65th JANNAF Propulsion Meeting (JPM)
Programmatic and Industrial Base Meeting (PIB)
12th Modeling and Simulation (MSS)
10th Liquid Propulsion (LPS)
9th Spacecraft Propulsion (SPS)
JOINT SUBCOMMITTEE MEETING
21 - 24 May 2018
Long Beach, California

Abstract Deadline Extended
10 January 2018

Announcement and Call For Papers
The May 2018 meeting of the Joint Army-Navy-NASA-Air Force (JANNAF) will consist of the 65th JANNAF Propulsion Meeting, the Programmatic and Industrial Base Meeting, and the Joint Meeting of the 12th Modeling and Simulation / 10th Liquid Propulsion / 9th Spacecraft Propulsion Subcommittees. Major Luke C. Dras with the Air Force Research Laboratory, Edwards AFB, CA, is the Meeting Chair. This meeting will be held Monday through Thursday, 21 - 24 May 2018, at the Hilton Long Beach in Long Beach, California. Please refer to page 4 for hotel and area information.

**ATTENDANCE REQUIREMENTS**

The overall security level of the meeting is Unclassified. All sessions will be held at the Hilton Long Beach in Long Beach, CA. Attendance, applicable to presenters as well, is restricted to invited U.S. citizens qualified to receive unclassified, limited-distribution information. No foreign nationals are permitted to attend.

**ALL non-government attendees** (which includes contractors, consultants and universities) attending this meeting must:

1. Be working on a current government contract or certified by a Sponsoring Government Official
2. Provide their organization’s DD 2345 Certification Number for receipt of militarily-critical technical data

**DD 2345:** For additional information, contact the Joint Certification Program Office (JCP) at 1-800-352-3572 or visit their Web site at [http://www.dla.mil/HQ/InformationOperations/Offer/Products/LogisticsApplications/JCP.aspx](http://www.dla.mil/HQ/InformationOperations/Offer/Products/LogisticsApplications/JCP.aspx).

**ALL Attendees:** To register, you must first have a JANNAF Secure Portal account. Please visit the Registration page of the meeting website for additional information and important links. All presenters are required to register and pay the registration fee.

Questions concerning attendance eligibility should be directed to the JHU WSE ERG Facility Security Officer, Mary Gannaway, at (410) 992-7304, ext. 211 or mtg@jhu.edu.

**PURPOSE**

The JANNAF Interagency Propulsion Committee focuses on the technology, development, and production capabilities for all types of propulsion systems and energetics for tactical, strategic and missile defense rockets and missiles, for space boost and orbit transfer, for in-space propulsion, and for gun systems. JANNAF provides a forum for discussion of propulsion issues, challenges, and opportunities across the Military Departments, Defense Agencies and NASA. JANNAF subcommittees focus their resources on technical issues of interest to the JANNAF agencies.

Work in all areas of DoD and NASA are solicited as defined below:

**6.1 Basic Research:** Systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products.

**6.2 Applied Research:** Systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met.

**6.3 Development:** Systematic application of knowledge toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

JANNAF accepts papers that are unclassified/unlimited and unclassified/limited for all meetings; and up to classified Secret as announced in the specific meeting’s announcement and call for papers.

**SCOPE**

**JANNAF Propulsion Meeting**

The JANNAF Propulsion Meeting (JPM) encompasses research and applications at the systems level. The JPM is held each year in conjunction with standing JANNAF subcommittee meetings on a rotating basis. The scope of the 65th JPM in 2018 spans seven mission areas, which are listed and described on pages 6-9.

**Programmatic and Industrial Base**

The JANNAF Programmatic and Industrial Base (PIB) Committee was created with the approval of the updated JANNAF Charter by the Department of Defense and the National Aeronautics and Space Administration in 2014. As stated in the Charter, the “Programmatic and industrial base areas of interest include integrated program plans and key decision points; industrial base assessments; risks and opportunities with respect to skills, knowledge, and experience; identification of commonality, innovative

---

**Table of Contents**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance Requirements</td>
<td>2</td>
</tr>
<tr>
<td>Meeting Purpose and Scope</td>
<td>2-3</td>
</tr>
<tr>
<td>Abstract Submittal Instructions</td>
<td>3</td>
</tr>
<tr>
<td>Author Timeline</td>
<td>4</td>
</tr>
<tr>
<td>Hotel and Area Information</td>
<td>4</td>
</tr>
<tr>
<td>Subcommittee / Mission Area Chart</td>
<td>5</td>
</tr>
<tr>
<td>JANNAF Propulsion Meeting Mission Areas</td>
<td>6-9</td>
</tr>
<tr>
<td>Modeling and Simulation Subcommittee Mission Areas</td>
<td>9-11</td>
</tr>
<tr>
<td>Liquid Propulsion Subcommittee Mission Areas</td>
<td>11-14</td>
</tr>
<tr>
<td>Spacecraft Propulsion Subcommittee Mission Areas</td>
<td>14-17</td>
</tr>
<tr>
<td>Workshops / Specialist Sessions</td>
<td>17</td>
</tr>
<tr>
<td>JANNAF Awards Program / Nominations</td>
<td>17-18</td>
</tr>
<tr>
<td>Upcoming JANNAF Meetings</td>
<td>18</td>
</tr>
</tbody>
</table>
acquisition, and partnership opportunities; integrated assessments to identify rocket propulsion industrial base (RPIB) rationalization opportunities; special actions from senior agency, department, or Executive Office of the President (EOP) leadership; and information provided to decision makers for either situational awareness or policy decisions.”

In conjunction with the JPM and PIB, the standing JANNAF subcommittees for Modeling and Simulation, Liquid Propulsion, and Spacecraft Propulsion will also hold their biennial meeting (held every 18 months). To learn more about the scope of the standing JANNAF subcommittees at this meeting, please review the information provided below and on pages 9-17.

**Modeling and Simulation Subcommittee**

The 12th MSS activities include model based systems engineering (modeling and simulation of systems, software analogs of systems, integrated system simulations, system-of-systems analysis and simulation); simulation credibility-uncertainty, verification, validation, reliability, and risk; and integrated health management-identification and management of off-nominal conditions in propulsion.

**Liquid Propulsion Subcommittee**

The 10th LPS is seeking papers on the advancement of liquid engine systems, technical problems and issues associated with the design, analysis, fabrication and testing, including liquid and gel propulsion technology topics that include the overall engine system, combustion components, turbomachinery and propellant feed systems.

**Spacecraft Propulsion Subcommittee**

The 9th SPS seeks abstracts on the full array of spacecraft propulsion technology interests including electric propulsion, advanced chemical propulsion, solar thermal propulsion, nuclear thermal propulsion, aerocapture, solar sails, tether systems, and technologies for the future.

**ABSTRACT SUBMITTAL INSTRUCTIONS**

- The technical areas to be addressed are defined in this announcement. Individuals who wish to submit an abstract should carefully review the topic areas listed on pages 6-17.

- The submission of an abstract represents an agreement to meet the abstract deadline date. Accordingly and begin the process early in an effort to process takes additional time, so authors should plan accordingly and begin the process early in an effort to meet the abstract deadline date.

- Please submit using the Abstract Submittal Form, which can be downloaded from the May meeting website.

- Indicate confirmation of management support on the Abstract Submittal Form to ensure availability of resources for your participation in the meeting.

- Many organizations require abstracts to be processed through an approval system prior to submission. This process takes additional time, so authors should plan accordingly and begin the process early in an effort to meet the abstract deadline date.

- Remember, you must be an invited and qualified U.S. Citizen to attend and present at this meeting. No foreign nationals are permitted to attend.

- The Extended deadline date for submission of completed Abstract Submittal Forms to ERG is 10 January 2018.

