Window Incremental Forest for System Delay Prediction in Satellite Laser Ranging

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Satellite laser ranging (SLR) data includes system delay, typically derived and subtracted through ground target measurements. To address the instability of data quality in SLR, attributable to the low accuracy and stability of ground target values, this study introduces a system delay prediction methodology utilizing Window Incremental Forest. By employing system delay measurements and meteorological parameter data acquired from the SLR system of Kunming station, a predictive model is developed that combines the random forest framework, window increment, and temporal integration mechanism, thus forecasting ground target ranging values based on historical data, time, and meteorological parameters. Experimental results indicate that this methodology outperforms traditional models including Support Vector Regression, Multilayer Perceptron, and Gradient BoostRegression Trees, achieving a root mean square error of 19.56144 ps, a mean absolute error of 15.5185 ps, and an adjusted R-squared value of 0.8725. Consequently, the Window Incremental Forest can effectively predict system delays, offering a robust solution for monitoring the accuracy and stability of ground target measurements and thereby enhancing the overall quality of SLR data.