A **Distributed Spacecraft Mission (DSM)** is a mission that involves multiple spacecraft to achieve one or more **common goals**.

**Constellation** is a space mission that, beginning with its inception, is composed of two or more spacecraft that are placed into specific orbit(s) for the purpose of serving a common objective (e.g., Iridium).

**OBJECTIVES**
- Extend TAT-C Capabilities, i.e., increase the dimension of the trade-space with:
  - Various trajectories, orbital planes, mission replanning, orbit and Maneuver Modeling, etc.
  - New trade modules (instrument, launch, onboard computing, etc.)
- Optimize the Trade-Space Exploration by Utilizing Machine Learning and a Fully Functional Knowledge Base (KB) to Efficiently Traverse a Large Trade-Space

**SCIENCE REQUIREMENTS - INPUTS**
- Mission Concept (Start epoch, Area of interest, etc.)
- Satellite Specs (Number of Sats, Types, Altitudes, etc.)
- Payload Specs (Type, Mass, Volume, Power, etc.)

**SCIENCE REQUIREMENTS - OUTPUTS**
- Spatial Metrics (res, swath, image overlap, coverage, etc.)
- Temporal Metrics (occultation time, %period time in sun, repeat & revisit times, etc.)
- Angular Metrics (zenith and azimuth angles, solar zenith and azimuth angles, etc.)
- Radiometric Metrics (signal to noise ratio, etc.)

**KNOWLEDGE BASE**
- Centralized store of structured data readable by humans and machines
- Support all TAT-C tasks:
  - Analysis: compose new mission concepts from existing model inputs
  - Exploration: discover new mission concepts by querying previous results
  - Layered client-server architecture over HTTP

**REDUCTION & METRICS MODULE**
- Reduction & Metrics is responsible for calling module ‘Orbits & Coverage’ to propagate the orbit of every sat and compute coverage given payload specs.
- Reduction & Metrics integrates coverage and computes all performance metrics.

**GRAPHICAL USER INTERFACE (GUI)**

**TRADESPACE SEARCH ITERATOR (TSI)**
- TSI reads user inputs given to the GUI to create iterator inputs (JSON files). Uses default values from Landsat 8 (w/ ETM+ payload) if no inputs
- TSI generates DSM architectures for a combination of variable values that satisfy iterator inputs
- A DSM architecture is a unique combination of variable values (altitude, inclination, FOV, number of satellites, etc.)
- For each arch, TSI creates files and sends commands to module ‘Reduction & Metrics’ to compute architecture performance and to module ‘Cost and Risk’ to compute architecture cost

**ORBIT & COVERAGE MODULE**
- Model orbits balancing accuracy and performance
- Compute coverage metrics for constellation/sensor set
- Compute ancillary orbit data for performance, cost, and risk

**COST & RISK MODULE**
- Improve on limitations of existing models w/ to constellations
- Aggregate model consisting of Cost Estimating Relationships (CERs) from widely accepted, publically available models
- Output: Probability density function showing most likely cost for mission lifecycle + selected mission components, including recurring, non-recurring, spacecraft bus, and payload

**CURRENT ACCOMPLISHMENTS**
- Definition Requirements
- Architecture and Overall Control Flow
- Current version (implemented in C++ and Python):
  - Modules: Tradespace Search Iterator (TSI), Reduction and Metrics (R&M), Orbit and Coverage (O&C), Cost and Risk (C&R) Assessment, Functioning Knowledge Base (KB)
- Homogeneous and heterogeneous, ad-hoc and precessing constellations
- Fully functional Graphical User Interface (GUI) and prototype OSSE interface
- Validation using Sustainable Land Imaging (SLI)

The authors wish to acknowledge the support of NASA Earth Science Technology Office (ESTO) Advanced Information Systems Technology (AIST) Program under NNB-1200019013-AIST.