ERG accepts only electronic submission of abstracts and papers. Abstracts must be submitted on the Abstract Submittal Form:

- Via email to: scohen@erg.jhu.edu (Distribution A only); OR
- Uploaded to the ERG secure server as follows:

  1. Go to https://webdatabase.cgia.jhu.edu/docorg/program/cgi-bin/Login.pl
  2. Choose Infobase: JANNAF Mtg Abstract Uploads
  3. Type in User Name: Abstract
  4. Type in Password [contact ERG at (410) 992-7300 or 7302 for current password, changed daily]
  5. Click the “Login” button
  6. Click on “May 2018 JANNAF Meeting”; choose “Add Document” (to the left of the page)
  7. Complete the “Add Document” form, being sure to Title your Document, select “Upload from Client”, click the “Browse” button and navigate to where you have saved your completed Abstract Submittal Form on your computer. Select the file and click “Open”. Choose the appropriate file format (MS Word or PDF) under Document Type, and click on “Apply”: **NOTE:** The upload site does not send a confirmation. To verify that your upload was successful, click the refresh button in your browser.
  8. Email scohen@erg.jhu.edu to notify that the file has been successfully uploaded.

JPM / PIB / MSS / LPS / SPS Announcement and Call for Papers
**AUTHOR TIMELINE**

<table>
<thead>
<tr>
<th>Date</th>
<th>Weeks before Meeting</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Jan 2018</td>
<td>19</td>
<td>Extended Deadline for receipt of Abstract Submittal Forms.</td>
</tr>
<tr>
<td>12 Feb 2018</td>
<td>14</td>
<td>Acceptance/rejection letters sent to authors.</td>
</tr>
<tr>
<td>19 Feb 2018</td>
<td>13</td>
<td>Deadline for changes to meeting invitation and preliminary program.</td>
</tr>
<tr>
<td>26 Feb 2018</td>
<td>12</td>
<td>Invitation, preliminary program, and registration materials forwarded to propulsion community.</td>
</tr>
<tr>
<td>19 March 2018</td>
<td>9</td>
<td>Deadline for award nominations and submittal of Student papers for Best Student Paper award consideration.</td>
</tr>
<tr>
<td>9 April 2018</td>
<td>6</td>
<td>Deadline for submission of changes to the final program.</td>
</tr>
<tr>
<td>23 April 2018</td>
<td>4</td>
<td>Deadline for receipt of papers and paper/presentation clearance forms. Papers not received by this date may be removed from the program.</td>
</tr>
<tr>
<td>30 April 2018</td>
<td>3</td>
<td>Deadline for reservations at the Hilton Long Beach.</td>
</tr>
<tr>
<td>7 May 2018</td>
<td>2</td>
<td>Deadline for reduced registration fee. Deadline for completion of online Registration Form (must have JANNAF Portal account as registration pre-requisite).</td>
</tr>
<tr>
<td>7 May 2018</td>
<td>2</td>
<td>Deadline for receipt of presentations.</td>
</tr>
<tr>
<td>21 May 2018</td>
<td>0</td>
<td>JPM/PIB/MSS/LPS/SPS Joint Subcommittee Meeting</td>
</tr>
</tbody>
</table>

**AWARDS**

Nominations for JANNAF Technical Executive Committee (TEC), PIB Executive Committee (PEC), MSS, LPS and SPS recognition awards are being solicited. Individuals interested in nominating an award recipient should follow the guidelines and instructions on pages 17-18.

**RECOMMENDATIONS FOR WORKSHOPS OR SPECIALIST SESSIONS**

Recommendations for workshops or specialist sessions are solicited at this time. Individuals interested in organizing and chairing a specialist session should contact the ERG Technical Staff member in their respective subcommittee by 10 January 2018. See page 17 for additional information and requirements.

**HOTEL AND AREA INFORMATION**

Sleeping rooms have been reserved with the Hilton Long Beach in Long Beach, California, where all sessions will be held. Long Beach is a working port with a vibrant downtown and easily accessible beaches. A variety of restaurants, shops and entertainment options are all within a short walk or free and quick bus ride from the hotel. Three nearby airports offer convenient arrival by air, and the hotel is near major interstates for easy access by car.

**Hotel**

The JANNAF room block is not yet open for reservations. When reservations open in late February, the room rate per night for all meeting attendees will be at the GSA FY 2018 per diem rate, currently $173 plus tax (currently 15.4%) per day, for single or double occupancy. More information and the link to reserve your room in the JANNAF discounted room block will be posted on the Hotel page of the May meeting website when the Meeting Invitation and Preliminary Program have been posted online, and registration has been opened. For those eligible for tax exemption, a document listing information required by the city of Long Beach will be posted at that time as well.

**Transportation**

The three airports closest to Long Beach are: Long Beach Airport (LGB - 10 miles); Los Angeles International Airport (LAX - 21 miles); and John Wayne/Orange County Airport (SNA - 30 miles). Driving time varies by time of day. Ground transportation costs from the Long Beach Airport range from $1.25 for the Long Beach Transit bus to downtown Long Beach, to $25 for a taxi. If traveling between the hotel and the John Wayne/Orange County Airport, expect to pay approximately $50 for a taxi. Transportation between the hotel and LAX ranges from $17 each way for Super Shuttle to approximately $50 for a taxi. More information can be found on the airports’ websites. Rental cars are available at each area airport. If renting a car or driving a personal vehicle, the hotel is offering a $15/day discounted parking rate to JANNAF attendees.
### SUBCOMMITTEES / MISSION AREAS AT THIS MEETING

Click on the Mission Area of interest in the chart below to jump to that section in this Call for Papers.

<table>
<thead>
<tr>
<th>Mission Area</th>
<th>JPM</th>
<th>MSS</th>
<th>LPS</th>
<th>SPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Tactical Propulsion</td>
<td>Model-Based System Engineering</td>
<td>Liquid Engine Systems</td>
<td>Chemical Propulsion</td>
</tr>
<tr>
<td>II</td>
<td>Missle Defense / Strategic Propulsion</td>
<td>Integrated Health Management</td>
<td>Liquid Combustion Subsystems and Components</td>
<td>Electric Propulsion</td>
</tr>
<tr>
<td>IV</td>
<td>Gun and Gun-Launched Propulsion</td>
<td>Simulation Credibility</td>
<td>Advanced Materials for Liquid Propulsion Applications</td>
<td>Future Technologies</td>
</tr>
<tr>
<td>V</td>
<td>Propulsion and Energetics Test Facilities</td>
<td></td>
<td></td>
<td>Spacecraft Modeling and Simulation</td>
</tr>
<tr>
<td>VI</td>
<td>Sensors for Propulsion Measurement Applications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VII</td>
<td>System-wide Application of Additive Manufacturing for Propulsion Applications</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**JPM MISSION AREAS**

The 65th JPM sessions will cover systems development within the seven mission areas described below. Questions concerning these areas or the topics being solicited should be directed to the respective Area Chair.

**Mission Area I: Tactical Propulsion**

**Co-Chairs:** Dr. Jeremy R. Rice, AMRDEC / Redstone Arsenal, AL

Telephone: (256) 876-6077

Email: jeremy.r.rice4.civ@mail.mil

Dr. David R. Gonzalez, NSWC / Indian Head, MD

Telephone: (301) 744-1513

Email: david.r.gonzalez@navy.mil

This area encompasses all tactical propulsion systems including those applicable to air-to-air; air-to-surface, surface launched and underwater missions. Typical systems include tactical missile boosters or sustainers, kinetic energy missiles, free-flight rockets, anti-radiation, anti-ship, anti-armor, anti-personnel/materiel missiles, ramjets, scramjets, and combined cycle propulsion. System studies that evaluate advanced propulsion concepts and demonstrations that incorporate one or more component technologies applicable to tactical propulsion are of interest. Examples of component technologies include propellants and fuels, fuel management systems, cases and combustors, inlets, nozzles, thrust vector control systems, thrust management systems, and advanced materials applications. Life cycle cost and demilitarization are also topics of interest.

