## Agenda

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<th>Presenter</th>
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<td>Ms. Uyen Tu, Contracting Officer</td>
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<td>Mr. David Alfano, Acting Division Chief</td>
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<td>Dr. Kai Goebel, Tech Area Lead</td>
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<td>Ms. Diana Acosta, Acting Tech Area Lead</td>
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<td>Mr. Richard Papasin, Tech Area Lead</td>
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Introduction

This Industry Day/Pre-Proposal Conference is intended to:

(1) Familiarize participants with the ISRDS-3 Statement of Work (SOW) requirements;

(2) Present the current status of the ISRDS-3 acquisition;

(3) Permit potential offerors an opportunity to network and discuss teaming or subcontracting arrangements

(4) Allow potential offerors an opportunity to submit questions regarding the recently posted draft Request for Proposal; and

(5) Allow industry representatives an opportunity to make a private presentation of corporate capabilities to the Government via one-on-one meetings.
General Guidance

- These slides shall not be interpreted as a comprehensive description of the Government’s requirements. Please refer to the draft Statement of Work and draft Request for Proposal.

- If there are any inconsistencies between this presentation and the draft Request for Proposal, the draft Request for Proposal will govern.

- Nothing discussed at this pre-proposal conference shall be construed as a revision to the draft Request for Proposal, unless subsequently confirmed via the final Request for Proposal or an Amendment.

- A communication blackout will commence immediately upon the release of the final Request for Proposal. The blackout period will continue until contract award.

- All communication from industry must be directed only to the Contracting Officer during this blackout period.
Questions

• Following the presentations, all questions related to this pre-proposal conference or the draft Request for Proposal must be submitted in writing to both the Contracting Officer at Uyen.K.Tu@nasa.gov and the Contract Specialist at daniel.p.chang@nasa.gov no later than June 7, 2018.

• At this time, the Government will not verbally entertain any questions. All questions and answers will be posted on the Federal Business Opportunities website in a timely manner.
Electronic Posting

• All documents pertaining to the ISRDS-3 Procurement can be found on the Federal Business Opportunities (FBO) website https://www.fbo.gov/. Please search using either the solicitation number 80ARC018R0012 or the procurement title ISRDS-3.

• This slide show presentation and the attendee list will be posted to this site.
FOIA Requests

• Freedom of Information Act (FOIA) Requests may be submitted electronically to foia@arc.nasa.gov

• No proprietary information will be disclosed.

• The NASA ARC FOIA Electronic Reading Room can be accessed at http://www.nasa.gov/centers/ames/business/foia/elec.html.
ISRDS-3 Requirements Overview

This procurement will be a follow-on contract to the existing ISRDS-2 contract (NNA14AA60C), which has a current performance period of April 1, 2014 through March 31, 2019 (consisting of a three-year base period, and two one-year option periods).

The purpose of ISRDS-3 acquisition is to continue to provide support multidisciplinary requirements from all mission directorates for enabling intelligent software technology research and development in four main technology areas:

- Autonomous Systems and Robotics (ASR)
- Collaborative and Assistant Systems (CAS)
- Discovery and Systems Health (DaSH)
- Robust Software Engineering (RSE).

The requirements include contract management, technical, operational, and research support.
Acquisition Description

The Statement of Work (SOW) describes the scope, complexity, and purpose of the service with details of the requirements to be procured under the contract.

- The Core Management is the overall management and administrative functions that ensure contract performance and compliance to support the research and development requirements.

- The Core Technology Research, Development and Support (Core Technical) requirement is the known minimum support needed in the next eight years of contract performance in terms of contract management and technical requirements within each of the key technology research areas.

- The IDIQ requirement includes the same functionalities and capabilities as the Core, but the task orders will address currently unknown, but expected, requirements. The IDIQ task orders will be issued to supplement support provided under the Core, and they will address complex and dynamic research and development requirements that span across several integrally-related technical areas.

- Technical directions for Core Technical requirements and individual task orders for IDIQ requirements will provide detailed, performance-based requirements.
Acquisition Strategy

• The ISRDS-3 acquisition will be competed as full-and-open competition pursuant to FAR and NFS Part 15—Contracting by Negotiations.

