AMOS Conference 2021

PROGRAM

All dates/times listed are Hawaii Standard Time (HST). Agenda is subject to change. Each day of the plenary conference will open with a livestream of keynote addresses and SSA Policy Forum discussions. Technical presentations will be presented live on-stage, with on-demand viewing of pre-recorded presentations available for virtual attendees upon completion of the in-person sessions. All posters are digital format this year and are accompanied by on-demand presentation videos.

**An asterisk indicates the session will be livestreamed for virtual attendees.*

Program at a Glance

FRI Sep 10	**Virtual Platform Open to Registered Attendees**
	On-Demand Launch | Digital Poster Presentations
SUN Sep 12 – TUE Sep 14	EMER-GEN® Program *(separate registration fee required)* On-site Registration
TUE Sep 14	**In-person and Virtual Technical Short Courses** *(separate registration fee required)* **Welcome Reception |** *Co-sponsored by Boeing*
WED Sep 15	**Conference Opening & Cultural Invocation*** **Opening Keynote Address* |** *Major General DeAnna M. Burt* **Special Presentation |** *T.S. Kelso Space Safety Award* **SSA Policy Forum* |** *Lessons Learned from Recent Satellite Servicing Missions* **Invited Talk* |** *Colonel Eric J. Felt & Colonel Joseph J. Roth* **Technical Session |** *Cislunar SSA. Sponsored by Ball Aerospace.* **Technical Session |** *Conjunction/Rendezvous and Proximity Operations* **Technical Session |** *Astrodynamics* **Featured Presentation |** *Semi-Empirical Metrics to Measure the Effects of Large Satellite Constellations on Astronomy* **Technical Session |** *Dynamic Tasking* **Poster Reception |** *Co-sponsored by SAIC*
	On-Demand Launch | Cislunar SSA, Conjunction/RPO, Astrodynamics, and Dynamic Tasking Technical Presentations
THU Sep 16	**Welcome Remarks** **Keynote Address* |** *Colonel Scott D. Brodeur* **SSA Policy Forum* |** *Large Constellations and Right-of-Way in Space* **Featured Presentation |** *EMER-GEN™ Briefing* **Featured Presentation |** *2021 AMOS Student Award Winner's Technical Presentation* **Technical Session |** *Optical Systems & Instrumentation. Sponsored by NorthStar Earth & Space* **Featured Presentation |** *The National Science Foundation's Daniel K. Inouye Solar Telescope* **Technical Session |** *Atmospherics/Space Weather* **Technical Session |** *Non-Resolved Object Characterization* **Poster Reception |** *Co-sponsored by SpaceNav*

AMOS Conference 2021

PROGRAM

On-Demand Launch | Optical Systems & Instrumentation, Atmospherics/Space Weather, Non-Resolved Object Characterization Technical Presentations

FRI Sep 17

Keynote Address*
SSA Policy Forum* | *Results of the Recent UN Resolution on Norms of Behavior in Space*
Invited Talk* | *Dr. Kelly D. Hammett*
Technical Session | *Space Situational/Domain Awareness. Sponsored by LeoLabs.*
Featured Panel* | *Space Research Opportunities with the U.S.*
Technical Session | *Machine Learning for SSA Applications. Sponsored by Lockheed Martin*
Conference Closing & Awards Ceremony
Pau Hana Reception | *Co-sponsored by L3 Harris*

On-Demand Launch | SSA/SDA and Machine Learning Technical Presentations

Sunday 12 September – Tuesday 14 September

EMER-GEN®
The 4th annual EMER-GEN® is a joint initiative of the AMOS Conference and SGAC. The program is designed especially for young professionals and students enthusiastic about careers in space. Separate registration required. Visit www.emer-gen.com to learn more.

02:00 PM HST – 05:00 PM HST **ON-SITE REGISTRATION |** *Aulani Ballroom Foyer*

Tuesday 14 September

ON-DEMAND LAUNCH: View the Poster Presentations on the Virtual Platform and leave comments and questions. Please view a submission's designated Office Hours to chat in real-time with the poster presenter during select times.

07:00 AM HST – 05:00 PM HST **ON-SITE REGISTRATION |** *Aulani Ballroom Foyer*

TECHNICAL SHORT COURSES: *Separate registration fee required for each course. In-person and Virtual short courses are offered this year. In-person short courses will not be livestreamed for virtual attendance. Virtual short courses are "live" with the ability to interact with the instructor and attendees in real-time. Learn more.*

07:00 AM HST – 11:00 AM HST ~~**VIRTUAL SHORT COURSE A |** Imaging of Space-Based Objects through Atmospheric Turbulence~~ ***CANCELLED***

VIRTUAL SHORT COURSE B | Introduction to ESA's Space Debris Software tools (DRAMA, MASTER, DISCOS, PROOF)

