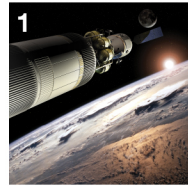# Technology Expertise Areas

1. SPACECRAFT SYSTEMS AND TECHNOLOGIES

»Spacecraft Systems and Architectures
- Mission Architectures
  - Clusters
  - Motherships/Hubs
  - Constellations
  - Formations
  - Swarms
- Platforms
  - Pico Satellites
  - Nano Satellites
  - Micro Satellites
  - Small Satellites

»Subsystems and Components
- Avionics
- Propulsion
- ADCS
- Structures and Materials
  - Materials
  - Structures
  - Mechanical Systems
  - Manufacturing
- Thermal Control and Management
- Communications
- Power
- Software

»Systems Engineering
- Subsystems Trades
- V & V
- Requirements Analysis

»Payloads and Instruments
- Life Science
- Space Weather
- Earth Observation
- Planetary Atmospheres
- Planetary Probes
- Heliophysics
- Assembly, Integration, Test
- Accommodations

»Sample Return and Reentry Technologies
- EDL
- Sample Acquisition
- Sample Recovery
- Preparation and Handling
- Containment
- Environmental Monitoring and Control

»Free Flyer Space Biotechnology
- Flight Systems Integration, Test and Operations
- Habitat Design and Development
- Experimental Sensors and Measurement Tools

»Mission Operations, Range Support, and Ground Systems Technologies
- Mission Operations Technologies
- Ground Systems and Technologies
  - Mission Planning Systems
  - ISHM
- Range Support Technologies

»Software Systems, Enabling Tools, and Associated Technologies
- End-to-End Mission Design and Simulation
  - Orbital Trajectory
  - More
  - Concept
  - Science Traceability
  - Instrument Definition
  - Ground Systems
- Software Systems
  - Mission Assurance Systems
  - Hardware-in-the-Loop Testing
  - Mission Design Technologies
- Enabling Tools

»Additional Areas to be Worked
- Power Systems
- Thermal
- Miniaturization
- Advanced Materials
- Radiation Hardening
- Plug and Play Capability
- Sustainability
- Intelligent Systems
- Autonomous Subsystems

2. SUSTAINABLE AND SUSTAINING TECHNOLOGIES

»Clean Energy
- Biofuels
  - Cellulosic
  - Algal
  - Algal Genetic Differences
  - Systems Engineering
    - Integrate Component Processes
    - Assess Potential Sustainability and Ecosystem Impacts
- Solar
  - Sun Photometry
  - Photovoltaic
  - Thermal
- Piezo
- Wind
- Climate Change/Future Environment
  - NASA Earth Exchange

»Building Management
- Prognostics
- Intelligent Control
- Water Recovery
- Data Mining/Analytics

»Modeling
- Predictive Modeling

»High End Computing
- Computational Throughput
- Predictive Modeling
- Visualization
  - Hyperwall

»Sustainable Systems
- ISRU
  - Bio ISRU
- Water Recycling
- Air Revitalization
- Solid Waste Management
- Systems Analyses/Trade Studies
- Bioremediation

»Green Aviation
- Electric Aircraft
- Airships
- Air Traffic Management
- Rotorcraft
- Fixed-Wing

»Prognostics for Sustainable Systems
- Energy Storage
- Algal
- Electronics
- Mechanical
- Wind Turbines
- Microgrid Health

3. NANO AND MICRO TECHNOLOGIES AND SYSTEMS

»Energy Conversion and Control
- Nano Wire-Based Solar Cell
- Substrate Sculpting for Enhanced Solar Energy Capture and Conversion
- Graphene and CNT Based Super Capacitors
- Materials and Device Energy Conversion
- Nanostructured Materials for Energy Harvesting and Saving