• This acquisition will result in a hybrid contract consisting of:
  • Firm-Fixed-Price (FFP) Contract Line Item Numbers (CLINs) for Phase-in and Core Management requirements;
  • Cost-Plus-Fixed-Fee (CPFF) CLIN for Core Technical requirement;
  • FFP and CPFF CLINs for Indefinite Delivery/ Indefinite Quantity (IDIQ) requirement.

• The contract will have an eight-year performance period, consisting of a two-year Base Period and three two-year Option Periods. A 60-day Phase-In Period will start right before the Base Period.

• This acquisition will be awarded under the North American Industry Classification System (NAICS) code 541715, Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology) with a size standard of 1000 employees.
Acquisition Strategy (Cont.)

• FAR 52.215-1 and NFS 1815.209 allow for an award to be made without discussions. The Government may award a contract based solely on the initial proposals received. The Government reserves the right to hold discussions if award on the basis of initial offers is determined not to be in the best interest of the Government. If discussions are necessary, then a competitive range will be set and negotiations will commence.
Small Business Goals

- All Offerors, except small businesses, must complete the portion of the instructions under Small Business Subcontracting specific to the Small Business Subcontracting Plan. Small businesses are not required to submit Small Business Subcontracting Plans; however, small businesses are required to indicate the amount of effort proposed to be done by a small business either at the prime level or at the first tier subcontract level. **All Offerors are required to respond to the Commitment to the Small Business Program.**

- The Government assessed the appropriate subcontracting goals for this acquisition, expressed as a percent of **TOTAL CONTRACT VALUE** (basic and all options combined), is as follows:

<table>
<thead>
<tr>
<th>Total Small Business Goals</th>
<th>35.0%</th>
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<tr>
<td>Small Businesses (SB)</td>
<td>15.0%</td>
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<tr>
<td>Small Disadvantaged Business (SDB) (Includes SDB’s in</td>
<td>5.0%</td>
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<td>represented and under-represented areas*)</td>
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<tr>
<td>Women Owned Small Business (WOSB)</td>
<td>7.5%</td>
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<tr>
<td>Historically Black Colleges and Universities and other</td>
<td>1.0%</td>
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<tr>
<td>Minority Serving Institutions (HBCU/MSIs)</td>
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<tr>
<td>Historically Underutilized Business Zones (HUBZones)</td>
<td>1.0%</td>
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<tr>
<td>Veteran Owned Small Business (VOSB)</td>
<td>3.5%</td>
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<tr>
<td>Service-Disabled Veteran-Owned Small Business (SDVOSB)</td>
<td>2.0%</td>
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Weighting and Scoring

Proposals will be evaluated in accordance with Federal Acquisition Regulations (FAR) Subpart 15.3 and NASA FAR Supplements (NFS) Subpart 1815.3. The following are the three evaluation factors that will be used:

- Mission Suitability
- Past Performance
- Cost/Price

Of the evaluation factors identified above, Mission Suitability is moderately more important than Past Performance, and Past Performance is slightly more important than Cost/Price. Mission Suitability and Past Performance, when combined, are significantly more important than Cost/Price.

The Source Selection Authority's (SSA) decision shall be based on a comparative assessment of proposals pursuant to source selection criteria prescribed in this solicitation. While the SSA may use reports and analyses prepared by others, the source selection decision shall represent the SSA's independent judgment.
Proposal Preparation

• Proposals shall be prepared in accordance with the Final RFP and subsequent written Amendments, if any.

• The Offeror shall acknowledge all Amendments with the proposal submission.

• The evaluation of proposals shall be in accordance with the Final RFP.
Acquisition Status

Estimated Acquisition Milestones

- Issue Request for Information: June 2017
- Issue Draft RFP: May 2018
- Industry Day: May 2018
- Issue Final RFP: June 2018
- Proposals Due: August 2018
- Evaluation of Proposals (Completion): December 2018
- Contract Award: January 2019
- Contract Effective Date (Phase-In begins): January 2019
- Start of Base Period: April 2019

Please note that these dates are subject to change. Updated milestones will be posted on FBO.
Contact Information

Contracting Officer: Uyen Tu
650-604-4958
uyen.k.tu@nasa.gov

Contract Specialist: Daniel “Paden” Chang
650-604-0395
daniel.p.chang@nasa.gov
Intelligent Systems Division
(Code TI)

