Architecture Performance Report

Target: HGV_330 — Run: 20251020T154731Z

Run ID	20251020T154731Z
Target ID	HGV_330
Generated	Test Mode

Executive Dashboard

- **Active Tracking tracking accuracy**: CEP50 = 0.70 km (target <0.1 km)
- **Active Tracking tracking error**: RMSE = 0.72 km (target <0.5 km)
- **Good >=2x Coverage**:

TRACKING ACCURACY	TRACKING ERROR	COVERAGE
0.70 km	0.72 km	100 %
CEP50	RMSE	≥2 sats

Architecture Configuration

This section describes the space segment architecture, including constellation design, orbital parameters, and propagation settings.

Configuration Summary

Ground Track Visualization (2D)

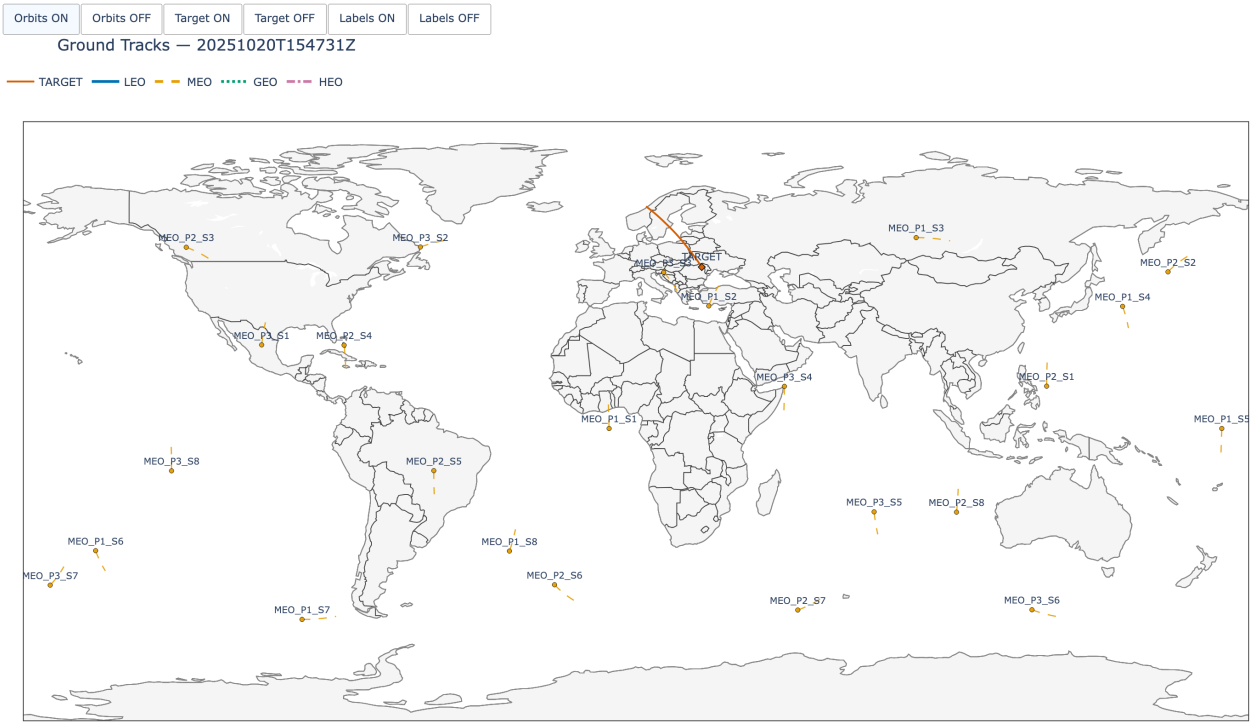

Figure: Satellite ground tracks projected onto Earth surface. Each colored line represents the sub-satellite point trajectory of one spacecraft. Target ground track shown in red.

