



Advanced Maui Optical and Space Surveillance Technologies Conference

A program of Maui Economic Development Board, Inc.



Conference Program

September 14-17, 2010



welina mai kākou

(welcome all)

We are pleased that you are participating in the 11th annual AMOS Conference! Although we will be sitting in a darkened ballroom, intently listening to technical briefings throughout the week, we are, indeed, in a culturally rich and beautiful setting...

It is our pleasure to share with you a few of the things that make Maui unique. We have sprinkled elements throughout the week to remind us of our Hawaiian "Sense of Place."

Among them are the lei kukui worn to designate our conference session chairs, our traditional Native Hawaiian invocation opening the conference, and a private Polynesian luau on Wailea Beach.

If there is anything our Conference Team can do to make your week more productive and enjoyable, please let us know.

Warmest Aloha,
The AMOS Conference Organizing Committee

mahalo to our sponsors

po'okela *(striving for the best)*



laulima *(working together)*



lōkahi *(collaboration and unity)*



kupa'a *(loyal and committed)*



mālama *(to care for)*



pō‘alua | tue, sep 14

6:00 - 7:30 pm WELCOME RECEPTION | Luau Gardens
Co-sponsored by The Boeing Company

Set against the backdrop of the Pacific Ocean on Wailea Beach, the conference kicks off with the welcome reception providing participants with a unique networking opportunity. Participants and their guests will be greeted with a shell lei, a beverage, and appetizers, all while listening to the Air Force Band of the Pacific's Papana Jazz Ensemble.



po‘akolu | wed, sep 15

6:00-7:15 am BREAKFAST | Luau Gardens at leisure

7:30-5:00 pm EXHIBITION AND POSTER ROOM | Jade-Plumeria Ballroom

7:30 CONFERENCE OPENING | Aulani Ballroom
Jeanne Unemori Skog, President & CEO, Maui Economic Development Board

INVOCATION | *Reverend Kealahou Alika, Keawala'i Congregational Church*

WELCOME REMARKS (via video) | *Daniel K. Inouye, United States Senator*

KEYNOTE ADDRESSES

Introductions

Colonel L. Kirk Lewis, Ret., Senior Analyst, Institute for Defense Analyses

Major General Susan Helms, Director of Plans and Policy, U.S. Strategic Command, Offutt Air Force Base, Nebraska

Lieutenant General John T. "Tom" Sheridan, Commander, Space and Missile Systems Center, Air Force Space Command, Los Angeles Air Force Base, California

9:00 BREAK

WELCOME COFFEE HOUR FOR SPOUSES AND GUESTS | Mala Lounge

9:20 ORBITAL DEBRIS
Session Chair, Thomas Schildknecht, Astronomical Institute, University of Bern

AIUB Efforts to Survey, Track, and Characterize Small-Size Objects at High Altitudes
Thomas Schildknecht, Astronomical Institute, University of Bern

Optical Photometric Observations of GEO Debris
Patrick Seitzer, University of Michigan

Detection of Faint GEO Objects Using Population and Motion Prediction
Masahiko Uetsuhara, Kyushu University

Orbital Debris Observation via Laser Illuminated Optical Measurement Techniques
Makoto Tagawa, Kyushu University

10:40 NON-RESOLVED OBJECT CHARACTERIZATION
Session Chair, Matt Hejduk, SRA International

Satellite Attitude from Small Aperture Telescopes
Daron Nishimoto, PDS, LLC

Noise-Tolerant Spectral Signature Classification in Unresolved Object Detection Using Adaptive Lattice Neural Networks
Mark Schmalz, Center for Computer Vision and Visualization

Satellite Surface Material Characterization from Multi-band Optical Observations
Doyle Hall, Boeing LTS – AMOS

11:40	LUNCHEON Lokelani Ballroom
1:00 pm	<p>Investigation of Properties and Characteristics of High-Area-to-Mass-Ratio Objects Based on Examples of Optical Observation Data of Space Debris Objects in GEO-like Orbits <i>Thomas Schildknecht, Astronomical Institute, University of Bern</i></p> <p>Comparison of Orbital and Physical Characteristics of Bright and Faint GEO Objects <i>Vladimir Agapov, Keldysh Institute of Applied Mathematics, RAS</i></p> <p>Catalogue-Wide Satellite Photometric Behavior Paradigms <i>Matt Hejduk, SRA International</i></p> <p>Phase Angle: What is it good for? <i>Paul Kervin, Air Force Research Laboratory – Maui</i></p> <p>Warming and Cooling of Spacecraft in Sunlight and Shadow from IR Spectroscopy <i>Ray Russell, The Aerospace Corporation</i></p> <p>Analysis of Unresolved Spectral Infrared Signature for Extraction of its Invariant Features <i>Anil Chaudhary, Applied Optimization, Inc.</i></p>
3:00	<p>EXHIBITION RECEPTION AND POSTER PRESENTATIONS Jade-Plumeria Ballroom <i>Co-sponsored by Analytical Graphics, Inc.</i></p> <p>Posters listed on last page of program</p>
5:00	<p>AMOS SITE CAPABILITIES TUTORIAL Aulani Ballroom <i>Capt Steven James, AFRL Detachment 15</i></p>
5:30-6:30	<p>NEW GENERATION NETWORKING RECEPTION Molokini Pool Deck <i>Sponsored by the Space Foundation (by invitation only)</i></p>
8:00-10:00	<p>"AN EVENING UNDER THE STARS WITH ORBITAL" DESSERT RECEPTION Pacific Terrace Rooftop <i>Sponsored by Orbital Sciences Corporation</i></p>