Organizational and Technical Overview
<table>
<thead>
<tr>
<th>Office of the Director</th>
<th>NASA Astrobiology Institute</th>
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<tbody>
<tr>
<td>Center Director: Eugene Tu</td>
<td>Director: Penelope Boston</td>
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<tr>
<td>Deputy Center Director: Carol Carroll</td>
<td></td>
</tr>
<tr>
<td>Associate Center Director: Deb Feng</td>
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<tr>
<td>Associate Director for Research and Technology: David Korsmeyer</td>
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<tr>
<th>Office of the Chief Engineer</th>
<th>Office of the Chief Scientist</th>
<th>Office of the Chief Technologist</th>
<th>Office of the Chief Counsel</th>
<th>Partnerships Office</th>
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<tbody>
<tr>
<td>Chief Engineer: Dean Kontinos</td>
<td>Chief Scientist: Jacob Cohen</td>
<td>Chief Technologist: Harry Partridge III</td>
<td>Chief Counsel: Thomas W. Berndt</td>
<td>Chief (Acting): Rose Grymes</td>
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<tbody>
<tr>
<td>Director: Penelope Boston</td>
<td>Director: Yvonne Pendleton</td>
<td>Division Chief: Barbara Miller</td>
<td>Director: Janice Fried</td>
<td>Public Affairs Office: Matt Buffington</td>
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<thead>
<tr>
<th>Aeronautics Directorate</th>
<th>Science Directorate</th>
<th>Exploration Technology Directorate</th>
<th>Programs and Projects Directorate</th>
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<tbody>
<tr>
<td>(Code A)</td>
<td>(Code S)</td>
<td>(Code T)</td>
<td>(Code P)</td>
</tr>
<tr>
<td>Director: Huy Tran</td>
<td>Director: Michael D. Bicay</td>
<td>Director: Rupak Biswas</td>
<td>Director: Jay Bookbinder</td>
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<tr>
<th>Center Operations Directorate</th>
<th>Engineering Directorate</th>
<th>Safety &amp; Mission Assurance Directorate</th>
<th>Office of the Chief Financial Officer</th>
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<tr>
<td>(Code J)</td>
<td>(Code R)</td>
<td>(Code Q)</td>
<td>(Code C)</td>
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<tr>
<td>Director: Robin Aube-Warren</td>
<td>Director (Acting): Chad Frost</td>
<td>Director: Michael Liu</td>
<td>Director/CFO: Paul R. Agnew</td>
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<tr>
<th>Human Capital &amp; Education Directorate</th>
<th>Information Technology Directorate</th>
<th>Office of the Chief Financial Officer</th>
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<td>(Code H)</td>
<td>(Code I)</td>
<td>(Code C)</td>
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<tr>
<td>Director: Joy Murphy</td>
<td>CIO: Jerry Davis</td>
<td>Director/CFO: Paul R. Agnew</td>
</tr>
</tbody>
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Agency CFO
## EXPLORATION TECHNOLOGY DIRECTORATE (T)

**Director:** Rupak Biswas  
**Deputy Director:** Aga Goodsell  
**Associate Director (Acting):** George Raiche  
**Operations Manager:** Patti Powell  
**Chief Scientist for Exploration Technology:** Meyya Meyyappan

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<thead>
<tr>
<th>Division</th>
<th>Chief (Acting)</th>
<th>Deputy (Acting)</th>
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<tbody>
<tr>
<td>Intelligent Systems Division (TI)</td>
<td>David Alfano</td>
<td>Scott Poll</td>
</tr>
<tr>
<td>Human Systems Integration Division (TH)</td>
<td>Alonso Vera</td>
<td>Jeffrey McCandless</td>
</tr>
<tr>
<td>Entry Systems &amp; Technology Division (TS)</td>
<td>Vacant</td>
<td>Vacant</td>
</tr>
<tr>
<td>NASA Advanced Supercomputing Division (TN)</td>
<td>Piyush Mehrotra</td>
<td>Bryan Biegel (Detailed Out)</td>
</tr>
</tbody>
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TI Budget % by Mission Directorate
Total Budget ~$59M
Code TI - Education Level (103 civil servants)

- Ph.D., 48, 47%
- M.S., 35, 34%
- B.S., 19, 18%
- M.S., 1, 1%
TI College Degree Majors

- Aero
- BioMed/Phys
- Comp
- Elec
- Geophysics
- Liberal Arts
- Math
- Mech
- Physics
- Robotics
- Misc Tech/Biz
Principal Technologies

**Autonomy and Robotics:** adaptive and optimal control; adjustable autonomy; automated planning & scheduling; distributed & multi-agent systems; computer vision; decision support systems; human-robot interactions

**Information Management:** data architecture design; ground & flight data systems; information retrieval, access, search, and integration; knowledge management; semantic technologies

**Software Engineering:** advanced V&V of cyber-physical systems; argument-based safety assurance; assured autonomy; human-system interaction analysis; flight software for space missions.

