

MODERNIZING THE LASER TRACKER NETWORK ADJUSTMENT WORKFLOW - AN INTEGRATED SOFTWARE SUITE FOR ACCELERATOR ALIGNMENT

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MOTIVATION

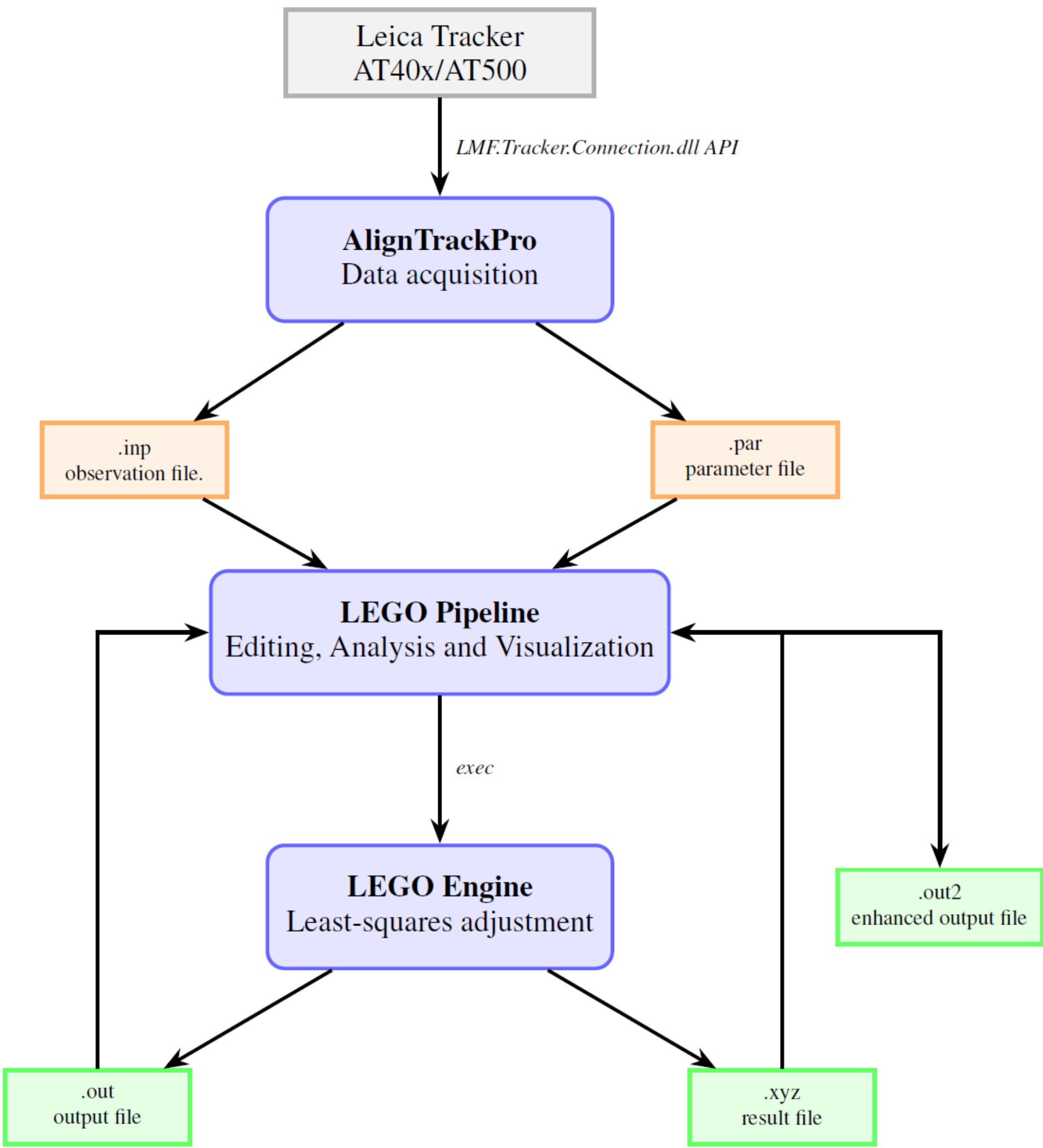
Commercial tracker software (e.g., Spatial Analyzer) adjusts networks in a single Cartesian frame with **one uniform vertical**.

Over large volumes the local vertical varies — neglecting gravity introduces **~0.2 mm over 50 m**, exceeding accelerator tolerances.

LEGO (SLAC, 1990s) solved this with gravity-compensated adjustment in geodetic coordinates — but became obsolete (last built 2012, dead on Win 11).

