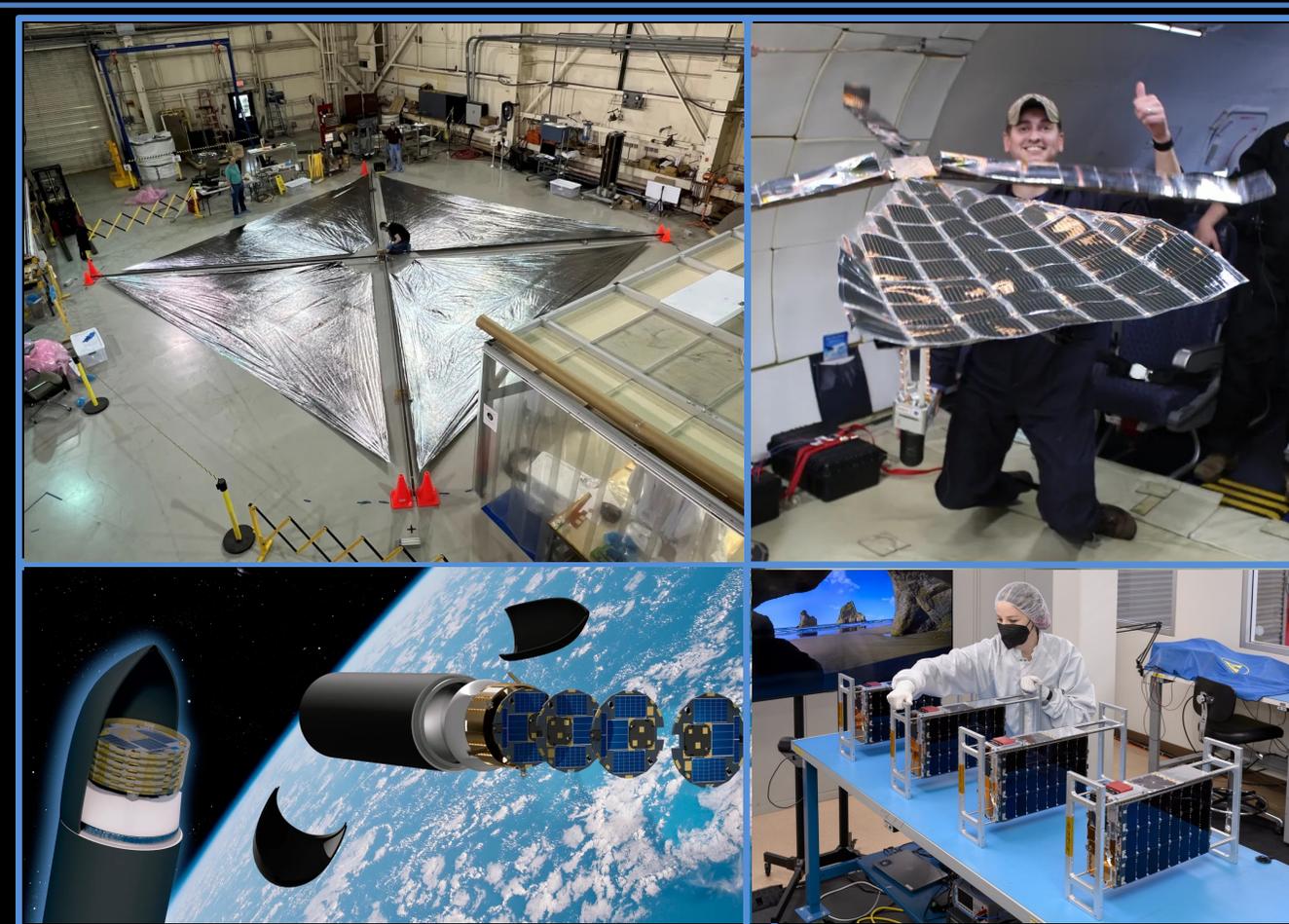# Introduction to the NASA Small Spacecraft Systems Virtual Institute (S3VI)