**Prognostics, Diagnostics, Machine Learning & Physics-based Modeling:** integrated systems health management for flight and ground mission support; analysis of large data sets; mathematical modeling of physical systems

**Quantum Computing:** quantum modeling and simulation; optimization; sampling; hybrid quantum-classical algorithms; quantum annealers; experimentation and benchmarking
Growth Areas, 2013-2018

- Assured autonomy for aviation transformation and in-time system-wide safety assurance
- Quantum computing approaches to solve difficult optimization problems
- Autonomy research for land, air, and space vehicles that operate in dynamic, uncertain environments
- CubeSat experiments to mature imaging, communications, and GNC technologies
- Swarms of small satellites
- Space robotics and autonomous technologies to enable life-detection missions and improve efficiency of spacecraft operations in preparation for next-generation human exploration
- Model-based systems engineering, state estimation, prediction of remaining life, anomaly detection and resolution
- Data Sciences for all NASA Mission Directorates, FAA, global civil aviation, and other external clients (OGAs)
Programmatic and Cross-Program Leadership

ARMD
- System-Wide Safety Deputy Project Manager
- Convergent Aeronautics Solutions Center Liaison
- University Led Initiative Thrust 5 Technical Officer
- Technical Challenge Leadership roles in SWS and UTM
- SBIR Subtopic Manager role

HEOMD
- Autonomous Systems and Operations Project Manager
- BioSentinel Deputy Project Manager
- SPHERES Project Manager
- SBIR Topic and Subtopic Manager roles
Programmatic and Cross-Program Leadership

SMD

- Airborne Science Mission Tool Suite Project Manager
- SOFIA MCCS/PIS Project Manager
- TESS Science Data Processing Pipeline Lead
- TESS SPOC Development Manager
- ESTO AIST Ames Center Program Manager
- SBIR Topic and Subtopic Manager roles

STMD

- Astrobot Project Manager
- Autonomous Medical Operations Project Manager
- Distributed Science Autonomy (DSA) Project Manager
- DSA Deputy Project Manager
- Starling 1 Project Manager
- Starling 1 Deputy Project Manager
- SBIR Subtopic Manager roles
Conferences, Workshops, Working Groups

- AIAA: Aviation, SciTech, Space (annual)
- AAAI: Conference on Artificial Intelligence (annual)
- IEEE: Data Mining, Robotics and Automation (annual)
- International Conference on Automated Planning and Scheduling (annual)
- NASA Formal Methods Symposium (annual)
- Prognostics & Health Management Society Conference (annual)
- SpaceOps (annual)
- American Geophysical Union (annual)
- Workshop on Spacecraft Flight Software
- NASA Spacecraft Fault Management Workshop
- Adiabatic Quantum Computing Conference
- SAE IVHM Working Group
- ISO Working Group on Prognostics
Selected Work for Other Government Agencies

- Air Force – ground data systems development and integration for satellite mission
- AFRL – software V&V
- AFRL – quantum computing
- DARPA TRADES – computational modeling for additive manufacturing
- DHS – autonomy technologies for UAVs
- FAA – software tools for airspace safety evaluation
- IARPA – quantum computing
- NAVAIR – data mining and machine learning for physiological episode detection
- Tardec – quantum computing
- USGS – bio-inspired optical sensor for displacement sensing
Intelligent Systems Division

Technical Area Overviews
Robust Software Engineering
Technical Area
Robust Software Engineering (RSE)

RSE is comprised of approximately 30+ researchers, many of them with advanced degrees who produced 40-50 publications a year in peer-reviewed conferences, and gifted software developers working on NASA missions.

RSE has a research group focused on advanced software/system engineering techniques and an applied group focused on developing flight software for NASA missions.

