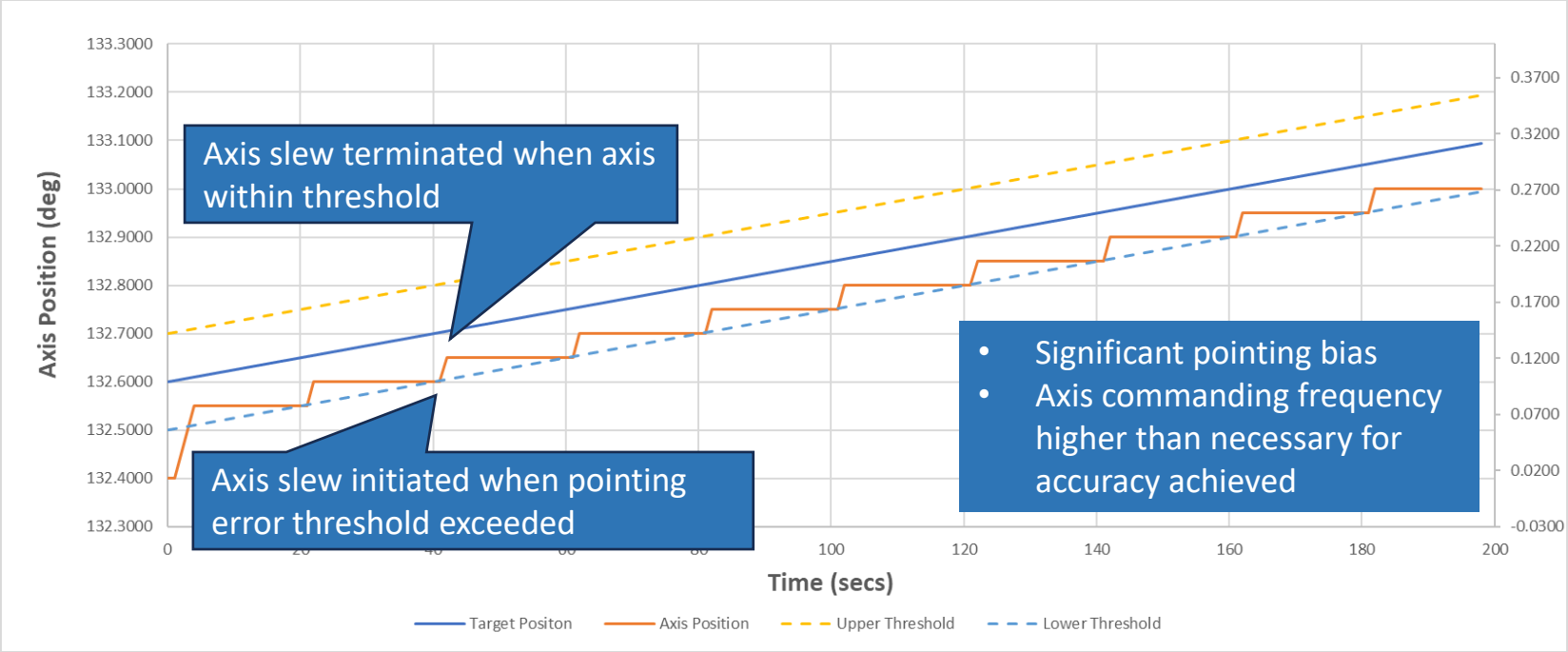

- Position data received 10 times/sec; Tracking Update loop runs once per second
- Tracking Threshold set to .1 deg for both axis
- Axis step rate: Azimuth: .1 deg/sec, Elevation: .05 deg/sec
- Tracking parms were not changed when moved from 12-bit encoders to 16-bit encoders
  - Increased encoder resolution does not materially affect commanding frequency