AMOS Conference 2021

PROGRAM

		VIRTUAL SHORT COURSE C | Observing and Characterizing Space Debris
08:00	12:00	**IN-PERSON SHORT COURSE 1 |** Conjunction Assessment (CA) Risk Assessment | *Vanda* **IN-PERSON SHORT COURSE 2 |** Deep Learning Methods for Space Domain Awareness | *Ilima* **IN-PERSON SHORT COURSE 3 |** SSA Optical Systems Modeling and Simulation | *Lokelani II* **IN-PERSON SHORT COURSE 4 |** Statistical Orbit Determination for Space Surveillance and Tracking | *Mauna Loa* **IN-PERSON SHORT COURSE 5 |** Supervised Learning: Review and Applications with Real Space Domain Awareness (SDA) Data | *Lokelani III*
11:00 AM HST	12:00 PM HST	**VIRTUAL SHORT COURSE BREAK |** *Explore the AMOS Virtual Venue, visit the Exhibit Hall, and view the Digital Poster Presentations.*
12:00	01:00	**IN-PERSON SHORT COURSE BREAK |** *Explore the AMOS Virtual Venue or pick up lunch at one of the many locations on-site or next door at the Shops at Wailea.*
12:00	04:00	**VIRTUAL SHORT COURSE D |** Polarimetry **VIRTUAL SHORT COURSE E |** Telescopes and Optics for Ground-Based Optical SSA
01:00	05:00	**IN-PERSON SHORT COURSE 6 |** Demystifying Machine and Deep Learning | *Ilima* **IN-PERSON SHORT COURSE 7 |** How to Kill Your Own Satellite | *Mauna Loa* **IN-PERSON SHORT COURSE 8 |** Next Generation Data Management for Space Data | *Lokelani II* **IN-PERSON SHORT COURSE 9 |** Space Weather Impacts on Near-Earth Space Operations | *Vanda* **IN-PERSON SHORT COURSE 10 |** The Dynamic Co-Evolution of Space Policy and Technology: Historical Overview and Lessons for Assessing Future Trends | *Lokelani III*
06:00	07:30	**WELCOME RECEPTION** | *Kahoolawe Lawn* Join us for an oceanfront reception at sunset as we welcome the AMOS 'ohana back to the island after a long pandemic year. *Co-sponsored by* BOEING

AMOS Conference 2021

PROGRAM

Wednesday 15 September

ON-DEMAND LAUNCH: Presentations from the Cislunar SSA, Conjunction/RPO, Astrodynamics, and Dynamic Tasking technical sessions will be available upon completion of the in-person session.

Session will be streamed to virtual platform

06:00 AM HST – 07:15 AM HST | BREAKFAST AT LEISURE | *Luau Gardens*

07:30 – 07:40 | **CONFERENCE OPENING*** | *Aulani Ballroom*
Leslie Wilkins, President & CEO, Maui Economic Development Board, Inc.

CULTURAL INVOCATION*
Kahu Kealahou Alika

WELCOME & INTRODUCTIONS*

07:40 – 08:10 | **OPENING KEYNOTE ADDRESS***
Introduction by Brian Weeden, Director of Program Planning, Secure World Foundation

Major General DeAnna M. Burt
Commander, Combined Force Space Component Command, United States Space Command

Vice Commander, Space Operations Command, United States Space Force

08:10 – 08:20 | **KEYNOTE Q&A*** | *Q&A sponsored by* KRATOS

08:20 – 08:30 | **SPECIAL PRESENTATION* | T.S. Kelso Space Safety Award**

08:30 – 09:30 | **SSA POLICY FORUM* | Lessons Learned from Recent Satellite Servicing Missions**
In April 2020, the first commercial satellite servicing mission successfully docked with a satellite above GEO, followed by the second docking in GEO in March 2021; as well, there is a planned orbital debris removal demonstration in LEO in mid-2021. This panel will discuss how existing SSA capabilities were able to monitor and support these recent and planned satellite servicing missions and the lessons learned for conducting future servicing missions and future SSA requirements.

Moderated by:
Brian Weeden, Director of Program Planning, Secure World Foundation

Joseph Anderson, Vice President of Operations & Business Development, SpaceLogistics
Ralph Dinsley, Executive Director, Northern Space & Security Ltd.
Mike Lindsay, Chief Technology Officer, Astroscale
Lt Col Alfred Maynard, Commander, 20th Space Control Squadron, United States Space Force

---

09:30 – 10:00

VIRTUAL EXHIBITS AND NETWORKING BREAK | *Conference Platform*
Explore the Exhibit Hall and interact with our conference partners. Schedule 1:1 virtual meetings, view demos, resources, and more.

Sponsored by KBR

10:00 – 10:30

INVITED TALK* | The Space S&T Challenges from LEO to Cislunar | *Aulani Ballroom*

Col Eric Felt, Director, Space Vehicles Directorate, Air Force Research Laboratory
Col Joseph Roth, Director, Innovation & Prototyping, Air Force Space & Missile Systems Center

10:30 – 11:45

CISLUNAR SSA | *Sponsored by* Ball

Co-chaired by **James Frith**, Air Force Research Laboratory and **Jesse Greaves**, University of Colorado Boulder

Tracking Objects in Cis-Lunar Space: The Chang'e 5 Case
Roberto Furfaro, University of Arizona

Hiding in Plain Sight: Observing Objects in Low Lunar Orbit and the L2 Dark Cone from a Lunar Surface Observatory
Jeffrey Van Cleve, Ball Aerospace

Risk Maps for Conjunction Potential Throughout the Cislunar Domain
Alexander Koenig, Massachusetts Institute of Technology