**Manufacturing technologies and fabrication techniques:** Papers are requested that emphasize manufacturing technologies and fabrication techniques. Papers need not be associated with a particular system but should be applicable to materials associated with such vehicles and their corresponding flight environment. Abstracts are especially sought on the following topics:

- Airbreathing propulsion systems
- Hybrid propulsion systems
- Solid propellant rocket propulsion systems
- Demilitarization
- Hypersonic propulsion systems
- Improved missile kinematics
- Insensitive munitions (from a systems perspective)
- Propulsion system product improvement
- Manufacturing technologies and fabrication techniques

**Airframe Structures and Materials:** Materials development and characterization, and structural concepts, design, test, and validation for Airframe applications and components exposed to extreme environments as found in atmospheric high speed or reentry conditions. Topics of interest include: TPS and hot structures, materials, structures and related technology for leading edges, exterior acreage surfaces, control surfaces, hot structures, and seals (penetrations). Further topics include hot and integrated structures; acreage thermal protection systems, including ceramic matrix composites, tiles, blankets, ablators, and metallics; fuel tanks, including cryogenic and hydrocarbon, composite and metallic; leading edges, including active, passive, and heat-pipe-cooled; design and analysis methods; and seals. Papers on structures and materials that have recently flown, or are planned for flight, on flight vehicles are encouraged.

**Mission Area II: Missile Defense / Strategic Propulsion**

**Chair:** Dr. Robert J. Jensen, Sierra Lobo, Incorporated / Edwards AFB, CA

Telephone: (661) 275-5468

Email: robert.jensen.12.ctr@us.af.mil

This area includes technology applicable to ballistic missiles, trans-atmospheric vehicles, and missile defense. Emphasis should be on system-level papers discussing propulsion technology for new vehicle systems, upgrades, modernization and sustainment; failure investigations; and economic considerations that include evolving business practices, life cycle cost estimation, and approaches that reduce development and operations costs and schedule. Papers are requested that emphasize sustainable manufacturing technologies and fabrication techniques. Papers need not be associated with a particular system but should be applicable to materials associated with such vehicles and their corresponding flight environment. Abstracts are especially sought in the areas of:

- Ground-based and sea-based strategic systems
- Ground-based, aircraft-based and sea-based missile defense
- Anti-satellite systems
- Advanced (including low or non-toxic) propellants
- Advanced (including light weight and/or high temperature) materials
- Insensitive munitions technologies
- Energy management approaches
- Dual mode systems (airbreathing/rocket)
- Unconventional propulsion
- Divert propulsion/attitude control propulsion
- Post boost control system propulsion
- Innovative propellant tank and valve technologies (including hot gas valve/pintles)
- Aging and Surveillance of propulsion systems
• Manufacturing technologies and fabrication techniques including the use of 3D printing for propulsion system components
• US-sourced sustainable materials
• Demilitarization or alternative applications of heritage propulsion systems

Mission Area III: Propulsion Systems for Space Access
Chair: Mr. Bruce R. Askins, NASA MSFC / Huntsville, AL
Telephone: (256) 544-1096
Email: bruce.askins@nasa.gov

This area focuses on existing or potential primary and auxiliary government, commercial or foreign propulsion systems for earth-to-orbit vehicles. Emphasis should be on system-level papers discussing propulsion technologies for new vehicle systems, upgrades and modernization, failure investigations, and evolving business practices that reduce development and operations costs while increasing mission reliability. Papers should address future access to space missions, future exploration missions and needs, vehicle system architectures, and the identification of critical propulsion requirements technologies that must be enabled to support these new system requirements.

Manufacturing technologies and fabrication techniques:
Papers are requested that emphasize manufacturing technologies and fabrication techniques. Papers need not be associated with a particular system but should be applicable to materials associated with such vehicles and their corresponding flight environment. Abstracts are especially sought in the following areas:

• Methods for development of design reference missions and vehicle systems architecture
• Description of vehicle systems analysis models and assumptions
• Details of architecture studies and descriptions of promising vehicle architectures
• Uncertainty evaluation of vehicle systems analysis
• Results of sensitivity analysis of key parameters on vehicle dry mass fraction margin, gross take-off weight, cost, reliability, and safety, with emphasis on propulsion
• Methods for identification and prioritization of critical enabling propulsion technologies
• Approaches for utilizing higher fidelity propulsion analyses in the overall systems architecture model(s)
• Methods to standardize model assumptions and fidelity in order to make relevant comparisons between vehicle architectures and various propulsion system options
• Description of promising new propulsion systems
• Description and status of the access to space propulsion system technology or development activities

Mission Area IV: Gun and Gun-Launched Propulsion
Chair: Mr. Paul L. Henderson, ARDEC / Picatinny Arsenal, NJ
Telephone: (973) 724-5518
Email: paul.l.henderson19.civ@mail.mil

This area embraces technologies applicable to small-, intermediate-, or large-caliber guns, as well as gun-launched rocket propulsion, for air, sea, or ground/mobile weapons systems. Typical rocket assisted systems include kinetic energy missiles and extended range projectiles, both guided and unguided. Abstracts are especially sought in the following areas:

• Conventional gun propulsion concepts to include solids and liquids
• Unconventional gun propulsion concepts
• System-level gun propulsion studies (gun tube wear and erosion, blast/flash mitigation, improved system survivability)
• Concepts to enable rocket systems to achieve high operating pressures (gun barrel and motor case)
• Assisted projectiles
• Assisted guided munitions
• Insensitive munitions

Mission Area V: Propulsion and Energetics Test Facilities
Co-Chairs: Mr. Michael D. Owen, NASA WSTF / Las Cruces, NM
Telephone: (575) 524-5403
Email: michael.d.owen@nasa.gov
Ms. Julie A. Carlile, AFRL / Edwards AFB, CA
Telephone: (661) 275-5098
Email: julie.carlile@us.af.mil

This area targets issues, technologies and achievements relevant to the operation and use of rocket propulsion test facilities for demonstration, development, characterization, and qualification of rocket, spacecraft, and gun propulsion systems, energetics, and materials for propulsion applications. Eligible test facilities include static test facilities for liquid rocket engines, solid rocket motors, electric and in-space propulsion systems, hypersonic test facilities, gel motors, hybrid propulsion systems, explosives, insensitive munitions, wind tunnels, altitude/vacuum chambers, and other rocket propulsion technologies; laboratory test facilities for energetics
and materials science characterization; and test ranges for missiles, guns and rocket sleds. Abstracts are specifically solicited on the following topics:

- Best practices and testing standards
- Integrating instrumentation, controls and data acquisition systems
- Static thrust measurement systems
- Propellant and materials handling and safety
- Accident and incident lessons learned
- Test facility modeling

Abstracts on improvements in base infrastructure, updates and upgrades of test stand capabilities, new propellant inventories, or other general advertisements of capabilities or assets will not be considered for this area.