Modified Tracking Approach: Step-Drift Tracking

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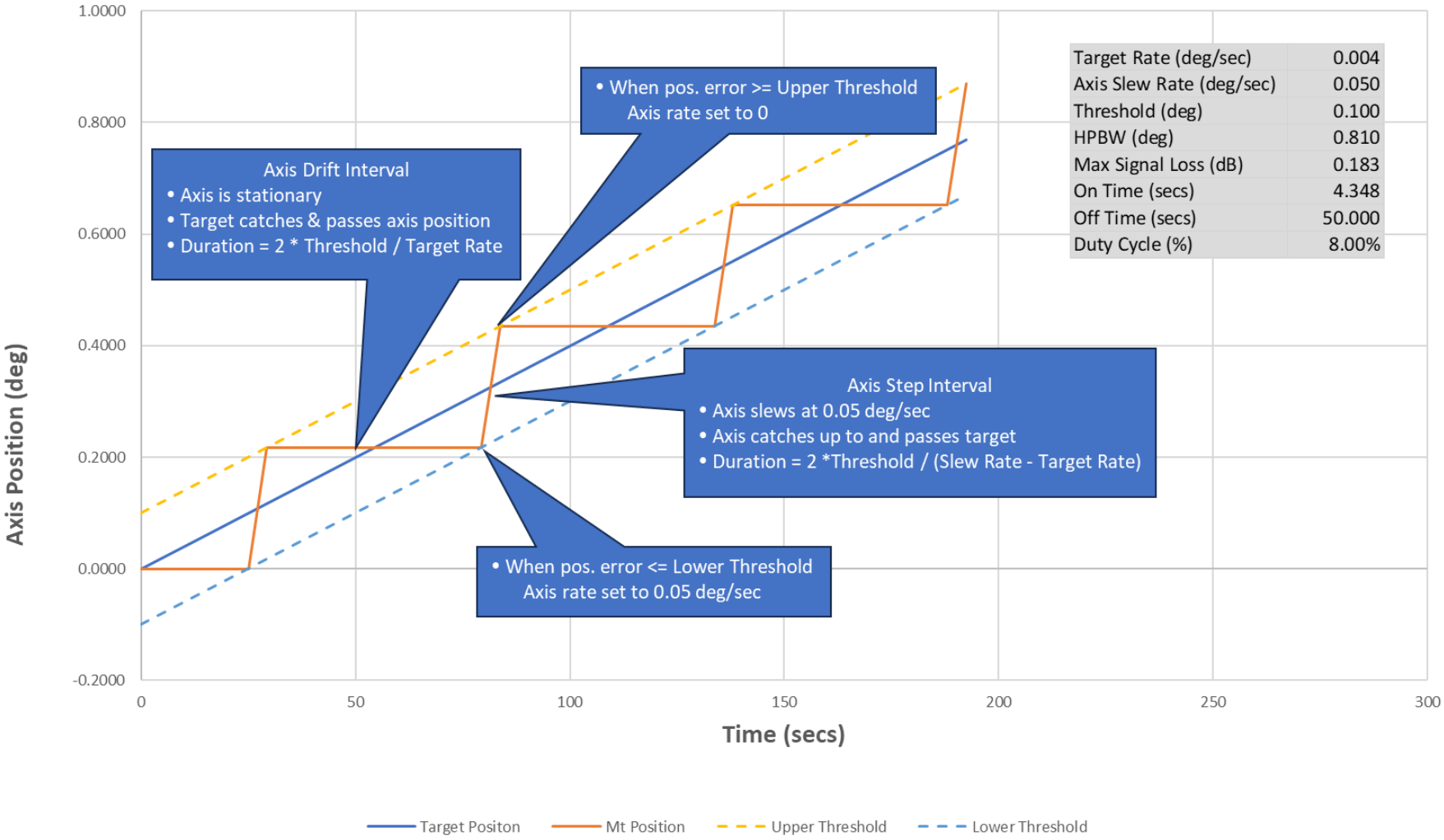