Research products are ultimately expected to be used by the flight software group and organized under three themes:

- Advanced verification and validation techniques
- Safety assurance technology,
- Model-based system engineering and applications.

Flight software follows a model-based development process and tools/frameworks developed and successfully used in the LADEE mission.
RSE research is motivated by NASA’s unique problems.

- Research addresses practical industry problems (e.g., cost of V&V in civil aviation) and future issues (e.g., the use of autonomy technology in aviation and space)
- Problem examples are derived from industry and NASA missions
- RSE technology is typically not export restricted or sensitive.
- RSE leverages the advances from a large community of practice in Computer Science, Computer Engineering, Statistics, and AI
- Research staff are expected to develop stature in their respective fields
  - Best paper awards
  - Keynote speakers
  - Conference organization
  - International recognition
- Flight software developers are expected to be open to using new techniques
The **advanced verification and validation** theme encompasses a wide range of formal and quantitative techniques.

- Static code analysis, model checking, statistics-based testing
- Search and optimization techniques to develop and verify assured autonomy
- Novel safety and assurance techniques, especially for certification
- Results are often useful to the other RSE themes and support the advanced capabilities produced by the other three Technical Areas
The **safety assurance technology** theme includes many methods from past efforts in synthesis projects & applications. It focuses on computer-assisted certification using automated program synthesis, verification using annotation inference and theorem provers, and the automated generation of safety cases.

AdvoCATE: An Assurance Case Automation Toolset and AutoBayes are examples of work derived from current and past research efforts in automated program synthesis. Techniques from the advanced verification and validation theme can be applied to the safety assurance technology theme.
Model-based system engineering and applications theme develops and applies advanced tools for software generation in support of NASA missions. The focus is on automation and early-in-design verification and validation hence this area seeks early-in-design engineering artifacts such as models of behavior or models used by autocoders that generate code.

This research theme is expected to feed into RSE main application domain, i.e., flight software for NASA missions

Mission size varies:

• Large: Adapting RSE methods to work with contractors for the Low Boom Flight Demonstrator (LBFD) or the DARPA Reusable Space Plane (XSP).

• Mid-sized: Adapt RSE methods and influence NASA-owned process on NASA's Lunar Atmosphere and Dust Environment Explorer (LADEE) to use advanced V&V to improve assurance and cost.

• SmallSat: Adapt RSE capabilities on high-risk, low-budget projects operating with few resources and often reusing legacy, hand-generated code.

RSE challenge is to identify opportunities in the development process for conducting early-in-design verification and test.
Discovery and Systems Health Technical Area
Discovery and Systems Health - DaSH

Understanding, modeling, and reasoning with engineering systems and science data. Work is centered around the emerging systems engineering discipline of Integrated Systems Health Management (ISHM).

**Applications Portfolio**

- **Earth Science**
  - Foliage change classification

- **Aeronautics**
  - Autonomous system operations
  - Safety for on-demand mobility
  - Terminal Area risk mitigation
  - ISS, SLS, Mission Ops
  - Smart habitats, HDU
  - In-space manufacturing

- **Human Exploration**
  - ISS, SLS, Mission Ops
  - Smart habitats, HDU
  - In-space manufacturing

- **Small Spacecraft**
  - LADEE, LCROSS, NODES, RP

- **Quantum Annealing**
  - Airspace Optimization

**Research/Technology Portfolio**

- **Machine learning**
  - Anomaly detection
  - Precursor identification
  - Knowledge discovery

- **Physics modeling**
  - Theory of quantum computing quantum annealing algorithms
  - Multi-physics modeling & optimization

- **Diagnostics & prognostics**
  - State awareness
  - Functional Fault modeling
  - Fault progression modeling
  - Uncertainty management
  - Optimal decision making
DaSH – Recent Activities and Future Directions

• **Recent Activities**
  - Demonstration of Real-Time Safety Margin Prediction for Terminal Space (2018 API)
  - SLS Goal Tree Development for Exploration Upper Stage
  - Flight Envelope Protection (Congressional Milestone)
  - Anomalous Flight Precursor Detection
  - Composites Modeling
  - Quantum Annealing

• **Forward plans/activities**
  - Real-Time Safety Margin for On-Demand Mobility
  - Physics Modeling for Additive Manufacturing
  - Quantum Security
  - SLS FFM EUS
Applications: ACAWS-Advanced Caution and Warning System

