

# 2024 Joint Physics of Sensing and Astrodynamics Program Review

Dr. Michael Yakes and Andrew Sinclair | November 4-8, 2024 | Arlington, VA -hybrid

Basic Research Innovation Collaboration Center (BRICC)  
4100 N Fairfax Drive, Suite 450 | Arlington, VA 22203

## Agenda Day 1 | Monday, November 4, 2024

| Time  | Topic                                                                                                                                             | Speaker                                            |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| 11:30 | <b>In-person check-in/Virtual login</b>                                                                                                           |                                                    |
| 12:00 | Data-Driven Spacecraft Trajectory and Behavior Prediction in Cislunar Space                                                                       | Natasha Bosanac, University of Colorado at Boulder |
| 12:30 | Remote sensing via multi-path optical interference of reflected light                                                                             | Lauren Zarzar, UC Berkeley                         |
| 13:00 | Laser Guide Star Assisted Extreme Adaptive Optics                                                                                                 | Lauren Schatz & Jeff Richey, AFRL                  |
| 13:30 | Optimizing Entanglement to attain Quantum Limit of Long-Baseline Imaging                                                                          | Saikat Guha, University of Maryland                |
| 14:00 | <b>BREAK</b>                                                                                                                                      |                                                    |
| 14:30 | Breaking the "Launch Once Use Once" Paradigm (SURI)                                                                                               | Howard Choset, Carnegie Mellon University          |
| 15:00 | Fundamental Bounds of Information in Photon Starved Passive Multidimensional Imaging and Recognition in the Presence of Environmental Degradation | Bahram Javidi, University of Connecticut           |
| 15:30 | Sensing with Fractal, Diffraction-encoded Beams                                                                                                   | Luat Vuong, UC Riverside                           |
| 16:00 |                                                                                                                                                   |                                                    |
| 16:30 | <b>REVIEW END FOR THE DAY</b>                                                                                                                     |                                                    |

## Agenda Day 2 | Tuesday, November 5, 2024

| Time         | Topic                                                                                                                                | Speaker                                                                   |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| <b>8:00</b>  | <b>In-person check-in/Virtual login</b>                                                                                              |                                                                           |
| <b>8:30</b>  | Photonic nanocomposite films made by pulsed laser deposition                                                                         | Abdalla Darwish, Dillard University                                       |
| <b>9:00</b>  | TBD                                                                                                                                  | Brandon Fetterolf, TBD                                                    |
| <b>9:30</b>  | Distinguishing UAVs from birds in 3D LiDAR point clouds                                                                              | András Majdik, Hungarian Computation Science and Automatization Institute |
| <b>10:00</b> | <b>BREAK</b>                                                                                                                         |                                                                           |
| <b>10:30</b> | Autonomous Space Situational Awareness in Complex Environments (LRIR)                                                                | Alex Soderlund, AFRL Space Vehicles Directorate                           |
| <b>11:00</b> | Spectral NLOS imaging: towards photo-realistic NLOS reconstructions                                                                  | Andreas Velten, University of Wisconsin                                   |
| <b>11:30</b> | Structured Terahertz Beams Containing Orbital Angular Momentum for Agile Aerial Sensing                                              | Yasaman Ghasempour, Princeton University                                  |
| <b>12:00</b> | <b>LUNCH</b>                                                                                                                         |                                                                           |
| <b>13:30</b> | TBD                                                                                                                                  | Maj Sean Allen, Space Systems Command                                     |
| <b>14:00</b> | Characterizing Highways & Automated Navigation in Cislunar Environment (CFIRE)                                                       | Kathleen Howell, Purdue University                                        |
| <b>14:30</b> | Non-imaging advanced scene characterization                                                                                          | Nick Vamivakas, Rochester Institute of Technology                         |
| <b>15:00</b> | <b>BREAK</b>                                                                                                                         |                                                                           |
| <b>15:30</b> | Understanding and addressing the dynamic coupling between robotic arms and base spacecraft to enable challenging in-space operations | Donghoon Kim & Ou Ma, University of Cincinnati                            |
| <b>16:00</b> | Unravelling dependencies on turbulence strength and propagation geometry in models of optical scintillation.                         | Jeremy Bos, Michigan Technological University                             |
| <b>16:30</b> | <b>REVIEW END FOR THE DAY</b>                                                                                                        |                                                                           |
| <b>16:30</b> | Networking/Social at Bronson Bier Hall                                                                                               |                                                                           |