Step-Drift Tracking : Az/El Boresite View

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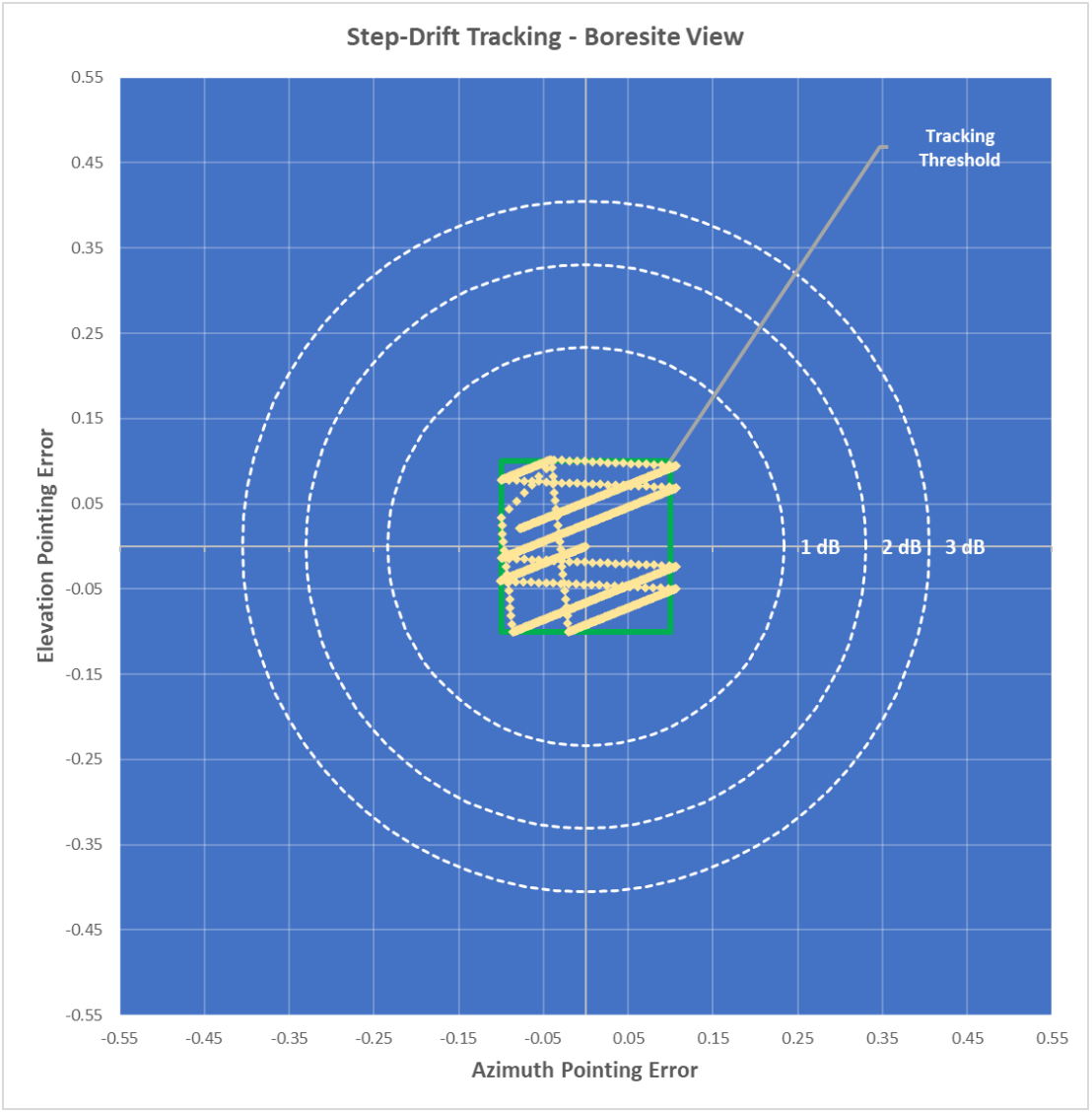
Step-Drift Sim Parms

Tracking Threshold: 0.1
HPBW (1420 MHz): .81
Axis Step Rate: 0.05
Target Rate:
Az: 0.005
El: 0.002