- Fault Management Solution that combines
  - dynamic and interactive graphical representations of
    - systems
    - systems modeling
  - automated diagnostic analysis and root cause identification
  - impact assessment
  - procedure identification
  - FR identification

- Benefits
  - Increased situational awareness
  - A clear representation of system health status
  - Faster and more accurate fault diagnosis and root cause ID
  - Automated mission and system impact assessment
  - Automated procedure and Flight Rule identification

- Approach
  - Architecture integrates distinct technology elements, e.g.,
    - TEAMS
    - IMS

- Results
  - Application to HDU
    - Anomaly detection system for HDU subfloor area
    - Fault diagnosis of HDU power system subset
      - Provided guided troubleshooting by recommending additional manual observations
      - Malfunction and recovery procedures automatically recommended and executed.
      - Level of automation for each instruction user-selectable (automated, consent to proceed, human execution)
Applications: Prognostics for Energy Storage for Electric UAV Propulsion

Problem/State of the Art:
• Current health capability provides alerting when component is at threshold. Conservative flight planning leading to wasted potential flight time.

Approach
• Particle filter algorithm to monitor battery usage and project when low limit will be reached.
• Flight test of Health Management and Prognostics to predict Remaining Useful Life (RUL) during flight.

• Benefits
  – Prevents dead stick condition from overestimating battery power.
  – Provides condition-based run time updates of available aloft time.
  – Enables flight plan battery estimation and monitoring for on-board contingency algorithms in autonomous system.

Results
• Early and consistent RUL estimates; amber and red alert warning
• Has resulted in near doubling of flight time due to trust in health management system

“Battery health prognostic feedback adds valuable Safety benefits to mission operations…”

“We are now allowing longer flights because we have Battery Health Management”

Dave Hare,
LaRC Subscale Test Vehicle Flight Operations Director
Applications: Data Mining: Identifying and Tracking Approach and Landing Issues at Southwest Airlines

- Open-sourced data mining software for analyzing flight data recorder output
  - Disseminated via DASHlink, a collaborative IVHM website with over 400 members worldwide.
  - sequenceMiner
    - A discrete sequence analysis program for anomaly detection
  - ORCA
    - A program for mining outliers in large multi-variate data sets using distance-based metrics
- Southwest Airlines employed sequenceMiner and Orca
  - Uncovered operationally significant exceedances of limits specified in SWA’s Flight Operations Manual that were not identified by SWA’s existing analysis methods:
    - parameter spikes driven by data errors
    - high roll and pitch events near final approach
    - hard nose over prior to landing
  - Events flagged by these software tools will be added to SWA’s daily exceedance review.
  - Southwest plans to incorporate these software tools into daily operations – 1600 flights/305 planes.
Applications: LADEE: Fault Management Systems Engineering

Objectives

• Assess the operational capability of single string LADEE to
  – Contain
  – Prevent
  – Detect
  – Isolate, and
  – Respond to conditions that may interfere with nominal mission operations.

• Manage faults and continue operations under various scenarios.
  – Weave “safety nets” by identifying strategies that leverage functional redundancies

• Mitigate the risk of a single string architecture
  – Engaging in Fault Management early in the project phase.
Autonomous Systems and Robotics Technical Area
Autonomous Systems and Robotics (ASR)

*Enabling complex systems and operations through the development of technologies that can respond to changing conditions, knowledge, and constraints*
Autonomous Systems and Robotics (ASR) Technical Area

lead: Diana Acosta
deputy: vacant

Advanced Controls and Evolvable Systems (ACES) Group
lead: Nhan Nguyen
deputy: Sean Swei
membership ~ 10 CS, 1 IPA, 17 SSC

Deployable Autonomy Technologies (DAT) Group
lead: Brian Glass
membership ~ 2 CS, 2 SSC

Intelligent Robotics Group (IRG)
lead: Mark Micire
deputies: Maria Bualat, Matt Deans
associate: Linda Kobayashi
membership ~ 10 CS, 1 IA, 26 SSC

Planning and Scheduling Group (PSG)
lead: Jeremy Frank
membership ~ 10 CS, 6 SSC
ASR Group Descriptions

Advanced Control and Evolvable Systems (ACES)
The main focus of the Advanced Control and Evolvable Systems (ACES) Group is to research, develop, implement, test, and deliver next-generation control architectures and avionics hardware. The core competency within the group spans across various intelligent Guidance, Navigation, and Control (GN&C) technologies as well as avionics hardware and software system disciplines. ACES conducts foundational and applied research in adaptive, robust, and optimal control, trajectory guidance and planning, avionics architectures and processes, and evolvable systems towards automated design.