hō'ike pō'akolu (highlights of the day)

WELCOME COFFEE HOUR | Mala Lounge at 9:00 am

Non-registered participants are invited to an informal presentation about optional island activities. This is a nice opportunity to mingle and map out plans for the week.



EXHIBITION RECEPTION AND POSTER PRESENTATIONS | Jade-Plumeria Ballroom at 3:00 pm

Co-sponsored by Analytical Graphics, Inc, the poster session is an opportunity for authors to present their work and have in-depth discussions with conference participants. Poster display boards are arranged throughout a portion of the ballroom together with industry exhibits in a convivial setting with seating and light refreshments to encourage interaction with the poster authors. The exhibit venue is open throughout the week serving as a locus for side discussions and pop-up meetings.



AMOS SITE CAPABILITIES TUTORIAL | Aulani Ballroom at 5:00 pm

The Maui Space Surveillance Complex (MSSC), located at the summit of Haleakala, is a national resource providing support to various government agencies and the scientific community. The tutorial summarizes MSSC systems, capabilities, and support procedures and includes a description of the telescopes and sensors. It will also include a brief overview of the Maui High Performance Computing Center (MHPCC).

pō‘ahā | thu, sep 16

6:00-7:15 am BREAKFAST | Luau Gardens at leisure

7:30-5:30 pm EXHIBITION AND POSTER ROOM | Jade-Plumeria Ballroom

7:30 KEYNOTE | Aulani Ballroom

Introduction

Colonel L. Kirk Lewis, Ret., Senior Analyst, Institute for Defense Analyses

Lieutenant General Michael A. Hamel, USAF (Retired)

Senior Vice President, Strategy and Development, Orbital Sciences Corporation

8:20 INTEGRATING DIVERSE DATA

Session Chair, Kim Luu, Air Force Research Laboratory

Operational Impact of Improved Space Tracking and Collision Avoidance in the Future LEO Space Debris Environment

David Sibert, ExoAnalytic Solutions, Inc.

Monte Carlo Method for Collision Probability Calculations Using 3D Satellite Models

Willem de Vries, Lawrence Livermore National Laboratory

9:00 BREAK

9:00-12:30 SPACE IN THE CLASSROOM | Mauna Loa and Ilima

An Audience with an Astronaut for Maui Middle School Students

Co-sponsored by the Space Foundation and held in association with Analytical Graphics, Inc., the Air Force Research Laboratory, Lockheed Martin, and Orbital Sciences Corporation

9:20 INTEGRATING DIVERSE DATA (continued)

How the Space Data Center is Improving Safety of Space Operations

T.S. Kelso, Center for Space Standards & Innovation

Data Calibrations for the Combined Solutions Using Ranging and Telescope Data

Joseph Chan, Intelsat

Global Space Situational Awareness Sensors

Brian Weeden, Secure World Foundation

Space Data Association, International Data Sharing for SSA

Richard DalBello, Intelsat General

Sharing SSA

Duane Bird, USSTRATCOM

11:00 INTEGRATING DIVERSE DATA PANEL DISCUSSION

Moderators: T.S. Kelso, Center for Space Standards & Innovation and Emmet Fletcher, European Space Agency

Panelists: Thomas Schildknecht, Astronomical Institute, University of Bern;

Vladimir Agapov, Keldysh Institute of Applied Mathematics, RAS;

Duane Bird, USSTRATCOM; Andrew D'Uva, Providence Access

12:00 LUNCHEON | Lokelani Ballroom

1:00 pm ADAPTIVE OPTICS AND IMAGING

Session Chairs, Michael Hart, University of Arizona, Steward Observatory, CAAO and Glenn Tyler, The Optical Sciences Company