Tracking Signal Loss

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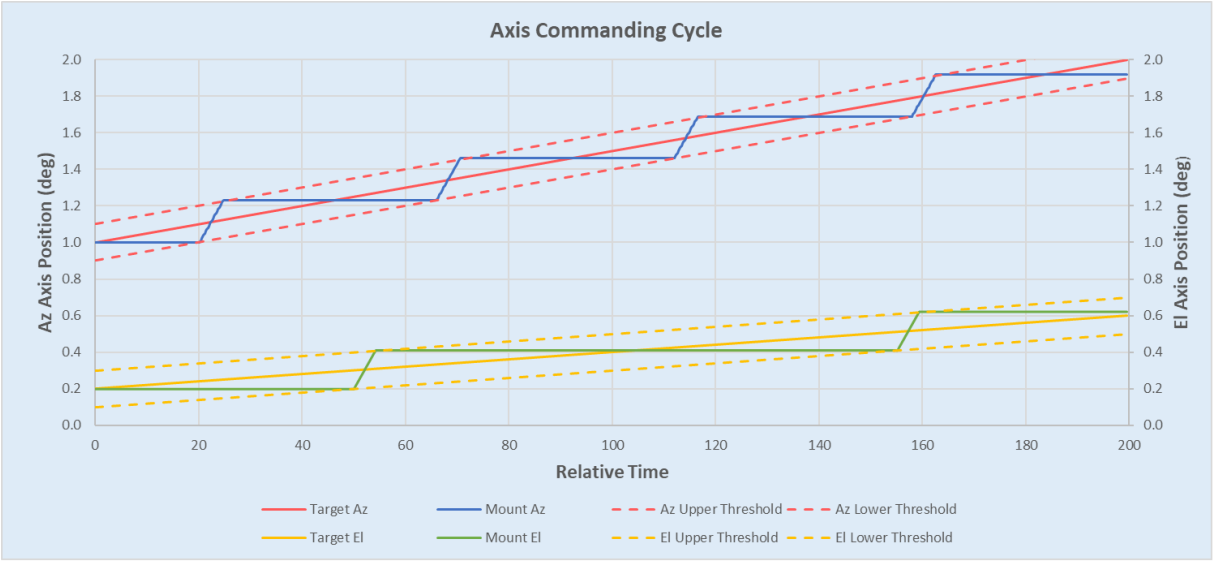
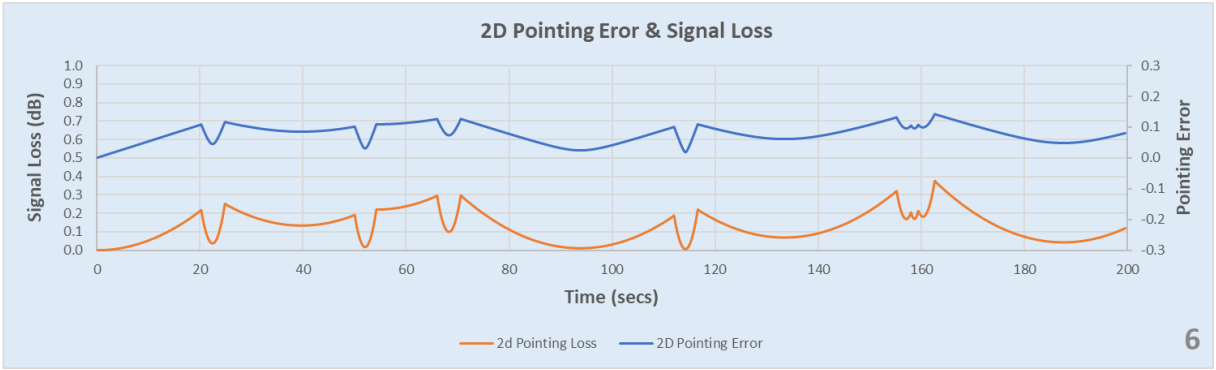
- Tracking signal loss is function of off bore site pointing error and HPBW which is frequency dependent
- Off bore site pointing error derived from combination of Az and El pointing errors using Pythagorean equation
- Tracking signal loss = 12* (OffBoreSiteError/ HPBW)^2

Tracking Sim Inputs
Threshold: 0.1
Axis Step Rate: 0.05
Target Rate:
Az: 0.005
El: 0.002
HPBW: .81