Mission Area VI: Sensors for Propulsion Measurement Applications
Chair: Dr. Gary W. Hunter, NASA GRC / Cleveland, OH
Telephone: (216) 433-6459
Email: gary.w.hunter@nasa.gov

This area captures technologies and advancements in sensors and measurement devices for rocket and gun propulsion applications. Emphasis should be on development, application, modeling and integration of sensors for use in various propulsion applications. Abstracts are specifically sought on sensors for:

- Storage, tanking and cryogenic systems, including true cryogenic mass flow, cryogenic temperature measurement, mass and level measurement in micro and zero gravity, pump and turbomachinery induced pressure fluctuations, leak and tank integrity monitoring, and other propellant feed and storage measurements
- High-temperature systems and hostile environments, including: extreme high-temperature measurements, real-time nozzle erosions and fuel regression, material ablation, flame propagation, high temperature electronics, packaging, and communications, and measurement and analysis of thermal effects on pressure transducers
- In-chamber diagnostics, including development of methods to measure velocity, temperature, pressure, and/or other flow quantities inside of firing combustion chambers
- Plume measurement technology, including methods to utilize plume measurements to understand chamber operating conditions and spacecraft contamination issues
- Systems health monitoring and non-destructive evaluation (NDE) and repair, including: test stand characterization and control, structure and sense line frequency characterization, micro and nanotechnologies, systems for conversion of sensor data into actionable knowledge, technologies for intelligent health management systems, integrated fiber optics, electromagnetic NDE technologies, NDE data processing and analysis, life cycle monitoring of solid rocket motors, and monitoring of aeroshells and ballutes during reentry
- Smart sensing technology, including development of sensors capable of automatic calibration and fault detection; intelligent sensors that are calibrated in situ and provide dynamic compensation for environmental changes (temperature, humidity, etc.); fault detection also including any fault that would cause a sensor to provide inaccurate information such as sensor damage, lead wire damage or disconnection, and the disbonding or detorquing of the sensor; smart and distributed sensor system approaches, systems architectures, and applications
- Chemical sensors suitable for solid rocket motor environments and applications (sensors of interest include those for measuring the chemical state or composition of a solid, including gaseous diffusion, liquid diffusion, changes in free volume, direct measurement of changes in molecular weight or molecular weight per crosslink due to chain scission or the reaction products which result from chain scission); and development and applications of sensors that do not alter the chemical equilibrium of the solid solution are of particular interest
- Sensor modeling and simulation including modeling and simulation methods for sensor selection and data validation approaches; and recent advances in micro/nano technology, embedded sensor systems, optical diagnostics, and multiparameter measurement technologies

Mission Area VII: System-wide Application of Additive Manufacturing for Propulsion Applications
Chair: Mr. James L. Cannon, NASA MSFC / Huntsville, AL
Telephone: (256) 544-7072
Email: james.L.cannon@nasa.gov

This area focuses on the use of Additive Manufacturing (AM) as an enabling technology from both an organizational and a systems perspective. Additive manufacturing is critical for reducing manufacturing time and cost to produce specific components for propulsion systems, and multiple JANNAF Subcommittees are addressing the specific application challenges within their areas. Affordability is a critical element for both government and commercial systems. New and innovative manufacturing techniques are working their way into mainstream manufacturing. Before additive manufacturing is widely accepted for general use, it is necessary to understand the technology well enough to proceed with a high level of confidence. This Mission Area emphasizes how the various JANNAF organizations are planning to address the challenges of integrating AM into...
propulsion systems. What are the synergies between the JANNAF organizations' AM plans and the AM centers of excellence such as America Makes (as well as others)? How are the JANNAF organizations addressing the integration of AM hardware into existing or new systems? Other areas to consider are overall cost considerations and ROI when incorporating AM hardware into new systems.

Papers should address AM technology roadmaps (government, industry, AM centers), AM integration challenges, strategies for incorporating AM hardware into new or existing systems, and economic considerations.

Additive Manufacturing Technology:

- Government AM Technology Road Maps/Plans
- AM Centers of Excellence Technology Road Maps/Plans
- Industry AM Technology Road Maps
- Synergy between roadmaps, what is missing?
- Challenges for incorporating AM hardware into systems
- Economic considerations of incorporating AM hardware into new systems
- Are we investing enough into AM?
- Are we investing in the right areas?

**JHU WSE ERG Technical Representative**
Mr. Peter Zeender, JHU WSE Energetics Research Group / Columbia, MD  
Telephone: (410) 718-5001  
Email: pzeender@erg.jhu.edu

**JANNAF Program Planning Committee**
Mr. Bruce R. Askins, NASA-MSFC / Huntsville, AL  
Telephone: (256) 544-1096  
Email: bruce.askins@nasa.gov

Mr. Ryan E. Hunter, NAWCWD / China Lake, CA  
Telephone: (760) 937-7893  
Email: ryan.hunter@navy.mil

Ms. Patricia D. Pearce, AFRL / Wright-Patterson AFB, OH  
Telephone: (937) 255-7294  
Email: patricia.pearce@us.af.mil

Mr. Paul J. Conroy, ARL / Aberdeen Proving Ground, MD  
Telephone: (410) 278-6114  
Email: paul.j.conroy.4.civ@mail.mil

Dr. Jeremy R. Rice, AMRDEC / Redstone Arsenal, AL  
Telephone: (256) 876-6077  
Email: jeremy.r.rice4.civ@mail.mil

Major Jonathan F. McCall, AFRL / Edwards AFB, CA  
Telephone: (661) 275-6112  
Email: jonathan.mccall@us.af.mil

Dr. Charles J. Trefny, NASA GRC / Cleveland, OH  
Telephone: (216) 433-2162  
Email: charles.j.trefny@nasa.gov

Dr. David R. Gonzalez, NSWC / Indian Head, MD  
Telephone: (301) 744-1513  
Email: david.r.gonzalez@navy.mil

**MSS MISSION AREAS**

The Modeling and Simulation Subcommittee (MSS) provides an overarching focus on M&S across all disciplines related to JANNAF Interagency simulation-based acquisition of propulsion systems for aerospace plane, hypersonic aircraft, rocket-based space-access systems, high-speed missiles, and in-space propulsion systems, and gun propulsion systems. Model-Based System Engineering, Integrated Health Management, and Simulation Credibility Panels of MSS pursue this focus in the following current mission areas: Model-Based System Engineering, Integrated Health Management, Space and Launch Vehicle Cost Estimation, and Simulation Credibility. At the 12th MSS Meeting, papers are sought to address specifics of these mission areas as described below.

**Mission Area I: Model-Based System Engineering**

**Chair:** Mr. Eric J. Paulson, AFRL / Edwards AFB, CA  
Telephone: (661) 275-9688  
Email: eric.paulson.1@us.af.mil

Model-Based System Engineering (MBSE) encompasses the development of methodologies, codes, and model simulations to quantitatively evaluate and optimize propulsion technologies across propulsion component, propulsion system, and vehicle system levels. The use of models complements traditional experiment during technology development with a goal of reducing technology development time and schedule, as well as use physics-based models to explore domains and behaviors that are particularly difficult or impossible to examine experimentally. Publications in this area typically fall under two MBSE topic headings: Modeling Methodologies/Approaches and System Analysis Results.

Examples of topics of interest for the MBSE mission area include the following:

- Modeling Methods/Approaches
  - Proposed performance/loss models for rotating detonation rocket engines analogous to JANNAF standard for constant pressure liquid rocket engines
  - Accommodating multidisciplinary modeling at multiple simultaneous levels of fidelity
Engineering decision support. Optimization, scheduling, and knowledge-based tools—integration into the engineering process

Advances in the development of models and methods for component modeling and simulations to aid propulsion design

Improvements in commercial software which enable advanced MBSE

Challenges/Boosts to using MBSE under a more commercial/less centralized propulsion technology development paradigm and shifts from horizontal to vertical integration in the launch industry

• System Analysis Results
  • M&S of vehicle system technology trades for space launch systems, prompt strike platforms, long-range ballistic missiles, cruise missiles, and hypersonic cruise vehicles
  • Simulations, methods, and models to evaluate performance capabilities, cost, and reliability of systems
  • Vehicle and launch facility, weapon and weapon platform, propulsion system and test facility simulations, interactions, integration

Mission Area II: Integrated Health Management
Co-Chairs: Mr. R. Scott Hyde, Orbital ATK / Brigham City, UT
Telephone: (435) 863-6307
Email: scott.hyde@orbitalatk.com

David K. Hogan, AMRDEC / Redstone Arsenal, AL
Telephone: (256) 876-1886
Email: david.k.hogan2.civ@mail.mil

Integrated Health Management (IHM) promotes advancement and development of best practices for IHM of propulsion systems within a “system of systems” environment. IHM technologies are focused on reducing maintenance and logistics costs, and increasing reliability of propulsion systems. IHM includes methods and tools for: data management and mining; integrated communications, command and control; diagnostics; prognostics, and integrated sensors and sensing systems. These tools enable making redline and contingency decisions using knowledge-based expert systems, model-based diagnostic and reasoning, fault models, neural networks, fuzzy logic, genetic and evolutionary algorithms, and life-cycle analysis.