February 28, 2024

**Access to Space for All
Systems Engineering Webinar Series**

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Deputy Director, NASA Small Spacecraft Systems Virtual Institute

www.nasa.gov

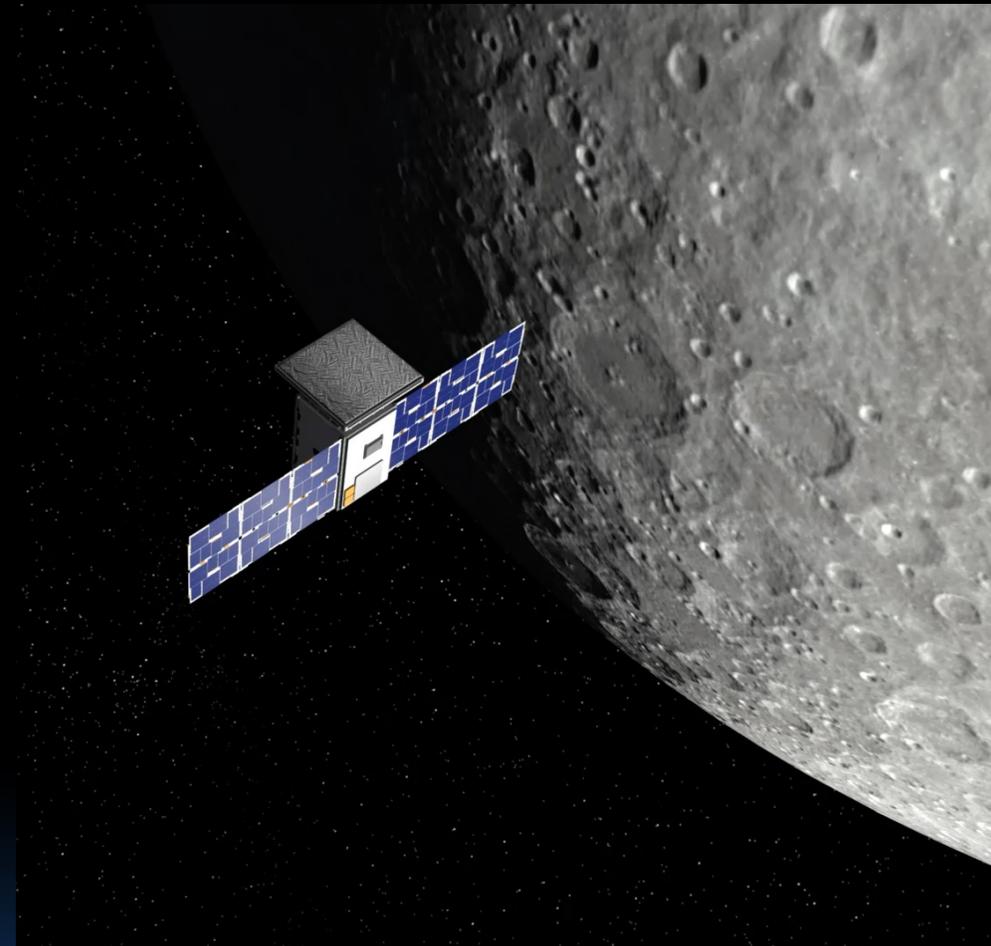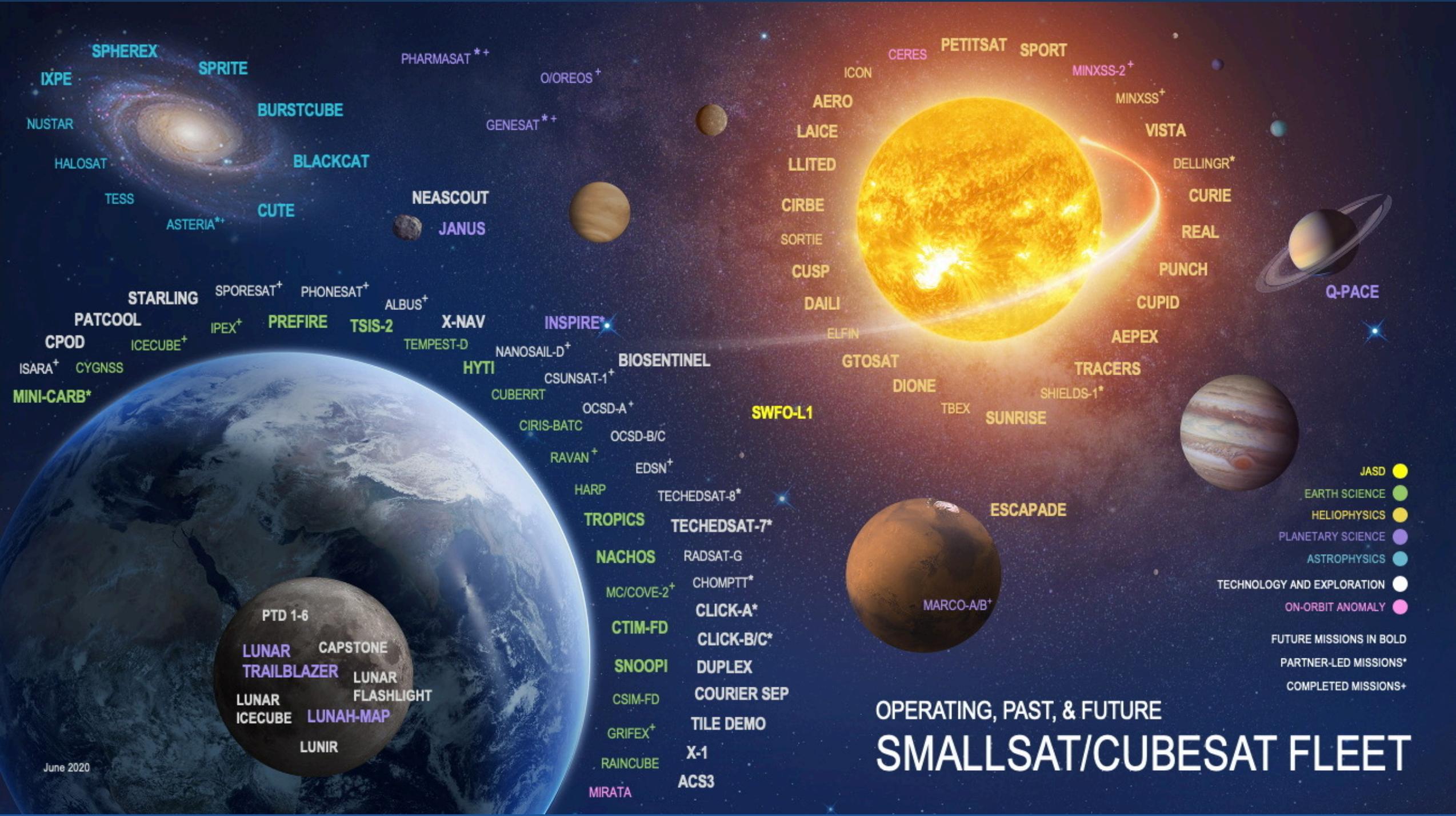*www.nasa.gov/smallsat-institute*