Constellation View (3D)

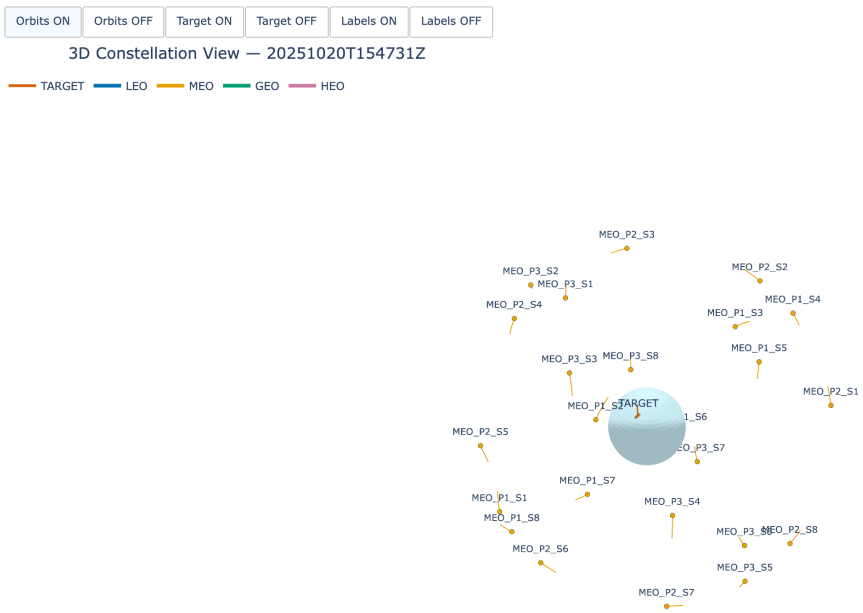

Figure: 3D visualization of satellite constellation geometry. Orbital paths shown in blue, Earth sphere in gray. Target trajectory shown in red. This view illustrates the geometric diversity of the constellation.

Technical Analysis

This section presents detailed technical analysis of tracking performance, including time-series error evolution, trajectory overlays, and geometry diagnostics.

Filter Performance vs Truth

Figure: Time evolution of tracking errors (X, Y, Z, norm) and filter consistency diagnostics (NIS/NEES). Triangulation errors shown with dashed lines for comparison.

Trajectory Overlay (3D)

