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Comparative Analysis of Data Preprocessing Methods for Precise Orbit Determination

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In Precise Orbit Determination (POD), employing proper methods for pre-processing tracking data is crucial not only to mitigate data noise but also to identify potential unmodeled effects that may elude the prediction model of the POD algorithm. Unaccounted effects can skew parameter estimation, causing certain parameters to assimilate the unmodeled effects and deviate from their true values. Therefore, enhancing the pre-processing of tracking data ultimately contributes to refining the prediction model.

The Rosetta spacecraft, during its two-year mission alongside comet 67P/Churyumov-Gerasimenko, collected a substantial dataset of tracking data. In addition to this data, also tracking data from the Mars Express spacecraft, orbiting Mars since 2004, will serve as a use case to assess and compare diverse data pre-processing methods. Both traditional and AI-based techniques are explored to examine the impact of various strategies on the accuracy of orbit determination. This aims to enhance POD, thereby yielding a more robust scientific outcome.