Seeking papers on the following, with the intent to establish a valuable interchange of technical solutions:

• Data Management and Mining: Advances in data mining, data fusion, machine learning, and statistics with applications to verification and validation of data, prognosis and diagnosis of system health.

Mission Area III: Space and Launch Vehicle Cost Estimation
Chair: Dr. Michael D. Watson, NASA MSFC / Huntsville, AL
Telephone: (256) 544-3186
Email: michael.d.watson@nasa.gov

Many launch and space vehicle programs have come in over budget and behind schedule. There is a need for accurate cost estimation for launch and space vehicles including their subsystems and components. This cost specialist session will address cost estimating methods for various launch and space vehicles, their subsystems, and their components; current cost estimating practices; new models emerging in commercial space sector; supply chain management costs; what causes cost overruns; and current and past launch vehicle cost estimating. Of interest are cost models and estimating techniques for the emerging commercial space transportation sector for sub orbital flights, low earth orbit servicing, and future lunar servicing missions.

Mission Area IV: Simulation Credibility
Chair: Dr. Dean R. Eklund, AFRL/Wright-Patterson AFB
Telephone: (937) 255-0632
Email: dean.eklund@us.af.mil

The focus of this Mission Area is on facilitating credible simulations because the credibility of simulations is a major issue for incorporating simulation tools and data into a technology-development program, for conducting simulation-based acquisition, for assessing system reliability to assure human safety and/or mission success, for identifying and assessing risks. Simulation credibility includes assessment and management of simulation uncertainty, sensitivity-uncertainty
analysis, experimental uncertainty, modeling uncertainty, simulation verification, validation of models and simulations. Papers are solicited on efforts and guidance on simulation credibility for unit, benchmark, subsystem, and system problems related to the following topics:

- Uncertainty sources and sensitivity analysis
- Propagation, quantification, and management of uncertainty
- Simulation verification
- Model validation
- Simulation credibility assessment
- Risk assessment and management
- Best practices, guidelines, and procedures for establishing simulation credibility.

Modeling and Simulation Subcommittee Chair
Dr. Michael D. Watson, NASA-MSFC / Huntsville, AL
Telephone: (256) 544-31846
Email: michael.d.watson@nasa.gov

JHU-WSE ERG Technical Representative
Mr. Alex Bishop, JHU WSE Energetics Research Group / Columbia, MD
Telephone: (443) 718-5008
Email: abishop@erg.jhu.edu

LPS MISSION AREAS
The JANNAF 10th Liquid Propulsion Subcommittee meeting will include sessions in four general technical areas: liquid engine systems; liquid combustion subsystems and components; liquid propellant feed and pressurization systems; and advanced materials for liquid propulsion applications. Papers are solicited that will aid in the design, development and test of efficient and stable liquid propulsion systems.

Mission Area I: Liquid Engine Systems
Co-Chairs: Mr. Jason B. Turpin, NASA MSFC / Huntsville, AL
Telephone: (256) 544-2807
Email: jason.b.turpin@nasa.gov
Mr. Nils M. Sedano, AFRL / Edwards AFB, CA
Telephone: (661) 275-5972
Email: nils.sedano@us.af.mil

System Analysis and Trades: Analytical tools, computational models, and methodologies for liquid engine system analysis and design trade methods; cost and weight models; boost/upper-stage engine design tools; model validation methods and criteria; technology and risk identification.

Health Management and Controls: New and innovative approaches for sensing engine system performance and hardware condition characteristics during all phases of operation (including preflight prep, prestart, start, flight, shutdown, safing and turnaround) with an emphasis on improving overall system reliability and maintainability. Papers discussing instrumentation innovations, failure prognostic and diagnostic algorithms, maintenance prognostic and diagnostic algorithms, and new and innovative target platforms for performing real-time health management are of interest.

Test Practices, Standards, and Facilities: Industry-consensus best practices and standards for the test and evaluation of liquid engines, components and propulsion/vehicle interaction. Status, capabilities, and operation of government and commercial rocket engine test facilities. This includes training, problem reporting, failure investigation, lessons learned, safety, FOD control, process control, and infrastructure improvements to meet aggressive technical goals. Concepts and innovations for engine life testing, engine fault detection, flight qualification testing practices, data reduction and uncertainty analysis methodologies, and other test needs to meet future demands are of interest.

Long-Life, Reusable, and Long-Duration Engine Design and Integration: Methodology for the design of long-life and long mission duration operable chemical rocket engine propulsion systems. Long-life engines with current performance levels that have extremely high reliability and operability with 40+ cycles of engine life. Design methodologies for engines with highly responsive, rapid turnaround operational capability.

Small Launch Vehicle Engines: Design, development, test, and evaluation approaches for small launch vehicle liquid propellant rocket engines: vehicle integration, safety and reliability, fabrication, testing, verification, validation, operations, and the affordable integration of those areas.

Liquid Engine Systems for Human-Rated Launch Vehicles: Design, analysis, development, test, and evaluation approaches and planning associated with liquid propellant rocket engines for use on human-rated launch vehicles; including NASA’s Space Launch System (SLS) and vehicles intended for commercial space tourism applications. Functional requirements and design concepts and/or design modifications for the engines on these vehicles. Approaches for meeting government (NASA, FAA, or OCST) safety and reliability requirements for operation with crew and passengers, including fault tolerance; fault detection, isolation, and recovery; crew interaction, reliability predictions and models, and qualification/certification testing requirements and approaches.

Liquid Rocket Engine (LRE) Development History: Papers addressing the important process which LRE have gone through in the course of their development. Particular subjects of note are successes, failures, mishaps, and lessons learned.
Topics can be detailed in their information or can provide a general overview of the program. Papers are not limited to flight systems; testbeds, proof-of-concepts, and R & D programs are encouraged as well.

**Operability:** Papers addressing the operational needs of rocket engines. Operability entails all aspects with rapid turn-around, automated checkout, cleaning, rapid remove-and-replace, etc. This mission area seeks new techniques, processes, design requirements, and proposed design changes to the combustion devices that enable operability.

**Mission Area II: Liquid Combustion Subsystems and Components**

**Co-Chairs:** Dr. Christopher S. Protz, NASA MSFC / Huntsville, AL  
Telephone: (256) 544-6956  
Email: christopher.s.protz@nasa.gov  
Mr. Robert N. Bernstein, AFRL / Edwards AFB, CA  
Telephone: (661) 275-5109  
Email: robert.bernstein.1@us.af.mil

**Thrust Chamber Assembly (TCA) Design and Applications:** This mission area addresses the components and subcomponent features required in all sizes of liquid rocket engines. Components include main combustion chambers, preburners, gas generators, nozzles, and their subcomponent features including items such as injectors, stability aids, and coolant passages. Papers on combustion devices are being sought that cover all aspects of design analysis, component test results, test rig development, diagnostic techniques, and novel design features that are being made possible by manufacturing advances.

**Hydrocarbon Fuel Properties, Performance, and Specifications:** Papers addressing chemical composition, physical properties, fit-for-purpose quality, cooling and combustion performance, and specification for various hydrocarbon fuels, including RP-1/RP-2, methane, LNG, JP-10 and other high energy density propellants, and alternatively derived fuels (F-T, flPK, ATJ, etc.); experimental and numerical efforts to characterize operational performance of these fuels in terms of cooling, combustion, and other application-specific processes.