Multi-conjugate Adaptive Optics Testbed for Horizontal Propagation

Sergio Restaino, Naval Research Laboratory

Exploiting Spectral Correlations for Segmentation and Shape Determination from Hyperspectral Datacubes of Rotating Satellites

Sudhakar Prasad, University of New Mexico

Daytime Image Measurement and Reconstruction for Space Situational Awareness Applications

Michael Roggemann, PDS, LLC

Characterization of Deep Turbulence Over 149 km Propagation Path Using Multi-wavelength Laser Beacons

Mikhail Vorontsov, University of Dayton, LOCI

- 2:20 **ADAPTIVE OPTICS AND IMAGING** (continued)
- Measurements of Tilt and Focus for Sodium Beacon Adaptive Optics on the Starfire 3.5 Meter Telescope
Robert Johnson, Starfire Optical Range
- 2:40 **BREAK**
- 3:00 Nonstationary EO/IR Clutter Suppression and Dim Object Tracking
Alexander Tartakovsky, Department of Mathematics, University of Southern California
- Images of a Geostationary Spacecraft with the Largest Telescope on Earth
Jack Drummond, AFRL/RDSA
- Recent Advances in High-resolution MEMS DM Fabrication and Integration
Thomas Bifano, Boston University
- Adaptive Optics at the World's Biggest Optical Telescope
Michael Hart, The University of Arizona
- Differential Photometry in Adaptive Optics Imaging
Szymon Gladysz, European Organisation for Astronomical Research in the Southern Hemisphere
- Improved Climatological Characterization of Optical Turbulence for Space Optical Imaging and Communications
Randall Alliss, Northrop Grumman Corporation
- 5:00 **ASTRODYNAMICS**
Session Chair, Terry Alfriend, Texas A&M University
- Operational Maneuver Detection Using Optimal Control Performance Metrics
Marcus Holzinger, University of Colorado at Boulder
- Edgeworth Filters for Space Surveillance Tracking
Joshua Horwood, Numerica Corporation
- ADJOURN**

SPACE

IN THE CLASSROOM

at the AMOS Conference

Student Workshop

Thursday, Sept. 16

Audience with an Astronaut
CAPT Robert L. Curbeam, Jr., USN (Retired)

Exhibit center tour

Hands-on demos

Teacher Workshop

Friday, Sept. 17

Classroom activities
Satellite Tool Kit (STK®) training

Rocket launches

Exhibit center tour

Workshops co-sponsored by



In association with



Special thanks to



Photo courtesy of NASA

pō‘alima | fri, sep 17

6:00-7:15 am	BREAKFAST Luau Gardens at leisure from 6am - 7:15am
7:30-4:30 pm	EXHIBITION AND POSTER ROOM Jade-Plumeria Ballroom
7:30-8:40	KEYNOTES Aulani Ballroom Introductions <i>Valerie Skarupa, Operationally Responsive Space Office</i> Peter Marquez, Director of Space Policy, White House National Security Council Elliot Holokauahi Pulham, Chief Executive Officer, Space Foundation
8:30-1:30	SPACE IN THE CLASSROOM Ilima Workshop for Maui School Teachers
8:40	ASTRODYNAMICS (continued) Large-Scale Simulation of a Process for Cataloguing Small Orbital Debris <i>Alex Pertica, Lawrence Livermore National Laboratory</i> Almost-Optimal Sensor Tasking Using Auction Methods <i>Richard Hujsak, Analytical Graphics Inc</i>
9:20	BREAK
9:40	Dynamic Tasking of Networked Sensors Using Covariance Information <i>Kim Luu, AFRL</i> Correlation and Initial Orbit Determination for Short-Arc Optical Observations <i>Kohei Fujimoto, The University of Colorado-Boulder</i>
10:20	MODELING <i>Session Chair, Keric Hill, Pacific Defense Solutions</i> Integration of Space Weather into Space Situational Awareness <i>Geoff Reeves, Los Alamos National Laboratory</i> A Parallel, High-Fidelity Radar Model <i>Benjamin Fassenfest, Lawrence Livermore National Laboratory</i> The Application of Parallel Discrete Event Simulation to the Space Surveillance Network <i>David Jefferson, Lawrence Livermore National Laboratory</i> A Bayesian Approach to Multi-Sensor Track Correlation <i>Matthew Horsley, Lawrence Livermore National Laboratory</i> Numerical and Probabilistic Analysis of Asteroid and Comet Impact Hazard Mitigation <i>Catherine Plesko, Los Alamos National Laboratory</i>
12:00	LUNCHEON Lokelani Ballroom
1:00 pm	MODELING (continued) Satellite Collision Modeling with Physics-based Hydrocodes: Debris Generation Predictions of the Iridium-Cosmos Collision Event and other Impact Events <i>H. Keo Springer, Lawrence Livermore National Laboratory</i> Forecasting Kp Using Unscented Kalman Filter-based Model <i>Charles Wetterer, Colorado Professional Resources</i> Real Time Polarization Light Curves for Space Debris and Satellites <i>John Stryjewski, CSC</i> SYSTEMS <i>Session Chair, Riki Maeda, Pacific Defense Solutions</i> Performances of Telescopes of New Series, ISON Annual Development and Observation Planning <i>Vladimir Agapov, Keldysh Institute of Applied Mathematics, RAS</i> Space Debris Characterization Using Thermal Imaging Systems <i>James Dawson, Dynetics, Inc.</i>

