FY23 Topic Areas Research and Technology Development (TRTD)

DECISION - Data-driven Efficient Configuration of Instruments by Scientific Intent for Operational Needs

Principal Investigator: Jack Lightholder (398)**; Co-Investigators:** Lukas Mandrake (398), Mark Wronkiewicz (398), Hallie Gengl (397), Scott Perl (397), Christian Lindensmith (383)

Strategic Focus Area: Modeling and Simulation

Objective

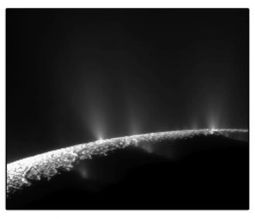
Future missions attempting to maximize science are likely to move science data processing onboard the spacecraft. This enables rapid follow-on decision making, autonomous transient detection and data driven prioritization strategies. These systems, referred to as Onboard Science Instrument Autonomy (OSIA) will require reconfiguration throughout the mission life cycle to adjust to evolving science and ConOps demands. DECISION places the ability to reconfigure onboard autonomy applications in the hands of the science team and mission operators through an intuitive graphical user interface. DECISION provides a step-by-step process for autonomy reconfiguration, with traceability of decision making.

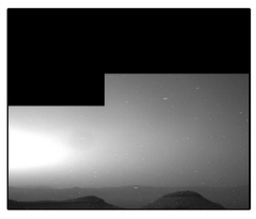
Onboard Science Instrument Autonomy (OSIA) Capabilities

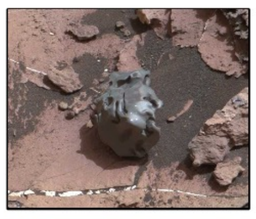
Feature Identification


Data Prioritization


Data Compression


Transient Detection

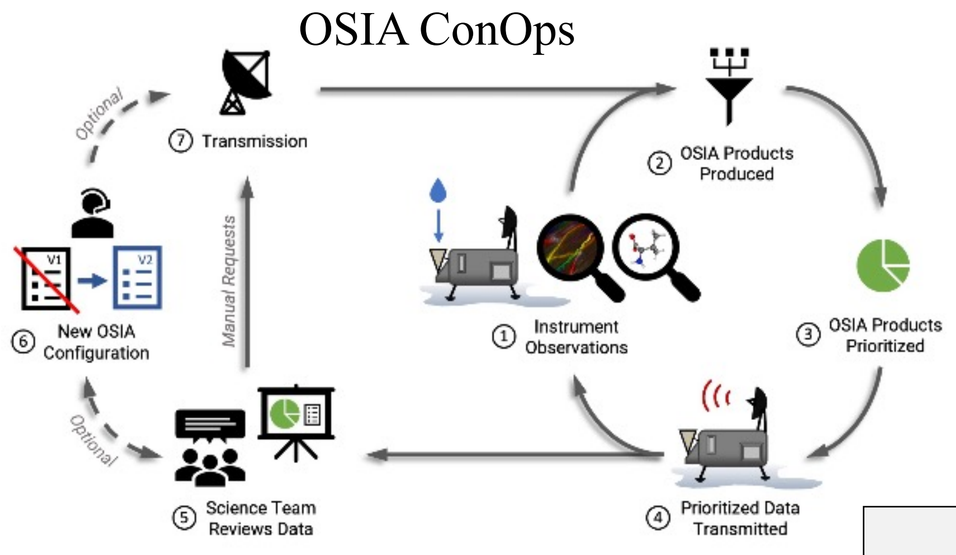

Instrument Health Monitoring


Novelty / Diversity Sampling

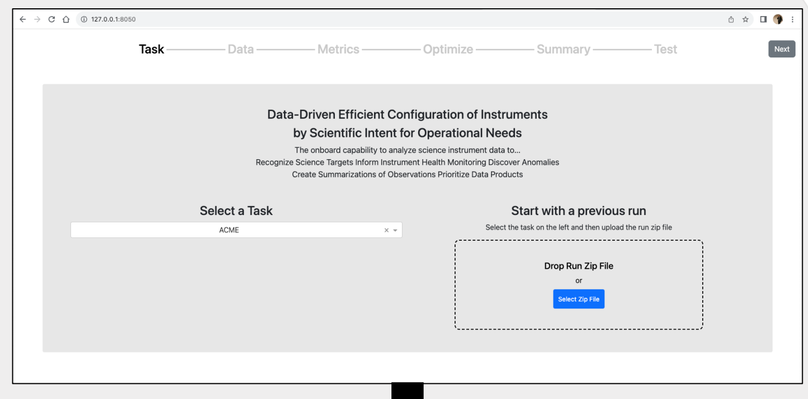
Architecture

- Complete Python implementation using Plotly Dash front end.
- Dakota (Sandia National Labs) genetic algorithm optimization engine.
- Support for local, AWS cloud and high-performance compute (supercomputer/cluster) environment runtime.
- Focus on translating data science approaches/terminology to the mission operations user community domain.