Webinar Overview

This webinar will focus on discussions and demonstrations of S3VI tools; other webinar opportunities; and databases that include:

- Small Satellite Reliability Initiative Knowledge Base Tool
- Community of Practice Webinar Series
- Mission Design Tools
- Small Spacecraft Information Search
- State-of-the-Art Small Spacecraft Report

This presentation will provide attendees information and knowledge of available resources and where to find them to aid in the design and development of their own small satellite missions.

OPERATING, PAST, & FUTURE
SMALLSAT/CUBESAT FLEET

June 2020

JASD — (yellow)
EARTH SCIENCE — (green)
HELIOPHYSICS — (orange)
PLANETARY SCIENCE — (purple)
ASTROPHYSICS — (cyan)
TECHNOLOGY AND EXPLORATION — (white)
ON-ORBIT ANOMALY — (pink)

FUTURE MISSIONS IN BOLD
PARTNER-LED MISSIONS*
COMPLETED MISSIONS+

OPERATING, PAST, & FUTURE
SMALLSAT/CUBESAT FLEET

May 2022

For questions, please contact Florence Tan.

Legend:
- HEOMD — red
- JASD — yellow
- EARTH SCIENCE — green
- HELIOPHYSICS — tan/gold
- PLANETARY SCIENCE — purple
- ASTROPHYSICS — cyan
- BIOLOGICAL & PHYSICAL — orange
- STMD — white
- ON-ORBIT ANOMALY — pink

FUTURE MISSIONS IN BOLD
PARTNER-LED MISSIONS*
COMPLETED MISSIONS+
SmallSat Mission ^{S}
Constellation Mission ^{C}

OPERATING, PAST, & FUTURE
SMALLSAT/CUBESAT FLEET

Scan this code for the latest fleet chart.
https://s3vi.ndc.nasa.gov/cubesatfleet/

Missions Tracked: 164

September 2023

Legend:
- IRAD
- ESBMD-SCMD
- JASD
- EARTH SCIENCE
- HELIOPHYSICS
- PLANETARY SCIENCE
- ASTROPHYSICS
- BIOLOGICAL & PHYSICAL
- STMD
- ON-ORBIT ANOMALY
- FUTURE MISSIONS IN BOLD
- PARTNER-LED MISSIONS *
- COMPLETED MISSIONS +
- SmallSat MISSIONS $
- NUMEROUS MISSIONS ^

Mission labels:
Pandora $, SPRITE, Aspera $, BurstCube, BlackCat, SPARCS, StarBurst $, COSI, CUTE, TESS $, IXPE $, NuSTAR $, JANUS $, NEA Scout, BioSentinel, PATCOOL +, CryoCube +, SporeSat +, Starling, ACS3, CPOD *, PREFIRE, TSIS-2 $, HyTI, GPDM, STF-1 +, CYGNSS $, IPEX +, GPX2, Mini-Carb *+, INCUS, R5-S4, R5-S3, R5-S2, PetitSat, SPORT, Dellingr *+, ASTERIA *+, R5-S1, RainCube +, R5-S6, CSIM-FD +, R5-S5, CIRIS-BATC, NACHOS-2, IceCube +, NACHOS-1 +, HARP +, CTIM-FD, CubeRRT +, TEMPEST-D +, EcAMSat +, ISARA +, HaloSat +, MinXSS +, OCSD-B/C *+, RadSat-g +, CSUNSAT-1 +, NanoSail-D +, NanoSail-D2 +, OCSD-A *+, EDSN +, Lunar Flashlight, Cislunar Explorers, PTD-1 HYDROS *+, PTD-3 T-BIRD *, PTD-4 LISA-T *, PTD-R *, CU-E3, LUNAR TRAILBLAZER $, LunaH-Map, Team Miles, Lunar IceCube, LunIR, CAPSTONE

EZIE, CeREs, 3UCubed, REAL, ICON $, DAILI, CURIE, AEPEX, LLITED, CuPID, CIRBE, PUNCH $, CuSP, AERO, MUSE $, VISTA, PADRE *, TRACERS $, CubIXSS *, SunRISE, I-COVEX *, DIONE, ELFIN (A/B) +, MinXSS-2, Q-PACE, SWFO-L1 $, Carruthers $, LMRST-Sat, ALBus +, QuickSounder $, GTOSat, WindCube, TBEx, Shields-1 *, DYNAGLO, LARADO $, SunCET, HelioSwarm $, MACS, ESCAPADE $, Mars Helicopter/ Ingenuity $, MarCO (A/B) +

ALBus +, PHARMASAT *+, TechEdSats ^, GeneSat *+, Courier SEP DEMO *, O/OREOS +, DiskSat *, PhoneSats ^+, RAVAN +, ACMES, SEEKER-1 +, TROPICS, FASTSAT-HSV +, TROPICS Pathfinder, DUPLEX *, Arcstone, CLICK-A *, MC/COVE, CHOMPTT *+, MC/COVE-2 +, NODES +, SNOOPI, V-R3X +, GRIFEX +, PY4, Athena *$, PACE-1, PolSIR, MiRaTA

Small Spacecraft Systems Virtual Institute Products & Activities

The S3VI provides the SmallSat research community with access to mission enabling information and maintains engagement with small spacecraft stakeholders in industry, government and academia. The S3VI resources listed below are available to all at: https://www.nasa.gov/smallsat-institute/

- Community of Practice Webinar Series
- Small Spacecraft Reliability Initiative Knowledge Base Tool
- LaunchPortal
- Small Spacecraft Guidebooks
- United Nations Office of Outer Space (UNOOSA) Systems Engineering Webinar Series

- NASA Small Spacecraft State of the Art Report
- S3VI WebPortal
- Quarterly S3VI Newsletter
- Small Spacecraft Information Search
- Space Mission Design Tool Catalog

S3VI is sponsored by NASA's Space Technology Mission Directorate

S3VI's Activities and Established Community Facilitate Integration and Sharing of the Agency's Interests and Investments in Small Spacecraft