»Nano Medicine
- Drug Delivery
- Wound Healing

»Engineered Materials and Structures
- Computational Modeling
- Carbon-Based Nano Structures
  - Wafer Scale Graphene
  - Single and Multi-Walled CNT
  - Nano Scale Additives for Oxidation resistance and Toughening
- Radiation Hardening Materials
- Lightweight Materials for TPS
- Materials for Biomedical Applications
- Multifunctional Hybrid Laminate Structures with Aligned CNT for Structural NDE
- Hierarchically Organized Materials – Nano Wires
- Adhesive Materials

»Propulsion

»Sensors, Electronics, and Devices
- Chem Sensors
- Radiation Sensors
- Biosensors
- Radiation Resistant Non-Volatile Memory
- X-Ray Tubes for Instrumentation
- Flexible Substrate Electronic Devices
- Nano Antenna and Materials-Based Optoelectronics and Plasmonics
- Waveguide Device Fabrication for High Sensitivity Optical Detections and Enhanced Energy
- Biophotonics and Chemical Imaging Using Multi Mode Optical Fibers and Microfluidics
- Electro-Optical Materials for Optical Switch and RF and IR Detectors
- Fiber Electronics for E-Textiles

4. SENSORS, INSTRUMENTS, DEVICES, MATERIALS, PHOTONICS, AND OPTICAL IMAGING

»Sensors
»Instruments
»Devices
»Materials
»Photonics, Optics

5. AERONAUTICS

»Aeronautics Test
- Wind Tunnel Experimental Technology
  - Photogrammetry
  - Schlieren
    - RBOS
  - PIV
  - Pressure Sensitive Paint

»Global Prediction, Monitoring and Response
- Predicting and Modeling Global Changes
  - Biospherics
  - Atmospherics
- Monitoring and Assessing the Risks
- Responding to Catastrophic Events

»Fundamental Aeronautics
- Experimental Fluid Dynamics
- Hypersonic
- Supersonic
- Subsonic
  - Rotary Wing
  - Fixed Wing
- Aerothermodynamics
- Aeromechanics
- Guidance Navigation and Control
- Systems Analysis
- Multi-Disciplinary Design, Analysis and Optimization
- Aeroelasticity
  - Aero-Servo-Elasticity
  - Aero-Propulsive-Servo-Elasticity
- Aerodynamics

»Airspace Systems
- Simulation Facilities
- Modeling and Simulation
- Human-in-the-Loop Simulation
- Collaborative Traffic Flow Management
- Uncertainty Characterization
  - Data Fusion
- Traffic Management Optimization
  - Guidance Navigation and Control

»Aviation Safety
- Prognostics
- Data Mining
- Human-Automation Integration
- Computer Science
  - V&V of Flight Critical Systems

6. HYPERSONICS AND ENTRY, DESCENT, AND LANDING (EDL) TECHNOLOGIES

»Aerothermodynamics
- Computational Fluid Dynamics (CFD) Development and Application
- Fluid Dynamics
- High Temperature Shock Tube Testing
  - Electric Arc-Driven Shock Tube
- High Temperature Gas Physics
  - Ballistic Range
- Shock Layer Radiation Modeling
- Supersonic Aerodynamics
  - Ballistic Range

»TPS Materials
- Material Characterization
- Material Modeling
- High Temperature Material Processing
- Material Science
- Material Engineering
- TPS Design and Development
- TPS Evaluation and Certification
  - Arc Jet Complex
- TPS Sizing

»Entry System Development
- Engineer Design and Analysis
- Airborne Entry Observation
- Free Flight Testing
- Flight and Ground Hardware Development
- Concept Development
  - Ballistic Range
- TPS Margin and Reliability Process Development
- TPS Instrumentation Development
- Entry System Engineering

»High Enthalpy Testing
- TPS Instrumentation Development
- Facility Characterization