Sim Results
Commanding Interval
Az: 44.4 secs
El: 104.2 secs
Pointing Error
Mean: .08 deg
Max: .14 deg
Signal Loss
Mean: .13 dB
Max: .373 dB





Target Rates

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- Targets outside of solar system move relative to a point on Earths surface at sidereal rate due to earth rotation

Azimuth Rates (deg/sec)

	Azimuth												
Elevation	**0**	**30**	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**	**360**
88	-0.0911	-0.0785	-0.0443	0.0026	0.0494	0.0837	0.0963	0.0837	0.0494	0.0026	-0.0443	-0.0785	-0.0911
85	-0.0348	-0.0298	-0.0161	0.0026	0.0213	0.0350	0.0400	0.0350	0.0213	0.0026	-0.0161	-0.0298	-0.0348
80	-0.0160	-0.0135	-0.0067	0.0026	0.0119	0.0187	0.0212	0.0187	0.0119	0.0026	-0.0067	-0.0135	-0.0160
75	-0.0096	-0.0080	-0.0035	0.0026	0.0087	0.0132	0.0148	0.0132	0.0087	0.0026	-0.0035	-0.0080	-0.0096
60	-0.0031	-0.0023	-0.0002	0.0026	0.0054	0.0075	0.0083	0.0075	0.0054	0.0026	-0.0002	-0.0023	-0.0031
45	-0.0007	-0.0002	0.0010	0.0026	0.0042	0.0054	0.0059	0.0054	0.0042	0.0026	0.0010	-0.0002	-0.0007
30	0.0007	0.0010	0.0017	0.0026	0.0035	0.0042	0.0045	0.0042	0.0035	0.0026	0.0017	0.0010	0.0007
15	0.0017	0.0018	0.0022	0.0026	0.0030	0.0034	0.0035	0.0034	0.0030	0.0026	0.0022	0.0018	0.0017
0	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026

Min Az Rate 0.0002 **Max Az Rate** 0.0963 **Max Az Rate** 0.0400 Below 85 degrees elevation

Elevation Rates (deg/sec)

	Azimuth												
Elevation	**0**	**30**	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**	**360**
90	0.00000	0.00164	0.00283	0.00327	0.00283	0.00164	0.00000	-0.00164	-0.00283	-0.00327	-0.00283	-0.00164	0.00000
75	0.00000	0.00164	0.00283	0.00327	0.00283	0.00164	0.00000	-0.00164	-0.00283	-0.00327	-0.00283	-0.00164	0.00000
60	0.00000	0.00164	0.00283	0.00327	0.00283	0.00164	0.00000	-0.00164	-0.00283	-0.00327	-0.00283	-0.00164	0.00000
45	0.00000	0.00164	0.00283	0.00327	0.00283	0.00164	0.00000	-0.00164	-0.00283	-0.00327	-0.00283	-0.00164	0.00000
30	0.00000	0.00164	0.00283	0.00327	0.00283	0.00164	0.00000	-0.00164	-0.00283	-0.00327	-0.00283	-0.00164	0.00000
15	0.00000	0.00164	0.00283	0.00327	0.00283	0.00164	0.00000	-0.00164	-0.00283	-0.00327	-0.00283	-0.00164	0.00000
0	0.00000	0.00164	0.00283	0.00327	0.00283	0.00164	0.00000	-0.00164	-0.00283	-0.00327	-0.00283	-0.00164	0.00000

Max El Rate 0.00327 **Min El Rate** 0.00000

Axis Speed

- > .01
- 0.004 to 0.01
- 0.002 to 0.004
- 0.000 to 0.002

- Moon rate should be somewhat lower than sidereal due to orbital motion
- Planetary rates will be sidereal with varying offsets due to relative earth-planet motion

