DOD HPC DEPARTMENT OF DEFENSE HIGH PERFORMANCE COMPUTING MODERNIZATION PROGRAM

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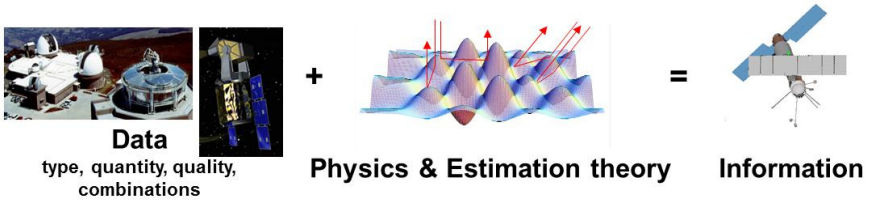
MREx Software on the HPCMP Portal

Model Based Radiometry Exploitation (MREx) uses an unscented Kalman filtering (UKF) in conjunction with Time-domain Analysis Simulation for Advanced Tracking (TASAT) code. MREx software currently generates a near real-time attitude solution from time resolved space object brightness data.



MREx is an emerging modeling and simulation technology and Air Force Research Laboratory (AFRL) software suite that is under continuous development to support space situational awareness (SSA). MREx is providing autonomous tools for processing complex and non-intuitive data types obtainable from simple sensors. It leverages a priori information on space objects to enable near-real time information collection of satellite condition and status, mapping this information content into specific data types to maximize information utility from all sources of acquired data. MREx is being developed to implement and test the effectiveness of combining a priori knowledge of the target and observations to derive information about the target's pose, shape, surface materials, and operational status. MREx uses an HPC-based coarse grain parallel implementation of TASAT. A particle estimator adjusts TASAT software inputs to match predicted radiometry to real observation data, providing autonomous processing of radiometric data. An unscented estimator updates TASAT input parameters to match predicted radiometry to observed data.

Advanced technology being employed in MREx includes advanced estimation performance metrics used to identify most likely solution with associated confidence. Model inaccuracies are addressed to quantify forward modeling limitations and their impact on the approach. The observability of estimation parameters is also being addressed to understand the information content in radiometric data.

MREx benefits include:

- Autonomous and near-real time results for pose estimation
- Tactical SSA applications
- Improved satellite characterization and modeling
- Observational data mined for shape, components, and materials information to improve satellite model
- Foundational SSA for improved predictive capabilities
- Interpretation of change detection
- Identify change due to shape, material, or attitude profile
- Increased SSA capabilities from small aperture sensors
- Approach extendable to evaluate information content of other types of observations and combinations
- Multiple filter bands or spectral data
- Poorly-resolved imagery
- Active radiometric data and imagery

Model-based radiometry exploitation development is challenging, requires compensating for modeling errors regarding materials and components. Additionally, space object glints are powerful, but highly nonlinear. However, development and lessons learned to date show that wavelength diversity is valuable. HPC is a key enabler; and real data results show that the model-based approach is viable.

For additional information, contact info@mhpcc.hpc.mil