Information Technology and Software

Universal and automated Monte Carlo method code for uncertainty propagation in large volume metrology databases

Widespread use of the Monte Carlo simulation within large measurement databases

A custom Monte Carlo uncertainty propagation routine was developed by NASA Goddard as a means to robustly propagate, analyze, and book-keep, the uncertainty associated with spatially transforming targets and unit vectors between databases with common targets.

BENEFITS

- Probability figures on large data sets

- Fast and structured approach

technology solution

THE TECHNOLOGY

A custom Monte Carlo uncertainty propagation routine was developed that fuses multiple measurements and their uncertainties from a network of different metrology instruments. The Monte Carlo error propagation routine generates N-different geometric best-fit transformations between two separate databases with at least 3 corresponding targets. Each of the geometric transformations involves simulating target measurements from the sum of the nominal targets and their randomly-drawn uncertainties. The user has the option of uninvolving common outlier targets as well as specifying the number of MC transformations to be used. The Monte Carlo error propagation method has been shown to be beneficial for propagating uncertainty through multiple James Webb Space Telescope (JWST) databases and for estimating transformation uncertainty for line-of-sight modeling scenarios where one or more targets may be omitted from a best-fit transformation. Typical run times for the Monte Carlo Transformation Uncertainty (MCTU) code range from 15 seconds for 10 targets to 2 minutes for several hundred targets on a 64-bit Windows 7 machine, using 1,000 Monte Carlo transformations. The MCTU software offers a robust approach to characterizing and propagating the uncertainty in transformed metrology database targets based on the uncertainty in a rigid body constellation of targets involved in the transformation.

APPLICATIONS

The technology has several potential applications:

- Metrology software
- Engineering probability calculations

PUBLICATIONS

Patent No: 9990335

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

GSC-17370-1
GSC-TOPS-92

More Information