

A Python-based Analysis Toolkit for SLR Ground Stations

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We are developing a flexible and extensible data analysis toolkit using the Python programming language which streamlines SLR measurement analysis, from raw time interval measurements to end-user data products (i.e., full-rate and normal point CRD files). Our toolkit leverages some standard routines available through the ILRS (i.e., CPF interpolation) and the IERS (e.g., solid earth tide and pole tide models), adapted for 2kHz high-precision ranging to satellites in LEO, MEO, and GEO. The toolkit is modularized, and leveraging the "package" design philosophy of modern Python development, so that the toolkit is simple to import into other systems as a standalone application or used in conjunction with other tools. The novel components of the toolkit include: an unbiased median filter for SLR signal detection/extraction, a raw laser event epoch pairing filter, file-interface modules for reading and writing ILRS CRD (v2) and CPF files, and utility modules for converting between date-systems and coordinate frames. The signal detection/extraction algorithms use the `numpy` Python package as much as possible. Doing so consolidates variables into industry-common data-types, but also ensures the bulk of computations are done at high-precision in C, where efficiency is highest, in conjunction with the flexible object-oriented nature of Python. To aid in the toolkit development, we have also made Graphic User Interfaces to serve as a front-end SLR data analysis platform for displaying and assessing analysis results.