**Combustion Stability:** Papers addressing design and performance challenges, modeling and simulations techniques, and scaling methods associated with combustion stability in main combustion chambers, preburners, and gas generators for all sizes of liquid rocket engines.

**Liquid Injection Systems:** The injection system of liquid rocket engines is critical to system performance. This mission area seeks papers describing new injector concepts, the physical processes required to understand injection concepts (including supercritical jets, sprays, and droplets), and methods to determine injector performance and stability.

**Modeling and Simulation:** Recent advances in modeling and simulation bring forward new capabilities to performance prediction and design of combustion devices. Papers are sought that look at the recent developments, new techniques, results of implementation or comparison with tests. Aspects covered include, but are not limited to: hot gas flow fields, heat transfer, cooling mechanism, integrated models, and injector element dynamics.

**Advanced Liquid and Gel Propellants:** Papers are sought addressing advanced liquid and gel propellants and the development of supporting technologies such as “green” propellants, fuel management systems and lightweight tankage systems to advance state-of-the-art chemical capabilities.

**Hybrid Rocket Engines:** Papers addressing hybrid rocket engine systems and the combustion process in these systems.

**Mission Area III: Liquid Propellant Feed and Pressurization Systems**

**Co-Chairs:** Mr. James L. Cannon, NASA MSFC / Huntsville, AL  
Telephone: (256) 544-7072  
Email: james.l.cannon@nasa.gov  
Mr. Alan M. Sutton, AFRL / Edwards AFB, CA  
Telephone: (661) 275-5925  
Email: alan.sutton.3@us.af.mil

**Turbomachinery Design and Applications:** Turbopump-fed liquid rocket engine systems require the use of high speed and high performance rotating machinery. Turbomachinery for this application requires support from a wide range of technical disciplines. Technical areas typically considered include the design, analysis, and testing of inducers, impellers, turbines, seals, bearings and structural elements. Papers on liquid rocket engine turbomachinery are being sought that cover all aspects of design, analysis, code development, component test results, test rig development, diagnostics techniques, and system level testing.

**Pressurization and Feed Subsystem Design and Applications:** This area covers all aspects of design, analysis and testing of the propellant feed system and engine system specific elements. The propellant feed system is composed of tanks, major component lines, pressurization systems, ducts, feed system control valves, and suppression systems. Engine system specific elements include ducts, flow measurement devices and valves. Papers are being sought which address design, analysis, tool development, diagnostics techniques, and testing of propellant feed system elements and engine system specific elements.
Mission Area IV: Advanced Materials for Liquid Propulsion Applications

Co-Chairs: Mr. Clyde “Chip” Jones, NASA MSFC / Huntsville, AL
Telephone: (256) 544-2701
Email: chip.jones@nasa.gov

Mr. Jamie B. Malak, AFRL / Edwards AFB, CA
Telephone: (661) 275-5539
Email: jamie.malak@us.af.mil

Material Applications in Liquid Rocket Engines: Papers are sought addressing advanced materials and processing for liquid rocket propulsion systems, including:

- Material technologies resulting in significant thrust-to-weight ratio increases and/or performance advantages over state-of-the-art capabilities
- Lightweight, high-temperature nozzle materials
- Polymer matrix composites (PMCs) for lightweight components and structures
- PMC resin development for high-temperature or cryogenic environments
- Materials for lightweight lines, ducts, valves, and tanks
- Metals, ceramics, and their composites for component applications
- Materials and production methods for lower lifecycle costs
- Near net shape production for components and structures
- Modeling of materials for liquid rocket engines

Materials for Commercial Space Transportation: The recent shift by NASA to commercial space transportation to the ISS under COTS has created the need for low-cost, high performance material solutions for a new generation of space vehicle engines. Papers are sought addressing areas such as:

- Materials selection criteria
- Material characterization requirements
- Flight qualification standards for materials
- Risk management as related to materials selections

Heavy Lift Launch Vehicles: A need for heavy lift launch vehicles (>100 metric tons payload) has been identified for future space exploration and other missions. Such a launch vehicle will likely require engines in the 1 million pound thrust class as well as smaller upper stage and other liquid-fueled engines. Papers are sought addressing materials and processes for:

- Manufacturing and production of new liquid fueled engines
- Integrated health management for materials and structures
- Lightweight tanks and composite ducts
- Materials for reusable engines
- Concepts for material solutions that optimize the entire propulsion system for improved performance

Nanotechnology for Liquid Propulsion Systems: Application of new nanomaterials to liquid propulsion systems has the potential to greatly increase performance of future engines. Papers are sought to address:

- Nanomaterials and nanoprocessing to improve strength, conductivity, density, modulus, and other properties
- Concepts of how to integrate nanotechnology into future liquid-fueled rocket engines
- Nanotechnology areas that may have high payoffs for liquid rocket engine systems

Materials for Green Fuel Engines: In addition to the traditional hydrogen, hydrocarbon and hypergolic engines, new engines with "green" fuels such as methane and ethanol as well as newer fuels that go beyond the traditional definition of green fuels have been proposed. Little work has been done to address the compatibility of these fuels and their combustion products with current and potential future engine materials. Papers are sought to address:

- Environmental corrosion issues for both the fuels and the combustion products
- Compatibility test methods
- Materials concepts for future green fueled engines
- Concepts for future engines and materials for them

Turbomachinery Materials: Turbomachinery require new materials or coatings to address new engine cycles such as oxygen-rich staged combustion. The chemical and temperature environments will be considerably different than prior expander or gas-generator cycles. Papers are sought to address potential issues such as:

- Hydrogen and oxygen compatibility
- Testing for oxygen promoted combustion and hydrogen embrittlement
- Development process for new materials
- Criteria for inserting new materials into turbomachinery for hydrogen-, hydrocarbon- and green-fueled engines

Additive Manufacturing: Processing methods using additive manufacturing techniques such as selective laser sintering, electron beam sintering, UV additive manufacturing, microwave additive manufacturing and other three-dimensional rapid prototyping methods offer considerable
potential for reduction of times to produce parts, cost savings and increased part complexity. Papers are sought for both the development of techniques and the practical use of additive manufacturing technologies as applied to liquid propulsion applications.

**Liquid Propulsion Subcommittee Co-Chairs**
Mr. James L. Cannon, NASA MSFC / Huntsville, AL
Telephone: (256) 544-7072
Email: james.l.cannon@nasa.gov

Dr. Daniel L. Brown, AFRL / Edwards AFB, CA
Telephone: (661) 275-5817
Email: daniel.brown.50@us.af.mil

**JHU-WSE ERG Technical Representative**
Mr. Benjamin Hill-Lam, JHU WSE Energetics Research Group / Columbia, MD
Telephone: (443) 718-5011
Email: bhill-lam@erg.jhu.edu

**SPS MISSION AREAS**

The 9th JANNAF Spacecraft Propulsion Subcommittee (SPS) seeks abstracts on the full array of spacecraft propulsion technology interests including electric propulsion, chemical propulsion, micro-thrust propulsion, solar thermal propulsion, nuclear thermal propulsion, aerocapture, solar sails, tether systems, and technologies for the future.

**Mission Area I: Chemical Propulsion**

Co-Chairs: Mr. A. Paul Zuttarelli, AFRL / Edwards AFB, CA
Telephone: (661) 275-6786
Email: anthony.zuttarelli@us.af.mil

Dr. Matthew Deans, NASA GRC / Cleveland, OH
Telephone: (216) 433-6585
Email: matthew.c.deans-1@nasa.gov

Ms. Caitlin A. Bacha, NASA GSFC / Greenbelt, MD
Telephone: (301) 286-6217
Email: caitlin.bacha@nasa.gov

Papers are invited that cover all areas of chemical propulsion including monopropellant, bipropellant, gel, solid, and hybrid chemical propulsion systems. Some current areas of interest include, but are not limited to, green propellants and propulsion system developments for modern spacecraft and new missions.