Cislunar Multiscale Dynamics and Implications for SSA
Aaron J. Rosengren, University of California San Diego

Robust Cislunar Initial Orbit Determination
Sam Wishnek, University of Colorado Boulder

11:45 AM HST – 12:45 PM HST

LUNCH | *Sponsored by* Peraton

12:45 – 02:30

CONJUNCTION/ RENDEZVOUS AND PROXIMITY OPERATIONS | *Aulani Ballroom*
Co-chaired by **James Blake,** University of Warwick, **Darren McKnight,** LeoLabs, and **Matthew Stevenson,** LeoLabs

Overcoming the Operational Challenges Encountered During a Decade of Conjunctions
Mark Vincent, Raytheon

Electric Propulsion Intelligent Control (EPIC) Toolbox for Proximity Operations in Low-Earth Orbit (LEO)
Axel Garcia Burgos, Massachusetts Institute of Technology

Space Situational Awareness (SSA) Activities Explored Through the ELSA-d Mission
Toby Harris, Astroscale

An Investigation into Potential Collision Maneuver Guidelines for Future Space Traffic Management
Mariel Borowitz, Georgia Institute of Technology

In-Space Inspection Maneuver Analysis Using Trajectory Optimization
Ian Connerney, Virginia Polytechnic Institute and State University

PHANTOM ECHOES 2: A Five-Eyes SDA Experiment on GEO Proximity Operations
Simon George, Defence Science and Technology Laboratory

SSA Positional and Dimensional Accuracy Requirements for Space Traffic Coordination and Management
Salvatore Alfano, COMSPOC Corporation

02:30	02:50	VIRTUAL EXHIBITS AND NETWORKING BREAK | *Conference Platform* Relax and recharge at the Recharging Station, brought to you by NORTHROP GRUMMAN
02:50	04:05	**ASTRODYNAMICS** | *Aulani Ballroom* Co-chaired by **Tom Kelecy,** The Stratagem Group and **Sam Wishnek,** University of Colorado Boulder

RSO Proper Elements for Space Situational and Domain Awareness
Di Wu, University of California San Diego

Application of Novel Filtering Approaches to Modern Space Domain Awareness
Jonathan Kadan, Virginia Tech

Improved Orbital Predictions using Pseudo Observations - Maximizing the Utility of SGP4-XP
Anthony Holincheck, Sceptre Analytics, Inc.

Improving Orbital Uncertainty Realism through Covariance Determination in GEO
Alejandro Cano Sanchez, GMV

Fragmentation Detection via Track-to-track Association of Optical Observations
Alejandro Pastor, GMV

04:05 04:20 **FEATURED PRESENTATION**
Semi-Empirical Metrics to Measure the Effects of Large Satellite Constellations on Astronomy
Doyle Hall, Omitron Inc.

04:20 05:20 **DYNAMIC TASKING**
Co-chaired by **David Brough,** Numerica and **Gabe Egolf,** Parsons

Expanding the Space Surveillance Network with Space-Based Sensors Using Metaheuristic Optimization Techniques
Cameron Harris, Virginia Polytechnic Institute and State University

A Deep Reinforcement Learning Application to Space-based Sensor Tasking for Space Situational Awareness
Peng Mun Siew, Massachusetts Institute of Technology

SNARE (Sensor Network Autonomous Resilient Extensible): Decentralized Sensor Tasking Improves SDA Tactical Relevance
Bob Carden, MITRE

Multi-Space-Object Tracking with the Poisson Labeled Multi-Bernoulli (PLMB) Filter & Probabilistic Admissible Region Constraints
Martin Adams, Universidad de Chile

05:30 07:00 **POSTER RECEPTION** | *Pacific Terrace Rooftop*
Meet the poster presenters while enjoying a cocktail. All posters are digital and can be viewed on the Virtual Conference Platform.

Co-sponsored by SAIC

Thursday 16 September

ON-DEMAND LAUNCH: Presentations from the Optical Systems & Instrumentation, Atmospherics/Space Weather, and Non-Resolved Object Characterization technical sessions will be available upon completion of the in-person session.

Session will be streamed to virtual platform

06:00 AM HST 07:15 AM HST BREAKFAST AT LEISURE | *Luau Gardens*

PROGRAM

07:30 – 08:00 **KEYNOTE ADDRESS***

Colonel Scott D. Brodeur
Director of the National Space Defense Center and Director of Operations, Joint Task Force Space Defense
United States Air Force

08:00 – 09:00 **SSA POLICY FORUM* | Large Constellations and Right-of-Way in Space**

Current practice leaves it up to individual operators to assess the risk threshold for an avoidance maneuver to prevent potential collisions and who will - or should - perform it. But as the deployment of mega-constellations in LEO continues, there will be an increasing number of close approaches between satellites from different constellations or operators with different risk criteria, maneuver protocols, and potentially competing interests. This panel will discuss the right-of-way for satellites and other potential solutions to mitigate this problem and improve the coordination and resolution of close approaches in space.