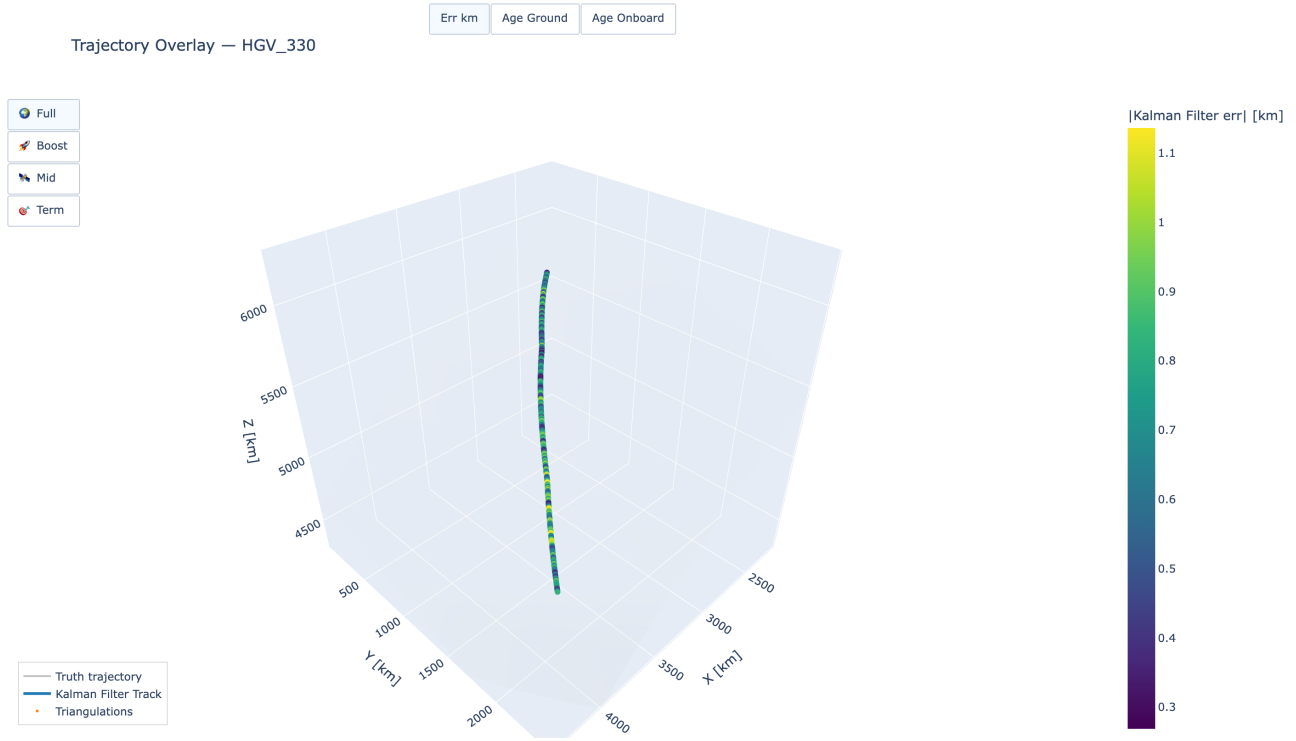

Figure: 3D visualization of truth trajectory (gray), Kalman filter track (blue line), and triangulation estimates (orange points). Truth points colored by tracking error magnitude. Earth sphere shown for reference (R = 6371 km).

Satellite Access Windows

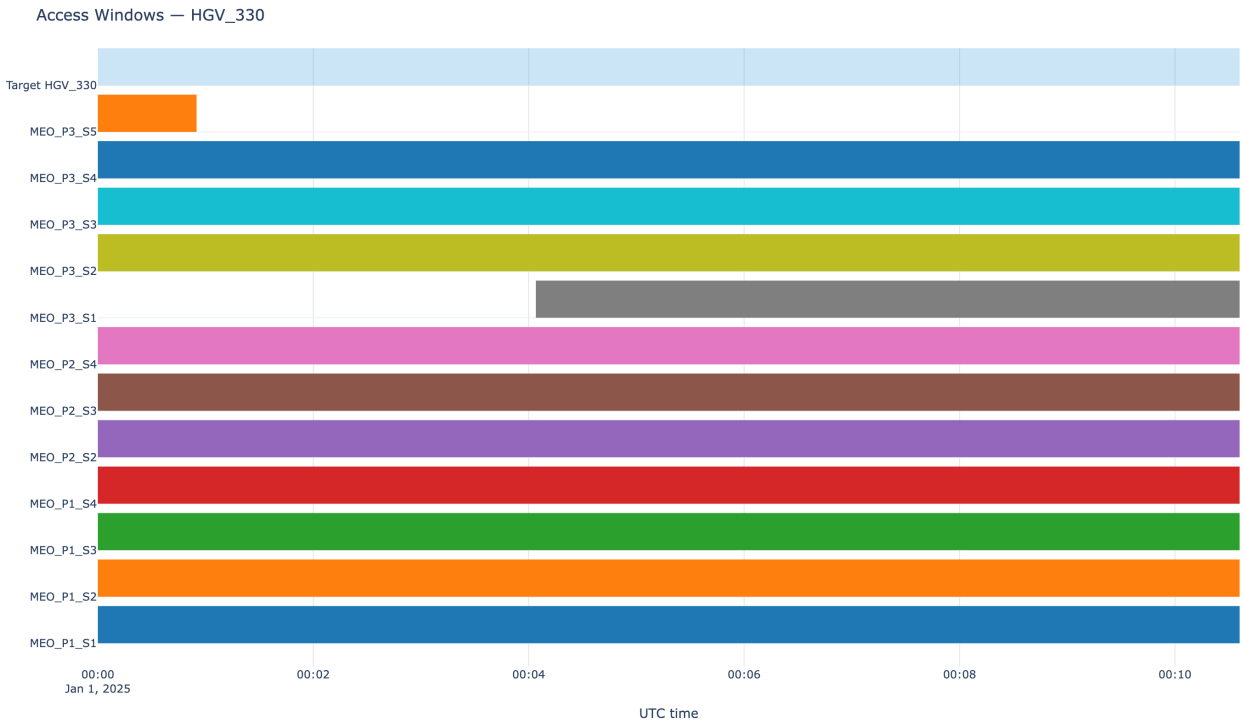

Figure: Timeline of satellite-to-target visibility windows. Each row represents one satellite, with colored bars indicating periods of line-of-sight access. Gaps between bars represent occultation or below minimum elevation angle.

Geometry Quality Metrics

Figure: Evolution of geometry quality over time. Top panel shows GDOP (Geometric Dilution of Precision). Bottom panel shows number of satellites with line-of-sight. Lower GDOP values indicate better geometry.