- Contribute / co-sponsor efforts to capture and share cross-community small spacecraft development efforts, lessons learned, and opportunities to collaborate

  S3VI Products and Support Elements:

- Serve in Expert Roles
  S3VI Products and Support Elements:

- Create new opportunities to share SmallSat information across NASA and (in part), the Community as a whole

  S3VI Products and Support Elements:

S3VI Products, Activities, & Support Areas

= Summits, Collaborations, Forums, Panels, Roadshow

= S3VI Web Portal

= Tools, Studies, Data, LaunchPortal

= SOA, Publications, Newsletter

= Webinars, SMEs

Small Spacecraft Reliability Initiative (SSRI) Knowledge Base

58 topic pages and 533 unique resource items

https://s3vi.ndc.nasa.gov/ssri-kb/

- Leverage knowledge from the SmallSat Community
- Free, publicly available tool targeting SmallSat mission successes
- Go-to starting place for information on a broad range of topics

- 2023 Enhancements:
    - Upgrade to the search bar on the home page to search all content, not just "resources"
    - Add fields to the Best Practices and Lessons Learned (BPLL) entities in the database, BPLL lists in the User Interface (UI), and "recommended edits" interface in the UI to support the extensive data you are collecting.
    - Application Programming Interface (API) and API documentation to support new database structure and website functionality.

- S3VI increases awareness of the Knowledge Base through training sessions, side bar meetings and papers/presentations at small satellite conferences

The S3VI's monthly small spacecraft community of practice webinar series covers topics relevant to all aspects of small spacecraft mission concept design, development, and operations.

The "Mission Accomplished" webinars, also part of the series, celebrate the success of small spacecraft in helping to achieve science, exploration and technology goals for NASA.

The series is open to the public. For more information see the links below.

https://www.nasa.gov/smallsat-institute/community-of-practice/
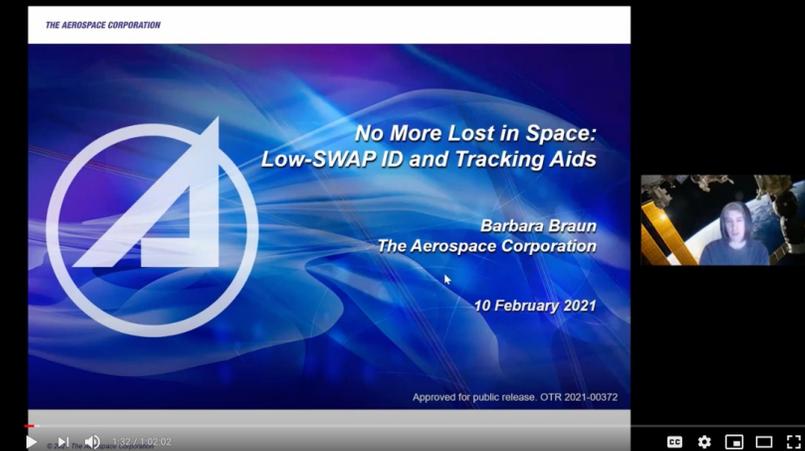
Lessons Learned and Mission Accomplished Webinars by Leading Experts

Space Mission Design Tools

GMAT — General Mission Analysis Tool
Brought to you by: dcooley, djcinsb, jjkparker, mstarkinmd, and 2 others

NASA TECHNOLOGY TRANSFER PROGRAM

Data Servers Processing And Handling
Engineering DOUG Graphics for Exploration (EDGE)
(MSC-24663-1)

openMCT

NASA Ames Research Center
Trajectory Browser

https://www.nasa.gov/smallsat-institute/space-mission-design-tools

The S3VI lists software tools found useful in the development of small spacecraft missions. The list is restricted to publicly available software from NASA or the Open Source community.

Design tool categories include:

- Small Spacecraft Avionics
- Guidance, Navigation, and Control
- Satellite Constellation Remote Sensing
- Trajectory Design and Optimization Tools
- Mission Operations Software
- Project Cost Estimation
- Radiation Analysis
- Graphics Rendering
- NASA Tech Transfer Program: Software in 15 different space project categories

CubeSat 201

Database that focuses on small
spacecraft processes, lessons learned, and associated references

https://s3vi.ndc.nasa.gov/cubesat201/

Small Satellite Information Search

ABOUT

SMALL SATELLITE INFORMATION SEARCH

Search small satellite information...