Moderated by:
Daniel Porras, Director of Strategic Partnerships and Communications, Secure World Foundation

Emmanuelle David, Executive Manager, EPFL Space Center
Zack Donohew, Scholar in Residence, Leeds School of Business, University of Colorado Boulder
David Goldstein, Principal Guidance Navigation and Control Engineer, SpaceX
Dan Oltrogge, Director, Integrated Operations and Research, COMSPOC Corporation
Ruth Stilwell, Executive Director, Aerospace Policy Solutions LLC

09:00 – 09:20 VIRTUAL EXHIBITS AND NETWORKING BREAK | *Conference Platform*
Explore the Exhibit Hall and interact with our conference partners. Schedule 1:1 virtual meetings, view demos, resources, and more.

Sponsored by CACI EVER VIGILANT

09:20 – 09:30 **FEATURED PRESENTATION | *EMER-GEN® Briefing*** | *Aulani Ballroom*

09:30 – 09:45 **2021 AMOS STUDENT AWARD WINNER**
Application of SoleiTool for Density Estimation using CubeSat GPS Data
Shaylah Mutschler, University of Colorado Boulder

09:45 – 11:15 **OPTICAL SYSTEMS & INSTRUMENTATION** | *Sponsored by* NORTHSTAR EARTH & SPACE
Co-chaired by **Bradford Barrett,** Air Force Office of Scientific Research,

Matthew Bold, Lockheed Martin, and **Stacie Williams**, Air Force Office of Scientific Research

Reducing Weight of Imaging Systems with Flat Lenses
Rajesh Menon, Oblate Optics

Operations Update for the Deformable Mirror Demonstration Mission (DeMi) CubeSat
Rachel Morgan, MIT Department of Aeronautics and Astronautics

Analysis of Wavefront Sensing Techniques for Extended Scene Imaging
Justin Knight, University of Arizona

Transformation of Space Surveillance Telescope into a Dedicated Sensor in the Space Surveillance Network
Jonathan Hutfilz, Space Systems Command

Design and Predicted Performance of 4-m Baseline Habitable-zone Exoplanet Observatory Telescope
Stahl H Philip, NASA

Characterization of The Eugene Stansbery-Meter Class Autonomous Telescope on Ascension Island
Corbin Cruz, Jacobs

11:15 AM HST	12:15 PM HST	LUNCH
12:15	01:30	**OPTICAL SYSTEMS & INSTRUMENTATION (cont.)** Co-chaired by **Bradford Barrett,** Air Force Office of Scientific Research, **Matthew Bold**, Lockheed Martin, and **Stacie Williams**, Air Force Office of Scientific Research *Synthetic-Aperture Silhouette Imaging (SASI): Laboratory Demonstration Traceable to Ground-Based Imaging of GEO Satellites* **Richard Paxman**, Maxar *Polarimetric 3D Imaging in Degraded Environments* **Kashif Usmani**, University of Connecticut *Optomechanical Design and Fabrication of a Wide Field of View 250-mm-aperture Freeform Imaging System* **Matthew A. Davies**, The University of North Carolina at Charlotte *Event-based Sensor Model for Space Domain Awareness* **Rachel Oliver**, U.S. Space Force

Development and Testing of a Novel Low-Cost LEO Optical Surveillance Sensor
Borja Del Campo Lopez, Deimos Space UK Ltd.

01:30 01:45 **FEATURED PRESENTATION**
The National Science Foundation's Daniel K. Inouye Solar Telescope
Thomas Rimmele, National Solar Observatory

01:45 02:45 **ATMOSPHERICS/SPACE WEATHER**
Co-chaired by **Randall Alliss,** Northrop Grumman and **Brandon "BT" Cesul,** KBR

Decorrelating Density and Drag-coefficient Through Attitude Variations
Vishal Ray, CU Boulder

Solar Flare Prediction With Recurrent Neural Networks
Jill Platts, AFRL/RISA

Accelerated AI Powered Atmospheric Predictions for Space Domain Awareness Applications
Danny Felton, Northrop Grumman

The Solar Particle Access Model (SPAM): A New Tool for Monitoring Solar Energetic Particle Impacts to Satellite Operations
Janet Green, Space Hazards Applications, LLC

02:45 03:05 VIRTUAL EXHIBITS AND NETWORKING BREAK | *Conference Platform*

03:05 05:20 **NON-RESOLVED OBJECT CHARACTERIZATION** | *Aulani Ballroom*
Co-chaired by **Heather Cowardin,** NASA Johnson Space Center, **Weston Faber,** L3 Harris, and **Zach Gazak,** Odyssey Systems

Inversion of the Shape of Space Debris from Non-Resolved Optical Measurements within SPOOK
David Vallverdu Cabrera, Airbus Defence and Space GmbH

Spectral Characterization of 2020 SO
Vishnu Reddy, University of Arizona

Space Object Identification, Discrimination, and Tracking
Steve Williams, Kratos

Automated Multi-Sensor Data Fusion Using the Unified Data Library
Tamara Payne, Applied Optimization Inc.

Comparing Photometric Behavior of LEO Constellations to SpaceX Starlink using a Space-based Optical Sensor
Chance Johnson, USAF/CAF

Studying the Potential of Hyperspectral Unmixing for Extracting Composition of Unresolved Space Objects using Simulation Models
Miguel Velez-Reyes, The University of Texas at El Paso

Extending Laboratory BRDF Measurements towards Radiometric Modeling of Resident Space Object Spectral Signature Mixing
Steve Williams, Georgia Tech Research Institute

Using AI to Analyse Light Curves for GEO Object Characterisation
Emma Kerr, Deimos Space UK Ltd.