»Multi-Physics Modeling and Simulation

7. INFORMATION TECHNOLOGIES

»Software
- Avionics and Controls
  - Flight Avionics
  - Spacecraft Flight Software
- Software Engineering Technologies
  - Tools
  - Verification and Validation
- Mission Operations
  - Human Spaceflight
  - Science Spacecraft
  - Unmanned Aerial Systems (UAS)
- Community Open Source Development
  - Policy
  - Practice
- Agile Software Development

»Web Applications
- Development
- Hosting
- Operations

»Information Processing
- Decision Support Systems
- Collaborative Design
- Work Systems Design
- Data Mining
- Integrated Information Systems

»High Performance Computing
- Modeling and Simulation
- Visualization

»Intelligent Systems
- Integrated Systems Health Management
  - Physics-Based Modeling
  - Diagnostics and Prognostics
  - Functional Fault Analysis
  - Machine Learning
- Mixed-Initiative Systems
- Autonomous Systems
  - Autonomy
  - Controls

»Robotics
- Autonomy, Planning, Scheduling, Execution
- Unmanned Aerial Systems (UAS)
- Image Processing
- Robotic Systems
- Drilling

»Human-Systems Engineering
- Human-in-the-Loop Simulation
  - Controls
  - Simulation
  - Human Factors
- Roles and Responsibilities
  - Function Allocation
  - Operations Definition
- Design Requirements
  - Lifecycle Maintenance and Repair
  - Displays and Controls
  - Human-Computer Interaction
  - Needs, Task, and Workload Analysis
- Process Engineering
  - Decision Support Systems
  - Data Management Systems
  - Collaboration Support Systems
- Human-Computer Interaction

»Cloud Computing
- Infrastructure as a Service
- Platform as a Service

»Information Security
- Security Penetration Testing
- Security Planning
- Agency Security Operations Center
  - Security Services Engineering
  - Incident Management

»Networking
- High Performance Networking
- Advanced Network Peering
- LAN/WAN Engineering
- LAN/WAN Operations

8. EXPLORATION TECHNOLOGIES

»Human Performance
- Modeling and Simulation
  - Cognitive Modeling
- Measures and Metrics
  - Vision Research
  - Visiomotor
- Countermeasures and Mitigation
- Performance Enhancing Technologies
  - Advanced Displays
  - Acoustics
  - Haptics
  - Manual Control
  - Virtual Environments

»Multi-Agent Operations
- Human Collaboration and Teamwork
- Human-Automation Integration
- Human-Robotic Integration
- Crew-Vehicle Systems Integration

»Training
- Protocol/Curriculum Development
- Skill Assessment and Maintenance
- Customization for Individuals
- Just-in-Time/Onboard Systems

»Robotics
- Human Robotic Systems
- Sensing and Perception
- Mobility
- Manipulation
- Autonomous Rendezvous and Docking

»Human Exploration Technologies
- Medical Monitoring and Care Technologies
  - Telemedicine
  - In Space Monitoring
- Environmental Control and Life Support
  - Atmosphere Revitalization
  - Water Processing
  - Waste Management
  - Systems Engineering
- Human Health and Performance
  - Exercise Countermeasures
  - Artificial Gravity
  - Bio Sentinels
  - Psychophysiology
- Radiation
  - Biological Countermeasures
  - Physical Countermeasures
  - Dosimetry
- Human-Centered Planning Systems
- Integrated Information Systems

»Autonomy and Avionics
- Automated Planning Technology
- Discrete Control Technology
- Software Verification Algorithms
- Avionics and Processing Systems
- Instrumentation and Sensors
- Technology Integration