**Agenda Day 3 | Wednesday, November 6, 2024**

| <b>Time</b>  | <b>Topic</b>                                                                                                          | <b>Speaker</b>                                     |
|--------------|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| <b>8:00</b>  | <b>In-person check-in/Virtual login</b>                                                                               |                                                    |
| <b>8:30</b>  | Ultra-broadband speckle imaging for space domain awareness                                                            | Stuart Jeffries, Georgia State University          |
| <b>9:00</b>  | Representations, Theory, and Algorithms for Autonomous Space Domain Awareness in the Cislunar Regime (CFIRE)          | Kyle DeMars, Texas A&M University                  |
| <b>9:30</b>  | Improved BRDF Measurement and Modeling with Out of- Plane and Wavelength Dependence                                   | Todd Small, Air Force Institute of Technology      |
| <b>10:00</b> | <b>BREAK</b>                                                                                                          |                                                    |
| <b>10:30</b> | The Science of Non-Resolved Space Object Signatures for Space Domain Awareness (SURI))                                | Miguel Velez-Reyes, University of Texas at El Paso |
| <b>11:00</b> | Leveraging Polarized Light Curves to Characterize High Altitude Objects                                               | John Crassidis, University at Buffalo              |
| <b>11:30</b> | Color Resolved Spacecraft Observations as a Tool for Sensing Material Identity and Chemical State                     | Ryan Hoffman, AFRL Space Vehicles Directorate      |
| <b>12:00</b> | <b>LUNCH</b>                                                                                                          |                                                    |
| <b>13:00</b> | <b>Poster Session (see list below)</b>                                                                                |                                                    |
| <b>15:00</b> |                                                                                                                       |                                                    |
| <b>15:30</b> | On the Problem of Deep Turbulence: Expanding the Field of View, Bandpass, and Observing Conditions of the Fresnel WFS | Justin Crepp, University of Notre Dame             |
| <b>16:00</b> | High Contrast Wavefront Sensing for Space Domain Awareness                                                            | Mala Mateen, AFRL                                  |
| <b>16:30</b> | <b>REVIEW END FOR THE DAY</b>                                                                                         |                                                    |