Rapid Discrimination of Resident Space Objects Using Near-Infrared Photometry
Harrison Krantz, University of Arizona Steward Observatory

05:30 – 07:00 **POSTER RECEPTION** | *Pacific Terrace Rooftop*
Meet the poster presenters while enjoying a cocktail. All posters are digital and can be viewed on the Virtual Conference Platform.

Co-sponsored by SPACENAV

Friday 17 September

ON-DEMAND LAUNCH: Presentations from the SSA/SDA and Machine Learning Applications for SSA technical sessions will be available upon completion of the in-person session.

Session will be streamed to virtual platform

06:00 AM HST – 07:15 AM HST BREAKFAST AT LEISURE | *Luau Gardens*

07:30 – 08:00 **VIRTUAL KEYNOTE ADDRESS*** | *Aulani Ballroom*
*Introduction by **Victoria Samson**, Washington Office Director, Secure World Foundation*

Carine Claeys
Special Envoy for Space / Head of the Space Task Force
European External Action Service

08:00 – 09:00 **SSA POLICY FORUM* | Results of the Recent UN Resolution on Norms of Behavior in Space**
In December 2020, the United Nations General Assembly adopted a resolution proposed by the United Kingdom that called on member states to provide their

---

thoughts on threats to space security and proposals for dealing with those threats, including developing norms of behavior for space. This panel will discuss the inputs received from governments and civil society and what it means for future multilateral discussions on space security, and how SSA can help reduce misperceptions and misunderstandings and increase the transparency of space activities.

Moderated by:
Victoria Samson, Washington Office Director, Secure World Foundation

Eric Desautels, Acting Deputy Assistant Secretary of State for Emerging Security Challenges and Defense Policy, Bureau of Arms Control, Verification and Compliance, United States Department of State
David Edmondson, Policy Head, Space Security and Advanced Threats, Security Policy Department, United Kingdom Foreign, Commonwealth and Development Office
Audrey Schaffer, Director for Space Policy, National Security Council
Jessica West, Senior Researcher, Project Ploughshares
Wen Zhou, Legal Adviser, Arms Unit, International Committee of the Red Cross

---

09:00 – 09:20

VIRTUAL EXHIBITS AND NETWORKING BREAK | *Conference Platform*
Explore the Exhibit Hall and interact with our conference partners. Schedule 1:1 virtual meetings, view demos, resources, and more.

Sponsored by PRIVATEER

09:20 – 09:40

INVITED TALK* | AFRL Support to Space S&T | *Aulani Ballroom*
*Introduction by **Lt Col J. Chris Zingarelli**, Commander & Materiel Leader, Air Force Maui Optical and Supercomputing, Air Force Research Laboratory Detachment 15*

Dr. Kelly Hammett, Director, Directed Energy Directorate; Deputy Technology Executive Officer (TEO) for Space Science and Technology, Air Force Research Laboratory

09:40 – 11:25

SPACE SITUATIONAL/DOMAIN AWARENESS | *Sponsored by* LEO LABS
Co-chaired by **Moriba Jah,** University of Texas at Austin
and **Danielle Wood,** Space Enabled Research Group, MIT Media Lab

Safety Norms for Space Security: How the Development of STM Norms Can Strengthen Security in Space
Daniel Porras, Secure World Foundation

Test on the New SSA System of JASDF
Ryotaro Sakamoto, Japan Air Self Defense Force

Swedish National Interests in Space Situational Awareness
Torbjörn Sundberg, Swedish Defence Research Agency

The Australian Space Agency's Inaugural SSA Technology Roadmap: Context, Methodology and Learnings
Aude Vignelles, Australian Space Agency

Report on 2020 Megaconstellation Deployments and Impacts to Space Domain Awareness
Ryan Hiles, Omitron, Inc.

Doppler and Angle of Arrival Estimation from Digitally Modulated Satellite Signals in Passive RF Space Domain Awareness.
Mohd Noor Islam, Clearbox Systems

Daytime Optical Contributions Toward Timely Space Domain Awareness in Low Earth Orbit
Jeff Shaddix, Numerica Corporation

11:25 AM HST	12:25 PM HST	LUNCH
12:25	01:25	**SPACE SITUATIONAL/DOMAIN AWARENESS (cont.)** Co-chaired by **Moriba Jah,** University of Texas at Austin and **Danielle Wood,** Space Enabled Research Group, MIT Media Lab *Geosynchronous Satellite Maneuver Identification and Characterization using Passive RF Passive Ranging* **Austin Beer**, Kratos *System Approach to Analyse the Performance of the EU Space Surveillance and Tracking System* **Jose Maria Hermoso**, CDTI *Adapting New Processes to Support Improved Space Based Surveillance Ground Operations* **Tom Kelecy**, Stratagem Group *Enhanced Standard Data Format for Reporting Electro-Optical Data Products for Space Domain Awareness* **Tamara Payne,** Applied Optimization Inc.
01:25	02:25	**PANEL* | Space Research Opportunities with the U.S.** *This panel will discuss the many opportunities that exist for the space domain awareness to engage with the US Government. This is a chance to hear leading representatives from the major military and civilian research groups present their approaches to these activities. Of particular interest to many is how the newly*

formed Space Force efforts are being coordinated with the traditional Air Force research organizations. Discussions will also include opportunities for international outreach and collaborative efforts.

