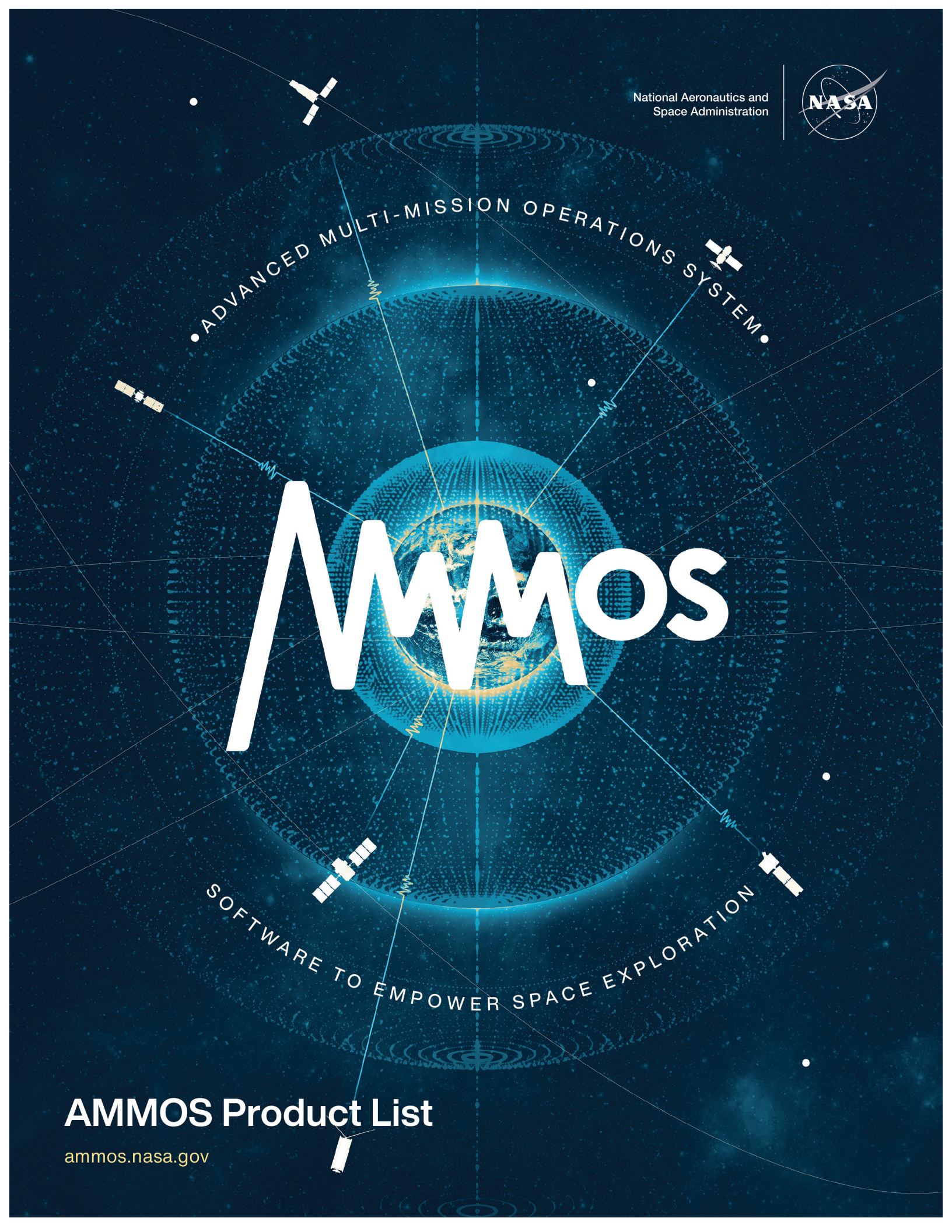
National Aeronautics and Space Administration



AMMOS Product List

ammos.nasa.gov

AMMOS Product List

About the AMMOS

NASA has developed the Advanced Multi-Mission Operations System (AMMOS), a common set of software products used to support robotic mission operations across NASA. Its proven reliability and cost-effectiveness have made the AMMOS NASA's recommended mission operations software.

The AMMOS products help you plan your mission, navigate, connect with your spacecraft and instruments, and generate science data. Products are designed, maintained, and sustained by NASA with security in mind.

The AMMOS continually evolves its software products to meet the challenges of future space exploration. To best support NASA's future autonomous missions, the AMMOS seeks to integrate Artificial Intelligence into its products to create resilient, intelligent ground systems capable of managing spacecraft operations, analyzing scientific data, and responding to anomalies without real-time human inputs. This commitment to new technology enhances mission safety and efficiency and enables spacecraft to explore farther and achieve more than ever before.

Who uses the AMMOS?