Step-Drift Interval

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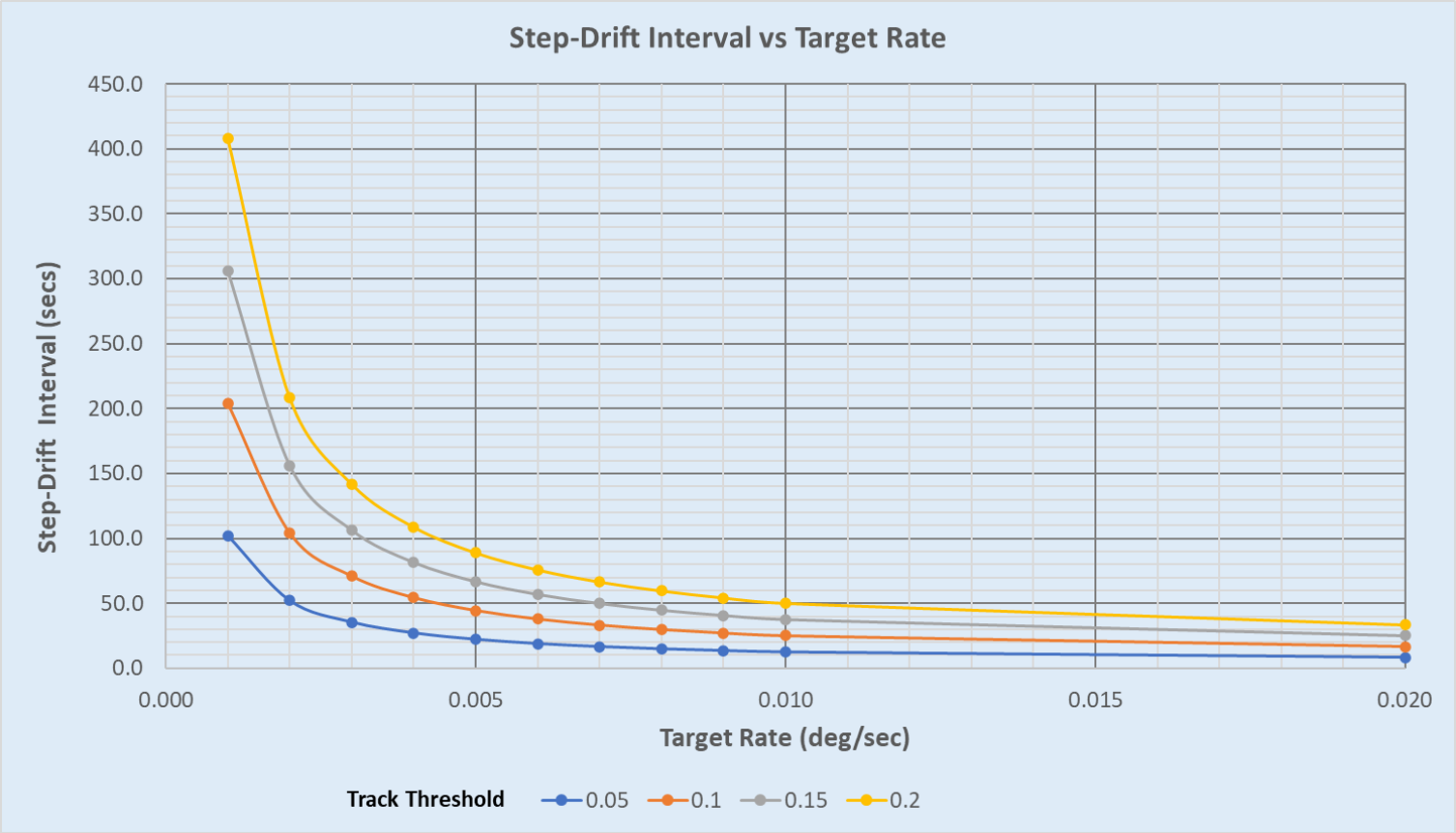
- Step-Drift Interval = Step Interval + Drift Interval
- Step Rate has minor effect on Step-Drift Interval
- Track Threshold and Target rate are primary factors in Step-Drift interval
  - Increasing track threshold increases Step-Drift interval
  - Increasing target rates decreases Step-Drift interval