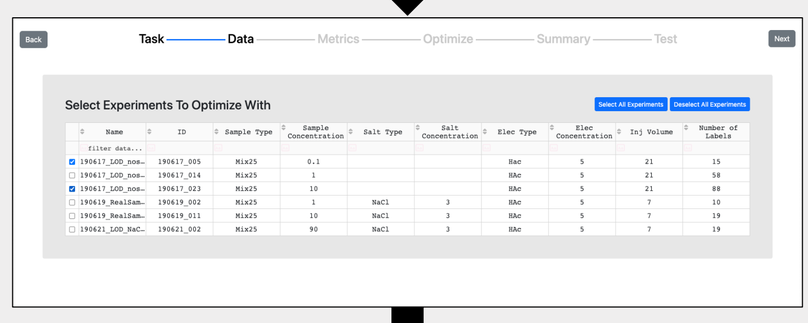
OSIA ConOps



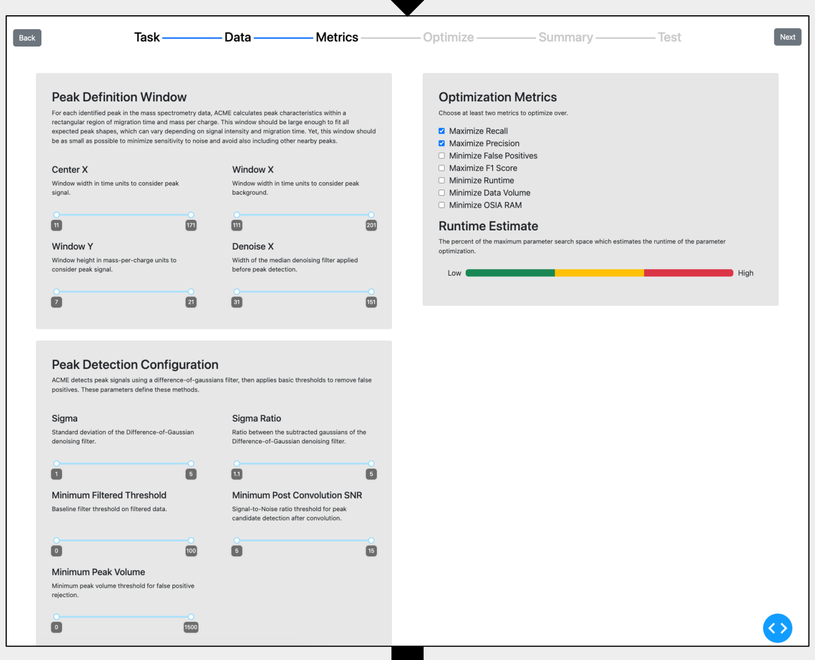
Configuration – Users select which onboard science instrument autonomy (OSIA) they wish to optimize. Optionally, users can load previous sessions to continue refining past results.



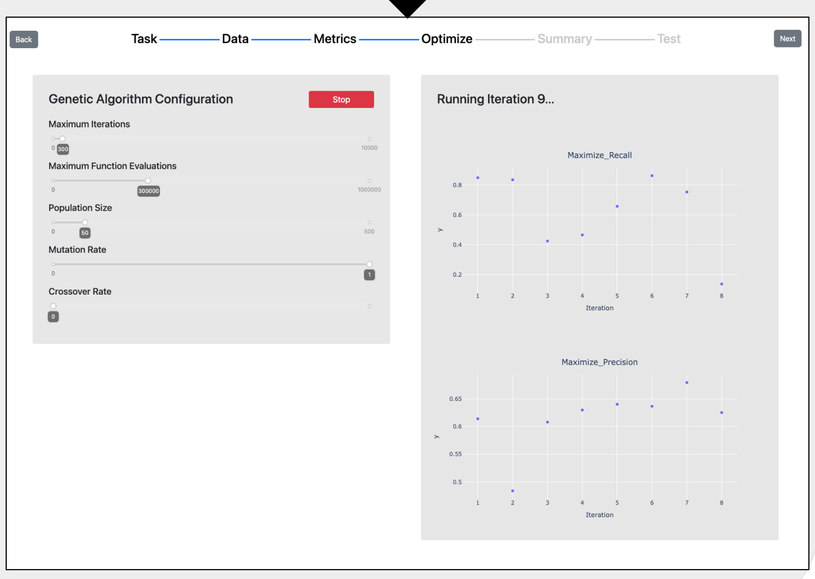
Data Curation – Prompts users to select labeled data which is pertinent to the use case the user is optimizing for.



Parameter / Metric Selection – Prompts users to select the search ranges of parameters which must be optimized. Metrics by which to judge performance are also chosen. Common metrics include minimizing runtime, minimizing onboard RAM usage, maximizing accuracy and maximizing precision. Users with complex optimization needs may select multiple metrics to optimize for.



Optimization Runtime / Monitoring – Users are provided with real time insight into the status of the optimization convergence. Real time plots allow the user to track convergence and decide when to move on to data exploration and system reconfiguration.



National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

www.nasa.gov

Contact:
Jack Lightholder
jack.a.lightholder@jpl.nasa.gov

Additional Information:
https://ml.jpl.nasa.gov/Instrument.html