Deployable Automation Technologies (DAT)
The Deployable Automation Technologies (DAT) Group conducts applied research and development in automated planetary and small-body sample acquisition and handling systems, instrument automation, and health monitoring. Light speed communication delays require that space sample acquisition systems, such as drills, be autonomous and able to self-recover from faults. The focus of the group is in instrument and sampling automation technologies for realizing this need.

Intelligent Robotics Group (IRG)
The Intelligent Robotics Group (IRG) is dedicated to exploring extreme environments, remote locations, and uncharted worlds. IRG conducts applied research in a wide range of areas, including computer vision, geospatial data, human-robot interaction, interactive 3D visualization, and robot software architecture.

Planning and Scheduling Group (PSG)
The Planning and Scheduling Group (PSG) builds automated planning and scheduling systems for NASA missions. These planning and scheduling systems are essential components of autonomous spacecraft, deep space probes, planetary rovers, and autonomous vehicles.
Our advancements are
- increasing performance, productivity and efficiency,
- improving science return,
- enhancing safety,
- informing system design decisions,
- enhancing situational awareness and
- enabling new capabilities
ASR Sample Projects

Aviation Transformation:
- Performance Adaptive Aeroelastic Wing (PAAW)
- Safe and Efficient Crew-Autonomy Teaming (SECAT)
- Safe Autonomous Flight Environment (SAFE50)

Human and Robotic Exploration:
- Astrobeep
- Autonomous Systems and Operations (ASO)
- Resource Prospector (RP)
- Synchronized Position Hold Engage and Reorient Experimental Satellites (SPHERES)

Science Discovery:
- Atacama Rover Astrobiology Drilling Studies (ARADS)
- Biologic Analog Science Associated with Lava Terrains (BASALT)
Collaborative and Assistant Systems
Technical Area
General Overview

As NASA missions become longer and more scientifically complex, the critical challenge of managing the data and information generated by the Agency’s varied scientific and engineering activities only increases in importance. The Collaborative & Assistant Systems (CAS) technical area tackles this challenge by applying its extensive data management research and development experience to address the specific needs of NASA missions, programs, and projects.

CAS focuses its efforts on building systems and developing techniques that address issues throughout the information management lifecycle – starting with data acquisition, and moving through data conditioning and integration; data storage, organization, and access; data visualization; and finally, data analysis, mining, and extraction. An underlying theme of CAS work involves enabling NASA’s distributed teams to rapidly access key information needed for collaboration and accomplishment of their missions.
Approximate FY18 Funding By Mission Directorate

- **ARMD**: 5%
- **STMD**: 19%
- **HEOMD**: 37%
- **SMD**: 33%
- **Other**: 6%
Collaborative Assistant Systems Technical Area

90+ Civil servants and Contractors

Area Lead
Richard Papasin

Deputy Area Lead
Peter Tran

Groups:

Data Repository Systems
Helen Stewart

Enterprise Information Management
Peter Tran

Information Integration
Rich Keller

Decision Support Systems
David Thompson

Ground & Flight Data Systems
Jay Trimble
Collaborative & Assistant Systems

https://ti.arc.nasa.gov/tech/cas

Areas of Expertise

Data architecture design, Ground & flight data systems, Information extraction, Semantic technologies, Information integration systems, Knowledge management systems, Data mining & analysis, and Intelligent information retrieval, access & search

Research & Development Groups

1. Data Repository Systems - Building archival systems that store mission science data and ensure long-term access for researchers and the public
2. Decision Support Systems - Developing novel approaches to support enhanced decision-making by scientists, engineers, astronauts, spaceflight controllers, and air traffic managers
3. Enterprise Information Management - Creating and managing infrastructure data systems required to carry out NASA’s organizational functions
4. Ground & Flight Data Systems - Implementing systems to process and transport data from scientific instruments and sensors aboard satellites, spacecraft, and planetary rovers
5. Information Integration - Designing techniques and systems to fuse disparate information from multiple sources, thereby enabling comprehensive search and analysis
Closing Comments