Select Source(s)

NASA's Small Spacecraft Systems Virtual Institute (S3VI) uses web technologies, databases, and virtual collaboration tools to collect, organize, and disseminate small spacecraft knowledge for the benefit of NASA and the community. S3VI has established this federated search capability that serves as an entry point to the SmallSat Parts On Orbit Now (SPOON) database and other NASA-internal and external databases to allow the public to search multiple databases for small spacecraft parts, technologies and conference proceedings. Currently, S3VI's federated databases consist of: the NASA Technology Portfolio System (TechPort), the NASA Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Program, the NASA Electronic Parts and Packaging (NEPP), satsearch, PMPedia, Small Satellite Conference Proceedings, CubeSat Developers Workshop Proceedings, Inter-Planetary Small Satellite Conference Proceedings and NASA's CubeSat Launch Initiative.

READ MORE...

https://s3vi.ndc.nasa.gov/

Small Satellite Information Search

Source	Type of Content
Federated/Common Search	The federated search capability serves as an entry point to NASA-internal and external databases to allow the public to search multiple databases for small spacecraft parts, technologies and conference proceedings.
NASA TechPort	Technical project information for the novel and crosscutting activities that are taking place across NASA
NEPP Radiation Parts and Publications	This database contains NASA Goddard Space Flight Center test reports on radiation tested electronics.
SmallSat Parts On Orbit Now (SPOON)	Small spacecraft parts and technologies that have achieved technology readiness level (TRL) 5 or more
Satsearch Database	Space products & services from global suppliers, including a myriad of small satellite components, subsystems, and platforms.
PMPedia (The Aerospace Corporation Database)	Collection of EEE (Electrical, Electronic, Electromechanical) non-space grade components with relevance to space applications.
NASA Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Program	Proposals that were awarded to small U.S. high technology companies and research institutions that participated in government-sponsored research and development (R&D) efforts in key technology areas needed by the agency and also have significant potential for successful commercialization.
Small Satellite Conference Proceedings	Conference proceedings presented at each of the Annual Small Satellite Conferences held in Logan, Utah from 1987 through 2021
CubeSat Developers Workshop Proceedings	Proceedings presented over the past fifteen years at each of the CubeSat Developers Workshops held in San Luis Obispo, CA
Interplanetary Small Satellite Conference Proceedings	Proceedings presented over the past seven years
NASA's CubeSat Launch Initative (CSLI) Reports	Final reports and publication lists for the small satellite payloads built by educational institutions, nonprofit organizations, and NASA Centers and programs that flew on past launches.

Contents

https://www.nasa.gov/smallsat-institute/sst-soa/

Report content is collected and reviewed by NASA experts, updated annually

FLEET CHART

2023 SMALLSAT
STATE OF THE ART

SSRI KNOWLEDGE
BASE TOOL

INFORMATION
SEARCH

COMMUNITY OF PRACTICE
WEBINAR SERIES

Questions?

www.nasa.gov/smallsat-institute/

craig.d.burkhard@nasa.gov

References

NASA Procedural Requirements 7123.1D, Systems Engineering Processes and Requirements, Expiration Date: July 05, 2028
https://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=7123&s=1B

NASA Procedural Requirements 7120.8A, NASA Research and Technology Program and Project Management Requirements, Expiration Date: September 14, 2028
https://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=7120&s=8A

NASA Procedural Requirements 7120.5F, NASA Space Flight Program and Project Management Requirements, Expiration Date: August 3, 2026
https://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=7120&s=5E

NASA SP-2016-6105 Rev2, NASA Systems Engineering Handbook
https://lws.larc.nasa.gov/vfmo/pdf_files/[NASA-SP-2016-6105_Rev2_]nasa_systems_engineering_handbook_0.pdf

- NASA Procedural Requirements (NPR) 7120.5: NASA Spaceflight Program and Project Management Requirements

  - Establishes the requirements that NASA formulates and implements space flight programs and projects

- NASA Procedural Requirements (NPR) 7120.8: NASA Research and Technology Program and Project Management Requirements

  - Research and Technology typically using ground systems or sub-orbital vehicles, aircraft, sounding rockets, and balloons)

  - More recently CubeSats, SmallSats, ISS payloads have been included