Telemetry Resetability Analysis Report

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This report presents the application of the Resetability (R) metric to real telemetry data.
The method quantifies the geometric reversibility of attitude trajectories over time using recorded quaternion telemetry.
Low values of R indicate moments where the rotational history is close to commutative and hence can be reset by a scaled
two-pass replay of recent orientation changes.

1. Input Data

The input telemetry file contains quaternion data (qw, qx, qy, qz) and timestamps.
A rolling analysis window evaluates the local resetability R and the net rotation angle θ_net across the trajectory.

2. Methodology

Using a sliding window approach, sequences of orientation quaternions are extracted and processed via the
Resetability algorithm implemented in `so3_reset.py`. For each window, the following quantities are computed:

- λ: scaling factor estimated from the net rotation angle.
- R: resetability index, where $R \approx 0$ indicates strong reset potential.
- θ_net: the total rotation magnitude within the window (degrees).

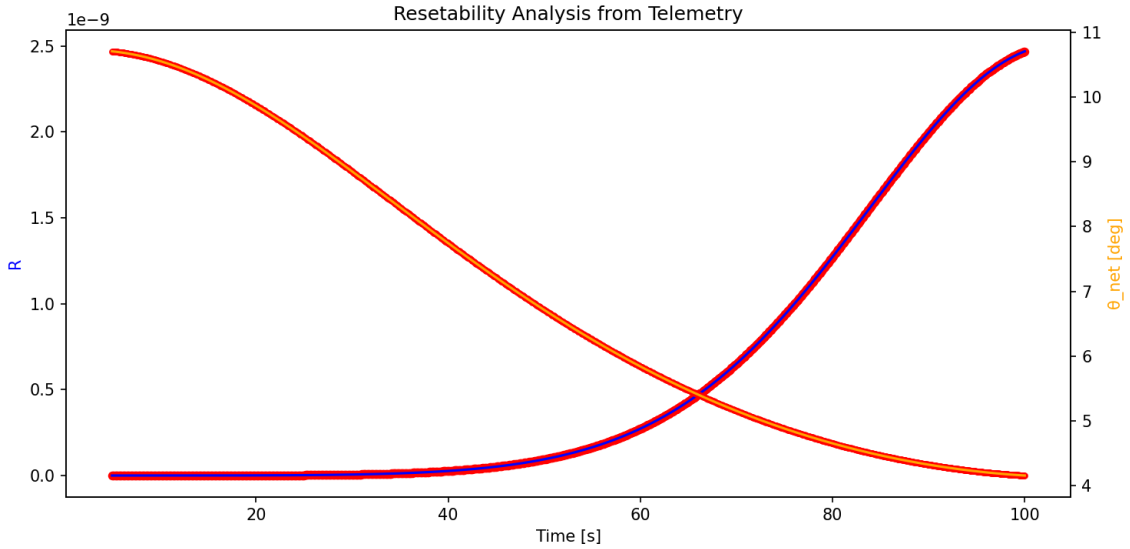
3. Results

The analysis results are stored as CSV files and visualized through static and animated plots.
Moments of low R combined with significant θ_net are considered "reset opportunities" —

intervals where attitude correction could be achieved with minimal control effort.

Generated output files:

- telemetry_analysis.csv — full timeline of R and θ_net values
- telemetry_reset_opportunities.csv — low-R, high-rotation segments
- telemetry_resetability_plot.png — static plot visualization
- telemetry_resetability_*.mp4 — animation showing R and θ_net evolution



4. Interpretation

The figure illustrates R (blue) and θ_net (orange) as functions of time.
Red markers highlight potential reset opportunities where the λ-reset primitive could be applied.
In operational scenarios, such segments correspond to times when a spacecraft or robotic platform could cancel residual orientation drift through replayed scaled control actions.

5. Conclusions

This telemetry analysis confirms that Resetability (R) can be computed directly from flight data, enabling real-time or post-mission detection of recoverable attitude states.
This capability bridges analytical SO(3) reset theory with real-world telemetry streams for both robotic and aerospace systems.