| POSTER SESSION |                                                                                                                              |                                                                                           |
|----------------|------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| 1              | Multiscale Astrodynamical Analysis for Improved xGEO Cislunar SDA                                                            | Aaron Rosengren, University of California, San Diego & Shane Ross, Virginia Tech          |
| 2              | Uncertainty Propagation for Maneuvering Objects in Chaotic Systems                                                           | Brandon Jones & Ryan Russell, University of Texas at Austin                               |
| 3              | Data-Driven Discovery of Cislunar Transport Mechanisms (D3CTM)                                                               | Roshan Eapen, Pennsylvania State University                                               |
| 4              | Dynamics near the L3 point of the Earth-Moon system: Invariant manifolds and connections with other libration points (EOARD) | Angel Jorba, Universitat de Barcelona                                                     |
| 5              | Symplectic methods in space mission design (EOARD)                                                                           | Augustin Moreno, Universitat Heidelberg                                                   |
| 6              | Near-linear uncertainty quantification and tracking in the cislunar regime (EOARD)                                           | Davide Amato, Imperial College                                                            |
| 7              | Multi-Phenomenological, Autonomous, and Understandable SDA and XDA Decision Support (SURI)                                   | Marcus Holzinger, University of Colorado at Boulder                                       |
| 8              | A fine-wire sensor array for ground-based and airborne in-situ measurements of optical turbulence in the atmosphere          | Andreas Muschinski, NothWest Research Associates                                          |
| 9              | The Science of Non-Resolved Space Object Signatures for Space Domain Awareness                                               | Francis Chun, U.S. Air Force Academy                                                      |
| 10             | High-resolution Imaging in Heterogeneous Media                                                                               | Alexei Novikov, Pennsylvania State University                                             |
| 11             | Ultrafast Automatic Event Recognition Using Multiphoton Atomic Transitions                                                   | Selim Shahriar, Northwestern University                                                   |
| 12             | The influence of boundary effects and type of environment on turbulence profiles                                             | Miranda Van Iersel, New Mexico State University                                           |
| 13             | Super-Resolution Imaging and Sensing with Relative Motion in Structured Illumination and Multiply-Scattered Light            | Kevin Webb, Purdue University                                                             |
| 14             | Touchless Charge Control of Neighboring Spacecraft in Geostationary and Cislunar Space                                       | Hanspeter Schaub, University of Colorado at Boulder                                       |
| 15             | Exploring the Imaging Physics of Photonic Lanterns                                                                           | Steve Eikenberry, University of Central Florida                                           |
| 16             | Quantum correlated interferometry for space domain awareness in the extreme sub-wavelength limit                             | Zubin Jacob, Purdue University                                                            |
| 17             | Towards Spatially-Selective Lensing for Imaging and Vision                                                                   | Matthew O'Toole, Carnegie Mellon University                                               |
| 18             | Data-Driven Identification of Spacecraft Transport Pathways in Cislunar Space (YIP)                                          | Natasha Bosanac, University of Colorado at Boulder                                        |
| 19             | Fast Autonomous Lost-in-space Catalog-based Optical Navigation (FALCON)                                                      | Simone D'Amico, Stanford University                                                       |
| 20             | Space Situational Awareness in Cislunar Space                                                                                | Daniel Scheeres, University of Colorado at Boulder & Terry Alfriend, Texas A&M University |
| 21             | Space Domain Awareness in a Photon-Starved Environment (SURI)                                                                | Stuart Jeffries, Georgia State University                                                 |

|    |                                                                                                            |                                                                                                          |
|----|------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| 22 | Space Object Understanding and Reconnaissance of Complex Events (SURI)                                     | John Crassidis, University at Buffalo                                                                    |
| 23 | Picard-Chebyshev Methods for Long Duration Propagation in Chaotic Dynamical Systems (YIP)                  | David Stanley & Robyn Woollands, University of Illinois at Urbana Champaign                              |
| 24 | Measuring and Controlling the Electronic Transport Properties of BaZrS3 Chalcogenide Perovskite Thin Films | Jack Van Sambeek , MIT                                                                                   |
| 25 | Thurster Pointing Constrained Optimal Control for Satellite Servicing using Indirect Optimization          | Himmat Panag & Robyn Woollands, University of Illinois at Urbana Champaign                               |
| 26 | Optimal multi-agent control and planning strategies for in-space servicing and assembly                    | Ruthvik Bommena, Kartik Nagpal, Negar Mehr & Robyn Woollands, University of Illinois at Urbana Champaign |