Decreased toxicity monopropellant thruster technology development has been of primary interest for spacecraft applications in the last decade. Monopropellant technology is of critical importance to spacecraft operations and principally relies upon catalyst technology.

New propulsion system architecture approaches and technology demonstrations that are being pursued to reduce cost, expand capabilities, and enable new missions are also of significant interest. Also, reuse or modification of existing propulsion systems and components has been an ongoing and emerging area of development where publications are sought. This includes the reuse of heritage components and developments in reusable vehicles, systems, or components.

Increasing community knowledge of lessons learned and the relative impact of forthcoming technologies and approaches will support the transition and evolution of these propulsion approaches. Papers are solicited on the following topics of particular interest for sessions supporting spacecraft chemical propulsion:

**Propellant Factors**

- Formulation, pre-cursor considerations, synthesis, and quality control measures
- Propellant advantages, disadvantages and their impact to operations (ground and flight)
- Propellant (decreased toxicity and state of the art) storage and management
- Decomposition, kinetics, and combustion environment impact to materials and duty cycle
- Impact of propellant impurities on performance including catalytic life

**Thruster/Engine/Component Factors**

- Impact of propellant impurities on delivered performance including catalytic and non-catalytic reactor performance and life
- Injection technologies and concerns such as propellant atomization or dispersion, including impacts of non-volatile residue accumulation factors and irregular feed
- Decomposition and ignition means for all areas of chemical propulsion including:
  - Development and performance of alternative catalysts, substrate, and active materials with respect to response and life limiting factors
  - Augmented catalytic and non-catalytic decomposition for monopropellants
- Developments and issues in the reuse, modernization, and/or requalification of components
- Integrated performance and operations including:
  - Duty and thermal cycle impacts to response, repeatability, and useful life
  - Relationship of propellant conditions, component design, and ignition factors
- Relationship of propulsion system conditioning requirements by mission
- Effectiveness in modeling variation of performance for system design and mission planning

**System/Mission Factors -**

- Throttleable and pulsed system delivered performance including combustion stability effects
- Propulsion system architecture considerations, configuration trades, and mission optimization
- Propulsion system operations, diagnostics, and failure management
- Operational condition concerns such as conditioning of propellants and testing of environments
- Status, infusion viability, and impact of new propulsion technology and pathfinder activities

**Mission Area II: Electric Propulsion**

**Co-Chairs:** Dr. Hani Kamhawi, NASA GRC / Cleveland, OH  
Telephone: (216) 977-7435  
Email: hani.kamhawi-1@nasa.gov

Dr. Robert B. Lobbia, NASA JPL / Pasadena, CA  
Telephone: (818) 354-0278  
Email: robert.b.lobbia@jpl.nasa.gov

Papers are invited in all areas of electric propulsion (including solar- and nuclear-powered systems). Topics of interest include:

- **Basic Research and Development of Electric Propulsion Thrusters:** This area includes physics of electric propulsion processes, thruster technology development, advanced and breakthrough concepts, high-power electric propulsion, hybrid and dual-mode systems using electric propulsion, alternate propellant research, laboratory plasma diagnostic techniques, and electric propulsion ground test facilities effects.

- **Systems Engineering of Electric Propulsion Subsystems:** This includes electric propulsion subsystem design, propellant storage and feed systems development, power processing units design and testing and integrated system testing of electric propulsion subsystems.

- **Electric Propulsion Flight Programs:** This includes reporting on flight electric propulsion hardware development, ground and flight system operations, space qualification programs, flight plasma diagnostics development and experiments, and in-flight programs status.

- **Electric Propulsion Mission Studies:** This includes reporting on mission studies that leverage electric propulsion systems to enable or enhance commercial, science, and human exploration space missions.

**Mission Area III: Cube / Nano Satellite Propulsion**

**Co-Chairs:** Dr. Colleen M. Marrese-Reading, NASA JPL / Pasadena, CA  
Telephone: (818) 354-8179  
Email: colleen.m.marrese-reading@jpl.nasa.gov

Dr. William A. Hargus, Jr., AFRL / Edwards AFB, CA  
Telephone: (661) 275-6799  
Email: william.hargus@us.af.mil

Mr. Khary I. Parker, NASA GSFC / Greenbelt, MD  
Telephone: (301) 286-4123  
Email: khary.i.parker@nasa.gov

Papers are invited to discuss micro-propulsion for CubeSATS, NanoSATS, and other small satellites. Applications, concepts, and designs for propulsion systems or components for small satellites are of interest. Of particular interest are papers on components such as valves, tankage, propellant feed system elements, and power conditioning for micro-propulsion applications. Other areas of interest include:

- Micro-propulsion
- Nano-propulsion
- Micro-thrust devices
- Cube satellite applications
- Micro satellite applications
- Nano-satellite applications
- Cube/Micro/Nano satellite propulsion systems
- Small component development and design for small propulsion applications
- Power conditioning for micro-EP applications
- System-level integration studies
- Mission design studies
- Nano-satellite applications
- Flight demonstrations

**Mission Area IV: Future Technologies**

**Chair:** Dr. Kurt A. Polzin, NASA MSFC / Huntsville, AL  
Telephone: (256) 544-5513  
Email: kurt.a.polzin@nasa.gov

Papers are invited for a range of advanced future space propulsion technologies, including but not limited to the following listed areas.

Nuclear Thermal Rocket (NTR) propulsion design, testing, and utilization for future human exploration missions of the solar system, including:

- NTR spacecraft and mission design for human Mars Exploration mission
• Solid core NTR concepts with or without bimodal capability
• Common reactor design for both propulsion and surface power generation
• Candidate nuclear fuel options
• Reactor controls and shielding
• NTR test methods and facilities
• NTR demonstration options
• Safety, reliability, risk analysis and crew-rating
• NTR vehicle operations and costs

Solar Thermal Propulsion engines and concentrators with specific interest in:

• Engine concepts (thermal storage, direct gain, bimodal, volumetric, etc.)
• Engine support structures, insulation techniques, and materials
• Inflatable, deployable or rigidized primary and secondary concentrators
• Reflectors
• Engine/concentrator integration and alignment
• Sun acquisition
• Sun tracking and pointing
• Mission concepts and applications utilizing a solar thermal propulsion system to enable new mission scenarios or to enhance current mission capabilities.

Advanced concepts for both near- and far-term future space propulsion focusing on technologies that promise significant gains in specific impulse, and/or power density, but are based on known fundamental physics, such as:

• Fusion energy in space propulsion including conventional magnetic schemes, inertial fusion schemes, inertial electrostatic confinement, magnetically insulated inertial fusion, fission-fusion hybrid systems, and concepts that utilize fusion reaction directly or indirectly.
• High-energy fuels
• Use of antimatter in propulsion systems
• Laser or microwave propulsion
• Mass drivers

Solar sail propulsion, electrodynamic and momentum exchange tether propulsion, aerocapture, atmospheric entry and thermal protection systems (TPS), and other innovative technologies that use the natural environments of space to derive propulsion without the expenditure of conventional fuel.