Signal Loss Vs Step-Drift Interval Tradeoff

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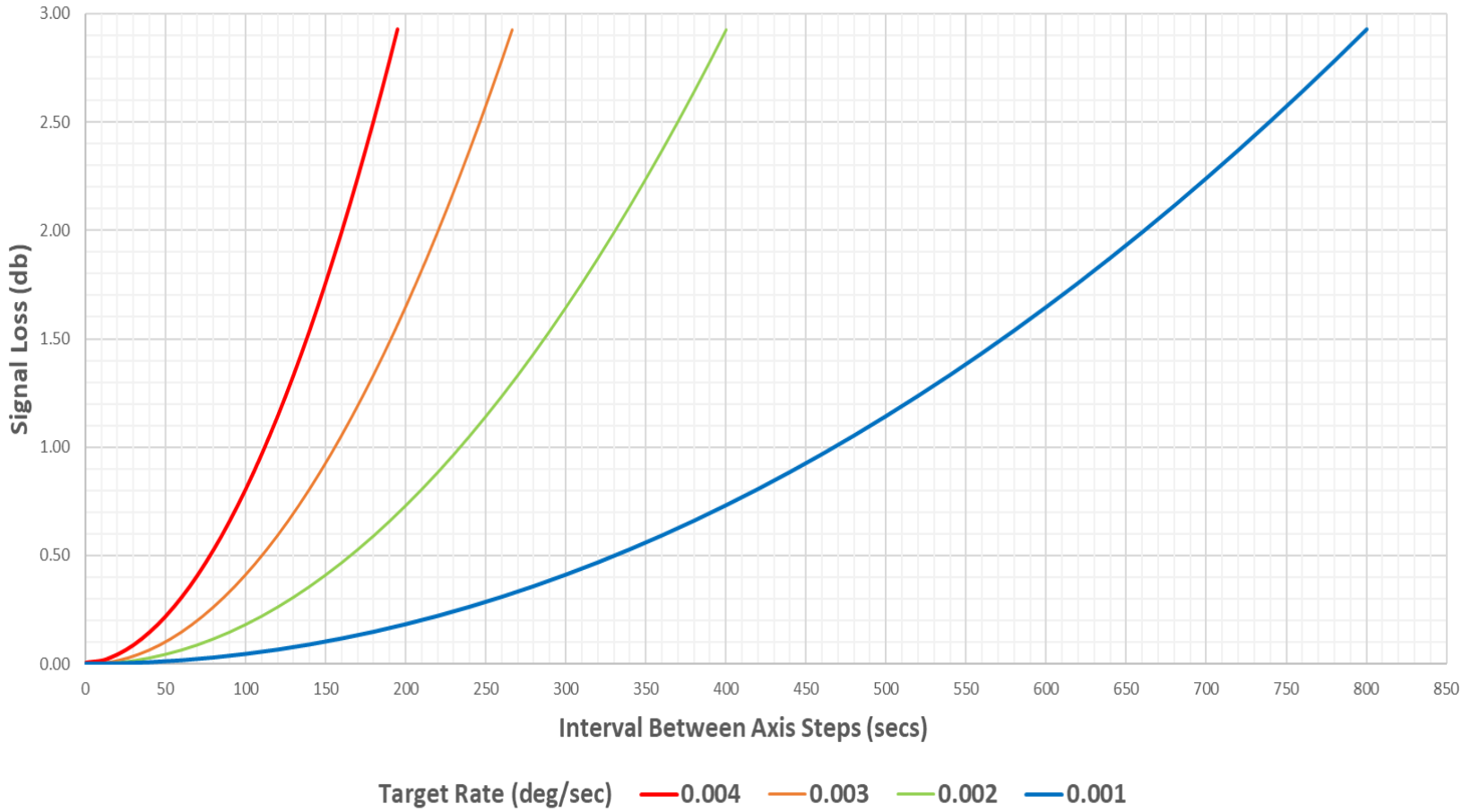
Signal Loss is function of threshold which in turn determines Step-Drift Interval



Plan

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- ✓ Prototype tracking algorithm modifications
- ✓ Test tracking algorithm prototype with mount simulator in Colorado Springs
- Test tracking algorithm prototype at site
- Integrate prototype algorithm into operational code
- Test modified operational code with mount simulator in Colorado Springs
- Test modified operational code at site