Communications Latency Analysis

This section analyzes the latency between data generation and processing, comparing ground and onboard processing times.

Latency Statistics

metric	value
Ground Processing p50 [ms]	293.18
Ground Processing p90 [ms]	294.71
Ground Processing mean [ms]	293.49
Onboard Processing p50 [ms]	258.43
Onboard Processing p90 [ms]	259.54
Onboard Processing mean [ms]	258.4
Total Samples	637.0

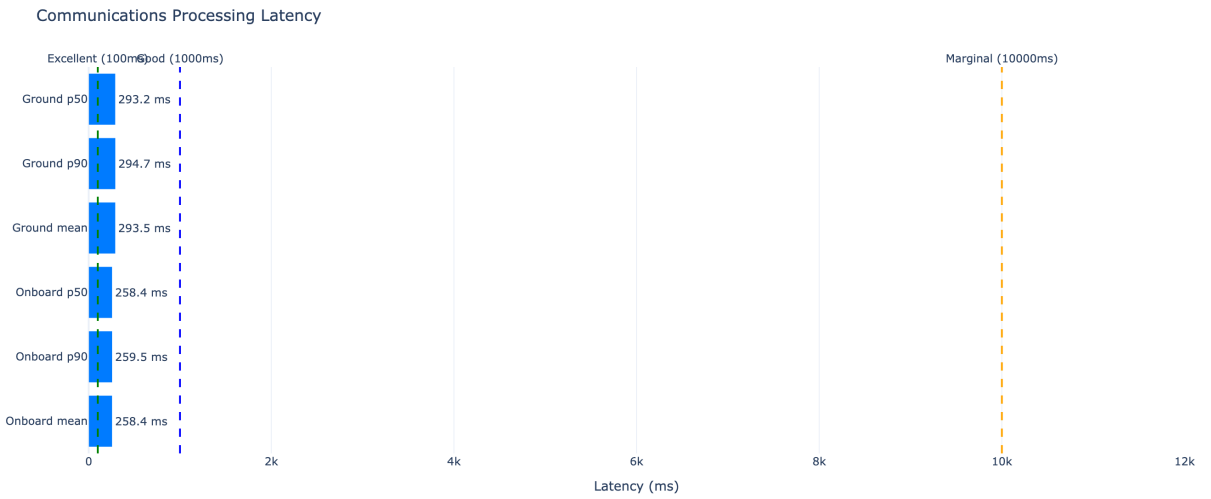

Figure: Distribution of ground and onboard processing latency. Lower latency indicates faster data processing.

Summary Metrics

Filter Performance

Index	RMSE [km]	Bias [km]	Median [km]	P50 |err| [km]	P90 |err| [km]	P95 |err| [km]
X	0.4194	-0.3589	-0.3538	0.3538	0.6403	0.7291
Y	0.2611	-0.1569	-0.1691	0.1997	0.4203	0.482
Z	0.5302	-0.4918	-0.5007	0.5007	0.7354	0.7996
NORM	0.7247	0.6962	0.6951	0.6951	0.9485	1.0154

Triangulation Performance

Index	RMSE [km]	Bias [km]	Median [km]	P50 |err| [km]	P90 |err| [km]	P95 |err| [km]
X	0.4687	-0.3578	-0.3511	0.3592	0.7463	0.8691
Y	0.3292	-0.1518	-0.157	0.2315	0.5384	0.6245
Z	0.5676	-0.489	-0.4908	0.4908	0.8537	0.947
NORM	0.8063	0.7624	0.7488	0.7488	1.1335	1.2216

Geometry & Access Statistics

metric	value
coverage_percent	100.0
gaps_count	0.0
coverage_duration_s	636.0
range_km_mean	26553.881
range_km_min	23209.879
range_km_max	30011.63
n_sats	12.0

Covariance Statistics

Index	mean [km²]	median [km²]	mean [km³]	median [km³]
P_xx	0.095228	0.092175	-	-
P_yy	0.087783	0.087962	-	-
P_zz	0.082093	0.07925	-	-
ellipsoid_volume	-	-	0.109175	0.105426

Filter Consistency (NIS/NEES)

metric	mean	std	p_within_95	chi2_95_low	chi2_95_high
NIS	2.522	1.9075	0.9451	0.2158	9.3484