Moderated by:
Geoff P. Andersen, Deputy Chief Scientist, United States Space Force

Thomas W. Cooley, Chief Scientist, Space Vehicles Directorate, Air Force Research Laboratory
Lindsay Millard, Principal Director for Space, Office of the Under Secretary of Defense for Research and Engineering
Joel Mozer, Chief Scientist, United States Air Force
William P. Roach, Chief Scientist, Air Force Office of Scientific Research
Ezinne Uzo-Okoro, Assistant Director for Space Policy, White House Office of Science and Technology Policy

02:25	02:45	VIRTUAL EXHIBITS AND NETWORKING BREAK | *Conference Platform*
02:45	04:45	**MACHINE LEARNING FOR SSA APPLICATIONS** | *Sponsored by* LOCKHEED MARTIN Co-chaired by **Islam Hussein**, Trusted Space and **Charlotte Shabarekh**, MIT Lincoln Laboratory *Toward Deep-Space Object Detection in Persistent Wide Field of View Camera Arrays* **Garrett Fitzgerald**, United States Space Force / University of Dayton *Geosynchronous Satellite Maneuver Classification via Supervised Machine Learning* **Thomas G. Roberts**, Massachusetts Institute of Technology *Toward Using Machine Learning Models for Data Association and Maneuver Classification of Resident Space Objects* **Triet Tran**, Cornerstone Consulting LLC *Inferring Space Object Orientation with Spectroscopy and Convolutional Networks* **Matthew Phelps**, USSF SMC/SPG Program Support *Detection & Identification of On-Orbit Objects Using Machine Learning* **Marcos Perez**, LMO *Pixelwise Image Segmentation for RSO Detection of GEO Spacecraft* **Tim Smith**, The Aerospace Corporation *Incremental Learning of Novel Resident Space Object Spectral Fingerprints* **Zach Gazak**, Odyssey Systems

Time Forecasting Satellite Light Curve Patterns using Neural Networks
William Dupree, Aptima, Inc.

04:45 – 05:05 **CONFERENCE CLOSING & AWARDS CEREMONY**
In collaboration with the Space Surveillance Technical Committee of the American Astronautical Society (AAS), the AMOS Conference recognizes outstanding efforts in the field of Space Situational/Domain Awareness by presenting the fourth annual AMOS Conference Best Paper and Student Awards.

05:05 – 06:00 **PAU HANA RECEPTION** | *Mei Court*
Commemorate the end of the 22nd AMOS Conference with live music, cocktails, and friends as we say *Aloha* and *A Hui Hou*

Sponsored by L3HARRIS™ FAST. FORWARD.

Digital Poster Presentations

All posters are in digital format and can be viewed on the Virtual Platform starting Fri Sep 10. Brief video presentations accompany the posters. Please view a poster's designated Office Hours to video chat with the poster presenter during select times.

Light Curve Analysis of Deep Space Objects in Complex Rotation States
Michael Abercrombie, The Boeing Company

SDA Environment Toolkit for Defense (SET4D) – Enabling Attribution for Orbital Assets and Electro-magnetic Spectrum Links Through Streamlined R2O
Sage Andorka, U.S. Space Force

On the Impact of Tactical Track Loading on Volume Revisit Performance and the Role of Augmenting Hosted Payloads – A GEO Space Domain Awareness Challenge
Jeff Asher, JHU/APL

A Visible Spectroscopic Atlas of Geostationary Satellites
Adam Battle, University of Arizona

Radar-Derived Spin States of Defunct GEO Satellites and Rocket Bodies
Conor Benson, University of Colorado Boulder

NGSatSentry: On-Orbit Detection System for Space Domain Awareness
Nicholas Bertrand, Northrop Grumman

A Study of Measuring Beam Wander from Stars for Ground-based Laser Illumination
Nazim Bharmal, Durham University

Artificial Debris Collision Risk Following a Catastrophic Spacecraft Mishap in Lunar Orbit
Nathan Boone, Air Force Institute of Technology

Bayesian Approach to Light-Curve Inversion of 2020 SO
Tanner Campbell, University of Arizona

Simplified Conjunction Analysis using a Graph Database for Identifying High Risk Objects
Janet Cathell, Sceptre Analytics

Cislunar Orbit Determination Behavior: Processing Observations of Periodic Orbits with Gaussian Mixture Model Estimation Filters
C. Channing Chow II, Cloudstone Innovations LLC

Utilization Potential for Distinct Orbit Families in the Cislunar Domain
Phillip Cunio, ExoAnalytic Solutions

Development and Testing of a Novel Low-Cost LEO Optical Surveillance Sensor
Borja Del Campo Lopez, Deimos Space UK Ltd.