A complete modernization was needed.

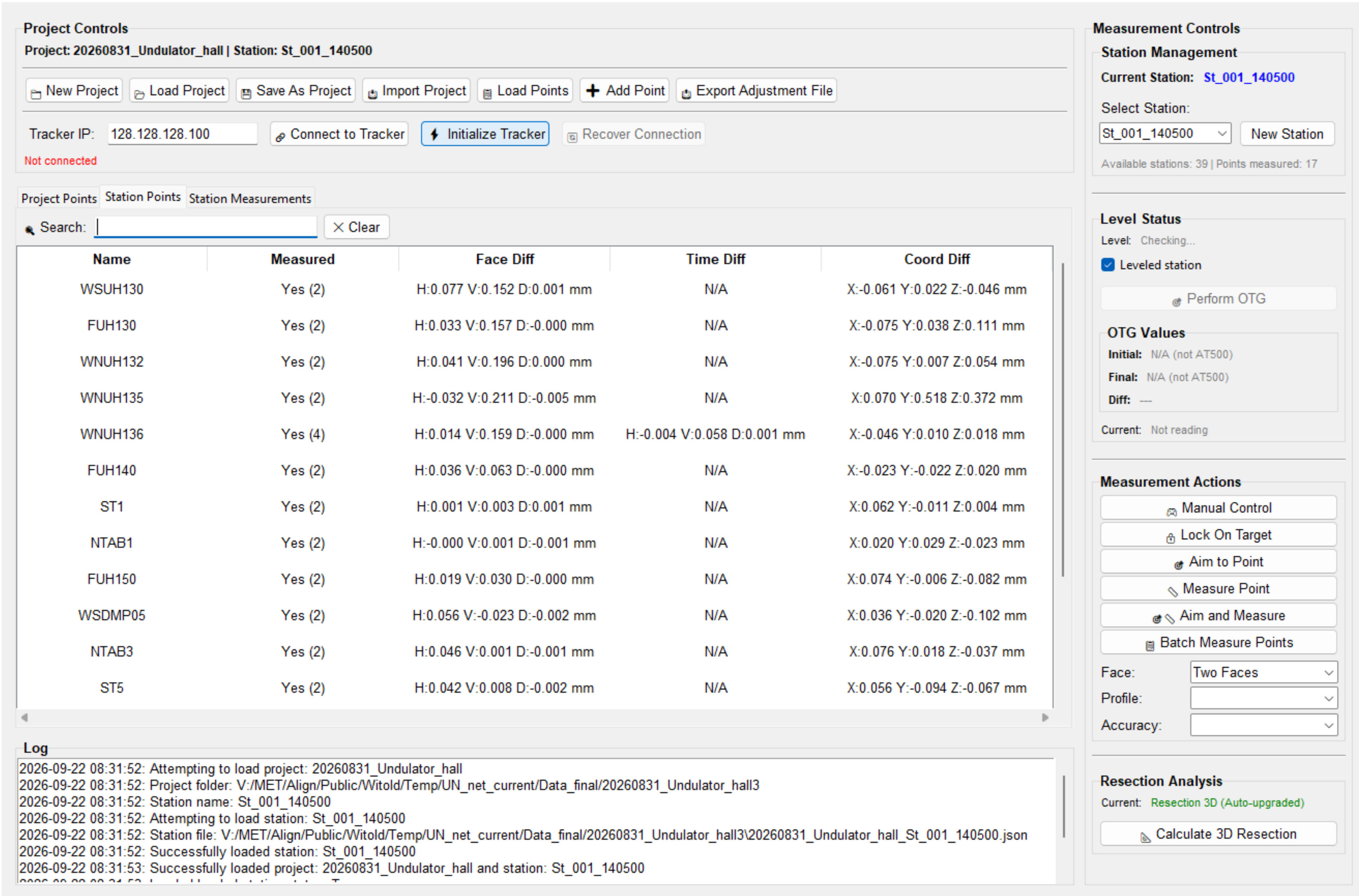
SYSTEM ARCHITECTURE



SYSTEM COMPONENTS

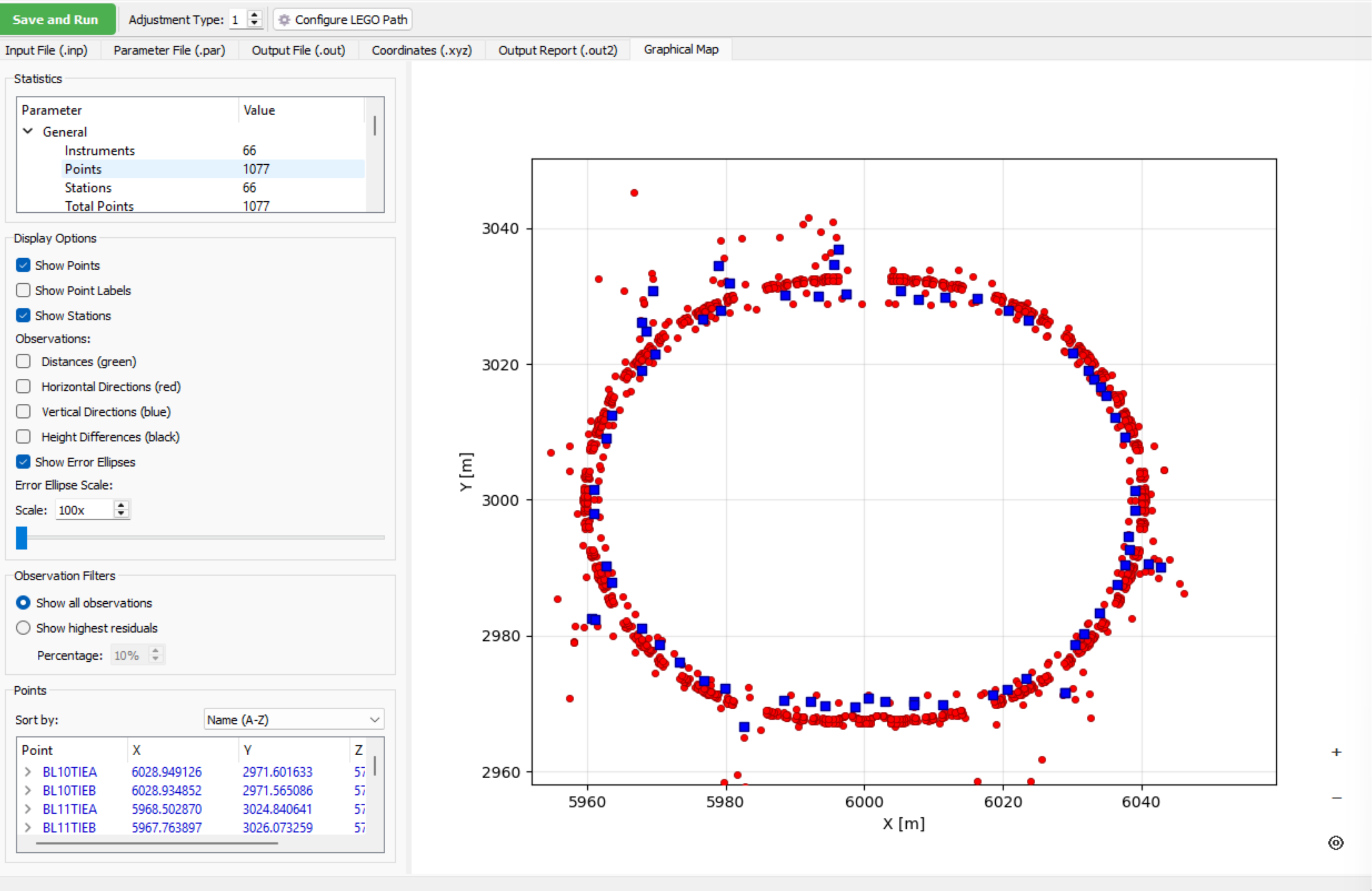
- ① **AlignTrackPro** (Python) Automated resection & two-face batch measurement; Orient-to-Gravity (OTG) inclinometer data; live outlier detection; direct export to LEGO / CERN LGC.
- ② **LEGO Engine** (C/C++, VS 2025) Rebuilt legacy adjustment engine. Fixed pointer/memory bugs; kept gravity compensation. Validated bit-for-bit against 2012 results.
- ③ **LEGO Pipeline** (Python) One-click "Save & Run"; multi-tab file editing; covariance export (.out2); Matplotlib network visualization.

ALIGNTRACKPRO



AlignTrackPro interface — project management (top), three data tabs (left), and measurement controls with real-time quality indicators (right). Face, time, and coordinate differences are color-coded to flag outliers.

LEGO PIPELINE



LEGO Pipeline — multi-tab file editing and interactive network map. Points (red), stations (blue), and observations shown as colored lines; error ellipses and residual filtering enable rapid spatial quality control.

ACKNOWLEDGEMENTS

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