Products can be scaled to fit the needs of all classes of missions, including instruments, small satellites, constellations, rovers, and larger missions. The AMMOS supports all mission phases, from proposal through operations. The AMMOS is developed for use by missions across NASA and has been utilized by more than 100 missions. It is also utilized by academia, private entities, and international governments.

The AMMOS Advantage

Developing and maintaining mission operations software can be challenging and costly. When a mission utilizes the AMMOS products, it saves resources for other mission needs. The AMMOS products are provided at no cost to NASA missions. The only cost to a NASA mission is for specific adaptation or customization.

How to access the AMMOS products

Many AMMOS products are open source and are accessible through the link below. Other products are accessible by contacting our mission support team. For most products, royalty-free licenses may be granted to United States Government entities (including NASA), Third Parties for Research use, and in some cases, partner U.S. government contractors. The Monte product is available to commercial entities with a licensing fee.

Functions of the AMMOS

Mission Design and Navigation

Trajectory Search & Optimization, Orbit Determination, Maneuver Design & Analysis, Solar System Ephemerides, Gravity Models

Mission Planning, Sequencing, and Analysis

Activity Planning, Sequence Generation & Validation, Mission Downlink Analysis, Multi-Mission Resource Scheduling, Relay

Instrument Data System

Science Product Management, Instrument Calibration, Science Data Visualization, Image Processing & Mapping, Instrument Autonomous Operations

Mission Control System

Secure Uplink & Downlink, Data Management, Data Visualization, Monitoring, Testbed Support

Security

Application Security, Data Security, System Monitoring

Product List

Mission Design and Navigation Products

Monte (Mission-Analysis, Operations, & Navigation Toolkit Environment)
Monte is NASA's gold standard for mission design and navigation software. It supports all phases of space mission development and operations, from early-stage mission design and analysis through flight navigation and beyond end of mission.

Natural Body Ephemerides (Open Source)
A mathematical model of the Solar System that shows time, position, and velocity of points in the path of planets, planetary satellites, comets, and asteroids around the Sun. These ephemerides constitute a map that a mission can use to develop a spacecraft trajectory.

Natural Body Gravity Models (Open Source)
Mathematical models of the gravitational forces of Solar System bodies which can be used in spacecraft navigation and science.

Mission Planning, Sequencing, and Analysis Products

Plan Development Environment
Collaboratively creates, modifies, simulates, and validates activity plans for a mission. Generates plans that meet mission constraints via an automated scheduling engine. Displays plans with customized views on a mission timeline. Expands plans into sequences of commands which can be exported into SeqDev.

Sequence Development Environment
An integrated development environment (IDE) for sequencing that supports spacecraft operators with the development of sequences of commands by providing syntax highlighting and content assist. Allows tailoring to a mission's flight software and sequencing language. Provides an interface to connect mission specific compilers, sequence checkers, and sequence modeling tools.

Sequence Generation
Integrates sequences of commands and simulates the predicted spacecraft behavior. Validates command syntax, execution, and adherence to flight rules. Generates file deliveries required for missions to use Deep Space Network (DSN) ground stations. Exports from PlanDev can be edited in SeqDev and used as inputs into SeqGen.

Resource and Activity Visualization Engine
Displays activity and sequence plans, ground events, and simulated versus actual spacecraft telemetry on a customizable and sharable timeline view. PlanDev is one of many sources of timeline data that can be visualized and compared in RAVEN.

Sequence Tracker
Tracks status of submission, review, and approval of products and files that a mission plans to send to a spacecraft.

Multi-Mission Time Correlation (Open Source)
Tracks drift between clocks on deep space missions with high precision clocks on Earth to pinpoint spacecraft locations, accurately command spacecraft activities, and precisely time tag scientific data.

Mission Independent Memory Examiner
Tracks, predicts, and compares flight software parameter values and other files stored in a spacecraft's computer memory to support analysis and anomaly investigation.

Multi-Mission Resource Scheduling Service
Provides infrastructure and access to a team of schedulers who negotiate on behalf of space missions of all types (domestic, international, and commercial) for dedicated communication time on Deep Space Network ground stations. Missions cover the cost of dedicated scheduler support only.

Mars Relay Operations Service
MaROS facilitates telecommunication coordination between operators of landed and orbiting spacecraft at Mars to dramatically increase the amount and timeliness of data returned to Earth for Mars Relay Network (MRN) missions.

Instrument Data System Products

Multi-Mission Geographical Information System (Open Source)
A collaborative, web-based mapping platform that streamlines visualization and analysis of localized instrument data from orbiters, rovers, airborne, and in-situ instruments. Developed to support both Planetary and Earth missions ranging from small-scale field campaigns to full operational settings.

AMMOS Science Targeting Toolkit for Robotic Operations
A web-based platform that allows a mission team to interact with a spacecraft's environment by using high-fidelity positioning information to support localized, precision movements of the spacecraft and its instruments.