| <b>Agenda Day 4   Thursday, November 7, 2024</b> |                                                                                                                       |                                                                                           |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| <b>Time</b>                                      | <b>Topic</b>                                                                                                          | <b>Speaker</b>                                                                            |
| <b>8:00</b>                                      | <b>In-person check-in/Virtual login</b>                                                                               |                                                                                           |
| <b>8:30</b>                                      | Space Domain Awareness in Cislunar Space                                                                              | Daniel Scheeres, University of Colorado at Boulder & Terry Alfriend, Texas A&M University |
| <b>9:00</b>                                      | HOTNMS: Harnessing Optomechanical effects for Tailoring Noise properties of Mechanical Sensors                        | Swati Singh, University of Delaware & Sunil Bhawe, Purdue University                      |
| <b>9:30</b>                                      | End-to-End Design of Low-cost Computational Telescopes                                                                | Laura Waller, University of California, Berkeley                                          |
| <b>10:00</b>                                     | <b>BREAK</b>                                                                                                          |                                                                                           |
| <b>10:30</b>                                     | Computationally-driven search for new infra-red absorbing semiconductors with long carrier lifetime                   | Geoffroy Hautier & Jifeng Liu, Dartmouth University                                       |
| <b>11:00</b>                                     | Innovative Single-Pixel Imaging Regularized by Event Data (InSPIRED)                                                  | Anthony Giljum & Zachry Theis, AFRL                                                       |
| <b>11:30</b>                                     | Statistically Inferred Multi-Modal Photon Information Content Quantification and Assessment Via Quanta Photogrammetry | Moriba Jah, University of Texas at Austin                                                 |
| <b>12:00</b>                                     | <b>LUNCH</b>                                                                                                          |                                                                                           |
| <b>13:30</b>                                     | Adaptive Data-Driven Actionable Intelligence for SSA in an Evidential Framework                                       | Mrinal Kumar, Ohio State University                                                       |

|              |                                                                                                                                            |                                      |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| <b>14:00</b> | Dynamics of Charge and Energy Transport in 2D/3D Mixed-dimensional Heterostructures enabled by Remote Epitaxy and Layer Resolved Splitting | Kyusang Lee, University of Virginia  |
| <b>14:30</b> | Investigations of the tolerance of chalcogenide perovskite semiconductors for point defects                                                | Rafael Jaramillo, MIT                |
| <b>15:00</b> | <b>BREAK</b>                                                                                                                               |                                      |
| <b>15:30</b> | Starlift (SURI)                                                                                                                            | Dmitry Savransky, Cornell University |
| <b>16:00</b> | Advancing Technologies for Logistics Architectures in Space (SURI)                                                                         | Koki Ho, Georgia Tech                |
| <b>16:30</b> | <b>REVIEW END FOR THE DAY</b>                                                                                                              |                                      |
| <b>16:30</b> | Networking/Social at Bronson Bier Hall                                                                                                     |                                      |

| <b>Agenda Day 5   Friday, November 8, 2024</b> |                                                                                                       |                                                               |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| <b>Time</b>                                    | <b>Topic</b>                                                                                          | <b>Speaker</b>                                                |
| <b>8:00</b>                                    | <b>In-person check-in/Virtual login</b>                                                               |                                                               |
| <b>8:30</b>                                    | Autonomous Distributed Angles-Only Orbit Determination using Multiple Observers                       | Simone D'Amico, Stanford University                           |
| <b>9:00</b>                                    | Electromagnetic Field Sensing Through Superradiance in 2D Materials                                   | Shengxi Huang, Rice University                                |
| <b>9:30</b>                                    | Atomically precise exfoliation of single-crystalline oxide thin-films and its pyroelectric properties | Jeehwan Kim, MIT                                              |
| <b>10:00</b>                                   | <b>BREAK</b>                                                                                          |                                                               |
| <b>10:30</b>                                   | Dynamic Vision Sensor for Observing Human-made Space Objects - Detection, Tracking, Characterization  | Carolyn Frueh, Purdue University & Thomas Schildneckt (EOARD) |
| <b>11:00</b>                                   | SHADOW IMAGING: Research in Fundamental Issues for a New Capability in Space Domain Awareness         | Peter McMahon-Crabtree, AFRL Space Vehicles Directorate       |
| <b>11:30</b>                                   | Design anomalous Kerr nonlinearity for photonic signal processing and sensing                         | Linran Fan, University of Texas at Austin                     |
| <b>12:00</b>                                   | Wrap-Up                                                                                               |                                                               |
| <b>13:30</b>                                   | <b>REVIEW ADJOURNED</b>                                                                               |                                                               |