9. SPACE AND EARTH SCIENCE TECHNOLOGIES AND APPLICATIONS

»Space Science Technologies and Applications
- Instruments, Observatories and Sensor Systems
  - Remote Sensing Instruments / Sensors
    - Detectors and Focal Planes
      - Optical
      - Infrared (Near and Far)
      - Radiation Testing
    - Electronics
      - Detector Control and Readout
    - Optical Components
      - Spectrometer
        - Echelle
        - Grism
        - Polarimeter
  - Cryogenic / Thermal
    - LN2 and LHe Cryostat Design
    - RET Developments
    - Temperature Control Systems for Optical Systems
  - In-Situ and Analog Instruments / Sensors
    - Sample Capture / Return
    - Sample Detection, Isolation, Tagging, Identification, Transport
    - Sample Acquisition, Handling and Delivery
    - Robotic Planetary Access, Subsurface Drills, Rovers, ISRU (In Situ Resource Utilization)
    - Sterilization / Cleaning Technology
    - Tools and Analog Testbed Integration
    - Instrument Development
      - Science Requirement Definition
      - Design
      - Integration and Test

»Modeling, Simulation, Information Technology and Processing
- Modeling
  - Geophysical, Planetary and Astrophysical Science Modeling
    - Computational Chemistry
  - Global Atmospheric Modeling
    - Planetary Atmospheres
    - Earth Atmosphere
    - Extrasolar Planetary Atmospheres
  - Observation Simulations
- Information Processing
  - Science Data Lifecycle
    - Science Processing Pipeline Development
    - Science Data Processing Algorithm Development
      - Time Series Data Analysis
      - Spectrometry
      - Polarimetry
    - Intelligent Data Understanding
    - Collaborative Science
      - Archive Product Design
      - Design of Web Tools to Enable Collaborative Science

»Earth Science Technologies and Applications
- UAV Based Technologies
  - Platforms
  - Science and Applications Instruments
  - Communications and Control
  - Systems Integration
  - Mission Ops
- In-Situ Sensors
  - Ground Based
    - Trace Gas Instruments
      - CO_2
      - CO
      - CH_4
      - O_3
      - N_2O
    - Spectroscopy
    - Aerosols
      - Composition
      - Size Distribution
      - Extinction
  - Airborne
    - Trace Gas Instruments
      - CO_2
      - CO
      - CH_4
      - O_3
      - N_2O
    - Meteorological Measurement System
      - High Precision Temperature, Pressure and Wind
    - Aerosols
      - Composition
      - Size Distribution
      - Extinction
  - Remote Sensing
    - Hyperspectral and Multi-Spectral Imaging
    - Sun Tracking Photometer
    - Radiometer
- Atmospheric Science
  - Cloud Modeling
  - Aerosols Modeling
  - Meteorological Forecasting
  - Ozone Modeling
  - Climate Change Impact
- Ecosystem Science and Predictive Modeling
  - Terrestrial Processes
    - Climate Change Impacts
    - Hydrological Processes
    - Natural Disasters and Extreme Events
  - Oceanic Processes
    - Coral Reef Ecology
    - Climate Change Impacts
  - Modeling Tools and Frameworks
- Observatories
  - Mirror Systems
    - Active Optics
    - High Contrast Optics
- Lab Simulations

10. BIOLOGICAL TECHNOLOGIES AND APPLICATIONS

»Bio-Payload Technologies
- Cell, Tissue, and Animal Habitat Systems
- Flight Systems Integration, Test and Operations
- Commercial and Translational Bioscience Technology

»Space Synthetic Biology
- Bioinformatics, Biocomputation Technologies
- Genetic Engineering Technologies
- Biological ISRU
- Advanced Materials
  - Bioplastics
  - Biological Molecular Fabrication
- Biosensors
- Bio Mining
- Human Health
  - Tissue Regeneration/Repair
  - Biological Delivery Systems
  - Synthesis of Pharmaceuticals
- Fuel Production
- Life Support
  - Food Production
  - Water Production
  - Oxygen Production
  - Waste Resource Recovery
- Astrobiology Missions

»In-Situ Bioanalytical and Sample Management Technologies
- Medical Monitoring Technologies
- Radiation Health and Biocounter-Measures
- Automated Bio Processing

»Biomimetics, Biologically-Inspired Technologies

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