Astria
An image data studio designed for in-situ missions, Astria offers a web-based application for high-performance browsing and analysis of large-scale imagery. Users can overlay data products, inspect pixel values, and share views via a URL. Provides teams with rapid, intuitive access to vast image archives.

Terrain Intelligence Generator
Built to work with unique instrument data formats to allow conversion from one format to another while retaining metadata. Processes raw instrument telemetry into visual products for surface and orbital mission operations. Combines data from multiple instruments to create an integrated view, with options for data co-registration, radiometric calibration, and 360° renderings. Generates surface characteristics to describe the environment, offering a precise spatial context for pathfinding and obstacle avoidance. Can be automated to generate terrain and orbital data.

Location Tracker
Maintains surface asset location and orientation over time. Mission teams can easily add, refine, or retrieve locations to support robotic surface navigation.

AMMOS Instrument Toolkit (Open Source)
A Python-based product that provides basic capabilities for instrument uplink, downlink, and sequencing. Designed for quick deployment, AIT is readily used for instrument test activities and can seamlessly transition to support instrument operations. Integrates with standard ground stations such as NASA's Deep Space Network (DSN) via the Consultative Committee for Space Data Systems (CCSDS) Space Link Extension (SLE) protocol.

Autonomous Exploration for Gathering Increased Science
A science targeting algorithm that performs edge computing via on-board computer vision that autonomously identifies and prioritizes potential science targets based on geological features.

DECISION (Open Source)
A ground-based optimization product that configures and tunes Machine Learning and Artificial Intelligence algorithm parameters. It generates optimized packages for deployment to the spacecraft, enabling sophisticated on-board analysis and scientific decision-making.

Science Yield improvemeNt via Onboard Prioritization and Summary of Information System Requirements (Open Source)
An on-board data prioritization product that enables a mission team to configure rules across instruments on-board the spacecraft to support downlink prioritization.

Mission Control System Products

Open Mission Control Technologies (Open Source)
Adaptable for a wide range of mission types, Open MCT is a mission control platform for visualization of real-time mission telemetry and other mission data on desktop and mobile devices.

Asynchronous Network Management System (Open Source)
Offers the capability to monitor and control agents that communicate using Disruption Tolerant Networking (DTN) protocols, including Asynchronous Management Protocol (AMP).

Initiatives

Multi-Center Open Source Mission Control Initiative (Open Source)
This initiative is the result of a multi-year study performed across NASA centers which looked at multiple open source mission control products and determined that an open source solution is feasible for use as a preferred NASA mission control system. The open source product Yamcs plus the AMMOS open source product OpenMCT would serve as the core of this new mission control solution.

Retiring Products

AMMOS Mission Data Processing & Control System
Performs spacecraft commanding and telemetry processing throughout the mission lifecycle. Includes a telemetry parameter database and an automation toolkit to streamline

testing and routine operations. Includes real-time monitoring and alarm capabilities. Features integration with the Deep Space Network (DSN) and any network providing Space Link Extension (SLE) services.

Space Link Extension Command Client
A stand-alone solution for commanding spacecraft. SCC offers a full-featured client that can be used to connect to the Deep Space Network (DSN) or any network providing Space Link Extension (SLE) services.

Security Products

Data Cryptography Services (Open Source)
Provides encryption and decryption of digital information, creates and verifies integrity check values, and applies and reverses Consultative Committee for Space Data Systems (CCSDS) Space Data Link Security (SDLS) protocol. Application-level security for DCS can be provided by CAM or transport layer security client authentication.

Common Access Manager
Provides application layer access control, including single sign-on, federation, authorization management, authorization checking & enforcement, identity data retrieval, and logging. CAM can use Lightweight Directory Access Protocol (LDAP), Active Directory, Kerberos, NASA Personal Identity Verification (PIV) smart card, and RSA SecurID® for identification and authentication.

System Security Monitor
Alerts designated recipients (e.g., System Administrators) when important system files have been altered unexpectedly. Monitors the integrity of a customized list of: operating system files, software application files, configuration files, and other files that are not expected to change when the system is operated.

Bundle Protocol Security Library (Open Source)
For users of Disruption Tolerant Networking (DTN), AMMOS offers the Bundle Protocol Security (BPSec) Library (BSL), which is NASA's open source software implementation of Consultative Committee for Space Data Systems (CCSDS) and Internet Engineering Task Force (IETF) standard security protocols. This library can be integrated into a mission to provide security of data sent over DTN, both in space and on the ground.

Contact the AMMOS

Have a question? We're here to help.

For questions about the AMMOS, guidance on how to get started with the AMMOS products, or to learn more about how the products can support NASA missions from formulation to operations, contact us and a member of our mission support team will follow up with you.

ammos@jpl.nasa.gov

Many AMMOS products are open source. Join our community!

https://github.com/NASA-AMMOS