• Review or summary of previous flight experiments
• Planned and/or funded missions
• Near-term mission concepts
• Advanced mission concepts
• Innovative system or subsystem designs
• Guidance, navigation and control
• Space environmental effects
• Development, characterization, modeling and testing of TPS materials

Mission Area V: Spacecraft Modeling and Simulation
Chair: Dr. Justin Koo, AFRL / Edwards AFB, CA
Telephone: (661) 275-5908
Email: justin.koo@us.af.mil

Virtually all the mission areas represented at JANNAF SPS have some Modeling and Simulation (M&S) activity as an essential, yet underrepresented, component of successful technology development. We strongly encourage prospective authors to develop separate M&S papers, in addition to mission area specific papers, so that knowledge of the unique and promising computational aspect of SPS can be disseminated throughout the community. These include computational models for physical behavior, innovative numerical methods, development of robust computational validation techniques and exploitation of novel hardware configurations. Topics of particular interest to the organizing committee are those supporting: catalyst development; electromagnetic and electrostatic thruster development; prediction of plume signatures and spacecraft/plume interaction behavior.

Spacecraft Propulsion Subcommittee Chair
Mr. David T. Jacobson, NASA GRC / Cleveland, OH
Telephone: (216) 433-3691
Email: david.t.jacobson@nasa.gov

Spacecraft Propulsion Subcommittee Deputy Chair
Dr. William A. Hargus Jr., AFRL / Edwards AFB, CA
Telephone: (661) 275-6799
Email: william.hargus@us.af.mil

JHU WSE ERG Technical Representative
Mr. David Owen, JHU WSE Energetics Research Group / Columbia, MD
Telephone: (443) 718-5006
Email: dowen@erg.jhu.edu
**WORKSHOPS/SPECIALIST SESSIONS**

Recommendations for workshops or specialist sessions are solicited at this time. **Individuals interested in organizing and chairing a workshop or specialist session should contact the JHU WSE ERG Technical Staff member in their respective subcommittee by the Extended Deadline of 10 January 2018.**

**Workshops**

The JANNAF Workshop is reserved for bringing the community together to address a specific task or problem, the outcome of which is important and substantial enough to warrant the publication of a final report detailing the discussions, conclusions, and recommendations that resulted from the workshop.

Requirements for JANNAF workshops and established best practices can be found in the JANNAF Workshop Guide for Chairs; this document will guide you through the planning and approval process for workshops held at a JANNAF meeting.

To request a workshop you must submit a **Workshop Request Form** to your JHU WSE ERG Technical Liaison or Shelley Cohen scohen@erg.jhu.edu. This form must be submitted to ERG by **Wednesday, 10 January 2018**. The agenda and invitation list is due **Monday, 12 February 2018** for inclusion in the Preliminary Program, and must be approved no later than **Monday, 9 April 2018** for inclusion in the Final Program.

**Specialist Sessions**

To request a Specialist Session for this JANNAF meeting, a **Specialist Session Request Form** must be submitted to JHU WSE ERG. This form requires a statement of justification for the Specialist Session as well as a well thought out agenda. Requests will be reviewed by the designated JANNAF subcommittee TSG chair and ERG for approval; this approval is necessary for any Specialist Sessions to be included in the Final Program.

The **Extended deadline for submission of a Specialist Session request is 10 January 2018**. If you have any questions about planning a Specialist Session please contact your ERG Technical Liaison or Shelley Cohen at scohen@erg.jhu.edu.

**JANNAF AWARDS PROGRAM**

In the tradition of recognizing the outstanding achievements by members of the propulsion community, the JANNAF Technical Executive Committee (TEC) and Programmatic and Industrial Base Committee (PEC), as well as the Modeling and Simulation (MSS), Liquid Propulsion (LPS), and Spacecraft Propulsion (SPS) subcommittees, are soliciting nominations for awards to be presented at the meeting. A TEC or PEC Award is justified if the achievement or service is in a technical or programmatic area that is not covered by an existing subcommittee, or is of such scope or magnitude that merits this recognition.

**Special Recognition Awards**

The **Special Recognition** awards for **Sustained Contribution** and **Lifetime Achievement** honor individual achievements, either in the last 18 months or for a lifetime of dedicated service. These awards are the most prestigious subcommittee awards and reflect on the awardees’ contributions to JANNAF.

Special recognition award winners will be selected by respective subcommittee Awards Committees based on review of the nomination in consideration of the following:

- Technical value of the achievement(s) including level of technical complexity and challenge, quality of results, degree of innovation and timeliness of research.
- Impact of the achievement on the broader propulsion community.
- For individuals nominated for lifetime achievement, demonstrated participation in technical societies as evidenced by positions held and papers published will be considered favorably.

**Outstanding Achievement Award**

The **Outstanding Achievement Award** is given for the most outstanding technical achievement in the subcommittee’s area by an individual, by a team within an organization, or by a team of organizations. To recognize the varied nature of the JANNAF subcommittees and the accomplishments of their communities, nominations may be solicited and given in the two focus areas of R&D Technology and Operational Systems.

The achievement shall have been accomplished in the previous 18 months. The nominees must have worked for the organization during the same 18-month period of performance.

The award recipients(s) must be able to attend the meeting to receive the award.

**Certificate of Commendation**

The **Certificate of Commendation** is given to recognize an individual whose contributions within the last 18 months have been pivotal in ensuring the success of a JANNAF activity.

**Certificate of Appreciation**

The **Certificate of Appreciation** is given to recognize individuals for outstanding contributions and dedicated service to JANNAF.
Nominations

To nominate an individual for one of the above awards please use the JANNAF TEC/PEC and Subcommittee Award Nomination Form. Nomination submissions should include the following:

- A description of the achievement or distinguished service, of no less than 200 and no more than 1000 words. The description must be typed or provided in electronic format (Adobe Acrobat PDF or MS Word) via Email.
- Supporting data (if desired) of no more than 10 pages.
- Supporting curriculum vitae, list of publications, and/or professional activities as required to support the nomination.
- Contact information for the nominee(s) and the nominator, including organization affiliation, phone number, and email address.

Nominations should be submitted to the appropriate JHU WSE ERG technical representative no later than Monday, 19 March 2018.

Best Paper Awards

In addition to the nomination awards listed above JANNAF recognizes authors of papers that exhibit excellence and significant merit with the Best Paper Awards. Best Paper Awards from this meeting will be given at the next JANNAF Subcommittee meeting.

Best Student Paper Awards

The Best Student Paper Award will be given to undergraduate or graduate students who author papers that exhibit excellence and significant merit. One paper will be selected to receive the Best Student Paper Award. All student-authored works will automatically be included in the initial round of consideration with the submission of an abstract; in order to facilitate identification of student-authored works please clearly state on your abstract that you wish to be considered for the Best Student Paper Award or contact the appropriate ERG technical representative.

As a reminder: student authors must conform to the same JANNAF eligibility requirements as other authors, per the policy on non-government attendees at JANNAF meetings given on page 2. Student authors are encouraged to work with their advisors to ensure they meet these requirements, and should contact JHU WSE ERG at their earliest convenience with questions regarding their eligibility and participation.

Student papers will be reviewed upon submission of their cleared manuscripts. In order to be considered for the student best paper selection, the completed paper must be provided to JHU WSE ERG by 19 March 2018. The Best Student Paper Award will be presented at the JANNAF meeting at which the paper is given.

UPCOMING JANNAF MEETINGS

48th Combustion
36th Airbreathing Propulsion
36th Exhaust Plume and Signatures
30th Propulsion Systems Hazards
Joint Subcommittee Meeting
Programmatic and Industrial Base Meeting
4-8 December 2017
Newport News Marriott at City Center
Newport News, Virginia
and
NASA Langley Research Center
Hampton, Virginia

65th JANNAF Propulsion Meeting
Programmatic and Industrial Base Meeting
12th Modeling and Simulation
10th Liquid Propulsion
9th Spacecraft Propulsion
Joint Subcommittee Meeting
21-24 May 2018
Hilton Long Beach
Long Beach, California

45th Structures and Mechanical Behavior
41st Propellant and Explosives Development and Characterization
32nd Rocket Nozzle Technology
31st Safety and Environmental Protection
Joint Subcommittee Meeting
Programmatic and Industrial Base Meeting
3-7 December 2018
Location TBA