Maximizing the Utility of Non-Traditional Sensor Network Data for SDA
Neil Dhingra, Orbit Logic Incorporated

Machine Learning for Launch Assessment: The Similarity-Based Launch Classification Tool (SLCT)
Michal Dichter, Applied Technology Associates, a BlueHalo Company

Compact Solutions for Detecting Space and Ground Based Optical Threats to Satellites
Cameron Dickinson, MDA Space Robotics & Operations

Qualifying and Reducing Neutral Density Uncertainty for Precise Orbit Determination using Physics-Based Data Assimilations
Nicholas Dietrich, University of Colorado Boulder

Preliminary Orbit Determination Using the Transit of Satellites in Front of Space-Based Illumination Sources
Daniel Dombrowski, Air Force Institute of Technology

Amorphous Closed Loop Feedback Control for SDA Payloads
David Ellis, Ball Aerospace

A Regional Greedy Algorithm for Space Domain Awareness Resource Allocation
Naomi Owens Fahrner, Ball Aerospace

Spooky Coordinated Tasking and Estimation on Uninformative Priors
Samuel Fedeler, University of Colorado at Boulder

Intrinsic Fault Resistance for Nonlinear Filters with State-Dependent Probability of Detection
Gunner Fritsch, Texas A&M University

Detection of Background Stars over an Artificial Satellite Pass using Blob Detection Algorithms
Andre Gaudin, University of Canterbury

Characterization of Orbital Debris Attributes Using Functional Data Analysis
Emily Gerber, L3 Harris

Relative Estimation in the Cislunar Regime using Optical Sensors
Jesse Greaves, University of Colorado Boulder

Establishing Consensus Between Implicitly Updated Decentralized Probability Distribution Functions
Juan Gutierrez, KBR

Photometric Characterization and Trajectory Accuracy of Starlink Satellites
Grace Halferty, University of Arizona

An Adaptive, Non-singular Measurement Model for Angles-only Orbit Determination and Estimation
James Hippelheuser, University of Central Florida

Dynamic Model Integration and Simulation Engine (DMISE) Assisted Design of Future Sensor Networks in Support of Space Traffic Management
Douglas Hope, Georgia Tech Research Institute

Headline-based Human-Computer Interface to Aggregate Space Indications and Warnings
John Ianni, AFRL

Asteroid Detection and Risk Prediction for the Earth
Tulika Jain, Shah & Anchor Kutchhi Engineering College

Observations of Satellites Using Near-Simultaneous Polarization Measurements
Audra Jensen, USAFA

Space Command and Control Program - Kobayashi Maru
Edward Jones, SMC/ECXC

Novel Closed Form Solution for Orbit Segment Altitude Extrema Over Spherical and Oblate Central Bodies
Darin Koblick, Raytheon Intelligence and Space

Use of Ground Stations of ERS Data Reception in the Interest of Space Situational Awareness
Oleksandr Kozhukhov, National Space Facilities Control and Test Center of State Space Agency of Ukraine

Characterizing the All-Sky Brightness of Satellite Mega-Constellations and the Impact on Astronomy Research
Harrison Krantz, University of Arizona Steward Observatory

Light Scattering Properties of a Solar Panel Including Wavelength and Polarization Dependencies in the Visible Spectrum
Joe Kurtz, University of New South Wales - Canberra

The Efficacy of Limiting Catastrophic Fragmentations in Low Earth Orbit by Regulating Probability of Collision with Large Objects
Mike Lindsay, Astroscale

Discovering 3-D Structure of LEO Obects
Jacob Lucas, The Boeing Company

Developing A Virtual Assistant for Space Operations
Jeremy Ludwig, Stottler Henke Associates, Inc.

Observations of Space Object 2020 SO Using 8-inch f/2 Schmidt Astrograph
Tim McLaughlin, Pine Park Engineering Corp

Earthshine: A Paradigm Shift for Daylight Imaging and Custody of LEO Satellites
Scott Milster, AFRL/RV

A Subset Simulation Based Technique for Calculating the Probability of Collision
Utkarsh Mishra, Texas A&M University

Self-Supervised Auxiliary Task Learning for Estimating Satellite Orientation
Klaus Okkelberg, The Boeing Company

A New Statistical Estimate of the Radar Coverage of the Low Earth Orbit Debris Environment
Chris Ostrom, HX5

Threats Prediction to a Satellite by Detected Asteroids
Linesh Patil, Shah & Anchor Kutchhi Engineering College

Survey on New Strategies and State of the Art for Space Debris Catalogue Generation for Optical Sensor Networks
Guido Pedone, Airbus Defence and Space GmbH

Debris Cloud Structure in Medium Earth Orbit
Marielle Pellegrino, University of Colorado Boulder

Clustering-Based Uncorrelated Track Association
Louis Penafiel, Aptima, Inc.

Detection & Identification of On-Orbit Objects Using Machine Learning
Marcos Perez, LMO

Polarimetric Space Situational Awareness using the Aero-Optical Prediction Tool
Christopher Persons, IERUS Technologies

Share My Space Multi-telescope Observation Stations Performance Assessment
Alexis Petit, Share My Space

Dual Use Star Tracker and Space Domain Awareness Sensor In-Space Test
Elozor Plotke, LinQuest Corporation

Performance of Northrop Grumman's Mission Extension Vehicle (MEV) RPO Imagers at GEO
Matt Pyrak, Northrop Grumman Space Systems

Orbital Diversity and Inclination Optimization for Large Count LEO Constellations in Non-polar Orbits
Chuck Quintero, JHU/APL

Multi-Target Ensemble Gaussian Mixture Tracking with Sparse Observations
Benjamin Reifler, The University of Texas at Austin

Patterns of Life and Maneuver Detection for Cislunar Trajectory Maintenance
Karina Rivera, University of Colorado Boulder

Future Space Domain Awareness Hosted Payloads
Anthony Rosati, U.S. Space Force AFSPC SMC/SPG

A Worldwide Network of Radar for Space Domain Awareness in Low Earth Orbit
James Rowland, LeoLabs

Photometric and Spectral Calibration of the Falcon Telescope Network
Nikola Ruby, Murray State University

Modeling Energy Dissipation and De-tumbling of a Defunct a Satellite Using a Finite Element Method
Ryotaro Sakamoto, University of Colorado Boulder

Optical Satellite Tracking in Earth's Shadow with Non-traditional Illumination
Kevin Schafer, MITRE

Ablative Collision Avoidance for Space Debris in the Lower Earth Orbit by a Single Multi-kJ Pulse from a Ground-based Laser
Stefan Scharring, DLR

Re-entry Event of CZ-3B R/B Observed by All-sky Meteor Cameras AMOS
Jiri Silha, Comenius University, Faculty of Mathematics, Physics and Informatics

Systems and Methods for Hybrid Lunar Surface and Space Domain Situational Awareness
Elvis Silva, Ball Aerospace

A Three-dimensional Photometric Model of a Satellite in Geostationary Orbit
Jovan Skuljan, Defence Technology Agency

Parametric Generation of Whistler Waves in the Ionosphere
Vladimir Sotnikov, AFRL

Identifying the Statistically-Most-Concerning Conjunctions in LEO
Matthew Stevenson, LeoLabs

Decentralized Space Information Sharing as a Key Enabler of Trust and the Preservation of Space
Ruth Stilwell, Aerospace Policy Solutions, LLC

Data Fusion of Historical Space Weather Outliers and Satellite Anomalies
Richard Stottler, Stottler Henke Associates, Inc.

A Spoken Language Interface for SSA/SDA Based on Modern Speech Processing Technology
Richard Stottler, Stottler Henke Associates, Inc.

Toward Intuitive Understanding of Complex Astrodynamics using Distributed Augmented Reality
Daniel Stouch, Charles River Analytics

Design Trades for Environmentally Friendly Broadband LEO Satellite Systems
Mark Sturza, 3C Systems Company

Speckle Interferometry of Binary Stars with a 1m Telescope, Grounded with AO from a 1.5m
Tanya Tavenner, AFRL/RDS

Investigating the Risks of Debris-generating ASAT Tests in the Presence of Megaconstellations
Sarah Thiele, The University of British Columbia

Cislunar Orbit Determination and Tracking via Simulated Space-Based Measurements
Michael Thompson, Advanced Space

Detecting Dim Targets in Cislunar Space using GEO/HEO-based Optical Sensors
Darren Thornton, Air Force Institute of Technology

The Machine Learning Enabled Thermosphere Advanced by HASDM (META-HASDM) System in Development That Will Support Space Traffic Management and Conjunction Assessment
W. Kent Tobiska, Space Environment Technologies

Agile Space Object Custody for Electro-Optical Sensors
Johnathan Tucker, University of Colorado Boulder

Daytime Sky Brightness Measurements and Comparison to Analytical Models
Vincent Vella, L3 Harris

Establishment of a Space Operations Squadron at the Japan Air Self-Defense Force in 2020: Current Status and Future Prospects
Quentin Verspieren, The University of Tokyo

Artificial Intelligence Enabled Dynamic Coalition Architecture for Space Traffic Management
W. Thomas Vestrand, Los Alamos National Laboratory

Object Detection from Radon Transformations using Machine Learning Techniques
Thomas Walker, Lockheed Martin Australia

Preliminary Viability Assessment of Cislunar Periodic Orbits for Space Domain Awareness Mission Architectures
Adam Wilmer, Air Force Institute of Technology

Semantic Segmentation of Low Earth Object Satellites using Convolutional Neural Networks
Julia Yang, The Boeing Company

Trends in Global Space Situational Awareness
Makena Young, Center for Strategic and International Studies

Establishing a Chain of Digital Forensics for Space Object Behavior Using Distributed Ledger Technology
Waqar Zaidi, L3Harris

A Complete SSA Scheme for a Sustainable Low Earth Orbit: Space Data Aggregation and IA Combined with In-orbit Inspection
Selma Zamoum, SpaceAble

AGO70: Passive Optical System to Support SLR Tracking of Space Debris on LEO
Matej Zigo, Comenius University in Bratislava

Cislunar SSA/SDA from the Lunar Surface: COTS Imagers on Commercial Landers
Peter Zimmer, J.T. McGraw and Associates, LLC (JTMA)

Overcoming the Challenges of Daylight Optical Tracking of LEOs
Peter Zimmer, J.T. McGraw and Associates, LLC (JTMA)