2:40	BREAK
3:00	<p>SYSTEMS (continued)</p> <p>An Overview of Wide-field of View Optical Designs for Survey Telescopes <i>Mark Ackermann, Sandia National Laboratories</i></p> <p>Optimization of Orbital Debris Monitoring with Optical Telescopes <i>James Shell, Space Protection Program</i></p> <p>Space Situational Awareness Applications for the Magdalena Ridge Observatory Interferometer <i>Anders Jorgensen, New Mexico Tech</i></p> <p>Status and Progress in the Space Surveillance and Tracking Segment of ESA's Space Situational Awareness Programme <i>Emmet Fletcher, European Space Agency</i></p> <p>Space Domain Awareness to Support DARPA GEO Spacecraft Servicing <i>Travis Blake, DARPA/TTO</i></p>
4:40	ADJOURN
5:30	CLOSING DINNER LUAU Luau Gardens

hō'ike pō'alima (highlight of the day)

CLOSING DINNER LUAU | Luau Gardens at 5:30 pm

Set against the backdrop of the Pacific Ocean, the conference wraps with a private luau on Wailea Beach. Say "Aloha" to friends as you experience the local flavors of Hawaii and entertainment by one of Hawaii's largest and longest running Polynesian production show, Tihati, as they present Te Au Moana, the ocean tide.



pō'aono | sat, sep 18

OPTIONAL AMOS TECHNICAL TOUR
Departs from Wailea Marriott at 7:30 & 10:00 am

Beginning at sea level, the tour will proceed to the 10,000 ft. summit of Haleakala for a visit to the Maui Space Surveillance Site where participants will visit the DoD's 3.6m AEOS telescope and Pan-STARRS at the UH Institute for Astronomy. Transportation and lunch will be provided for the approximately seven hour trip.



exhibitors

Air Force Research Laboratory, RDSM

The Maui Space Surveillance System, also known as the Air Force Maui Optical & Supercomputing Site (AMOS), is operated by the Air Force Research Laboratory's Directed Energy Directorate.

Air Force Safety Center

The mission of Air Force Safety is to prevent mishaps and preserve combat capability. In enabling that mission, Air Force Safety provides an array of capabilities that commanders and Airmen employ to identify, assess and mitigate strategic, operational, and tactical risks to mission accomplishment.

Analytical Graphics, Inc./Scalable Display Technologies

Analytical Graphics, Inc. develops commercial off-the-shelf analysis software used in more than 32,000 worldwide installations. Scalable Display Technologies produces groundbreaking software that automatically calibrates and edge-blends multiple projectors into seamless digital displays.

Applied Optimization Inc.

Applied Optimization Inc. develops mathematical algorithms and software for SSA and operates two telescope sites for verification of the data collection, reduction and analysis methods.

Applied Technology Associates

Applied Technology Associates (ATA) is a precision measurement, sensing and controls company that offers engineering services, custom hardware solutions, and integration and test services / facilities to government, aerospace and commercial customers.

The Boeing Company

Boeing is the world's leading aerospace company and the largest manufacturer of commercial jetliners and military aircraft combined.

Boston Micromachines Corporation

Founded in 1999, Boston Micromachines Corporation (BMC) is the leading provider of advanced microelectromechanical systems (MEMS)-based mirror products for use in commercial adaptive optics systems.

FLIR Infrared Camera

Come see the latest from FLIR Systems, the global leader in infrared cameras. FLIR will feature its SC Series infrared cameras which boast high speed, high resolution, and high sensitivity.

HNu Photonics

HNu Photonics is a science and technology company creating cutting-edge technologies and transforming innovative ideas into state-of-the-art products with commercial, scientific and military applications.

Lockheed Martin, Santa Barbara Focalplane

Santa Barbara Focalplane, a Lockheed Martin Missiles & Fire Control Business, is a world leader in the design, custom development and manufacture of multi-spectral infrared focalplane array detectors, camera cores and complete camera imaging systems.

Oceanit

Oceanit's HANDS program is an Air Force program that successfully built and deployed a worldwide network of optical ground stations to provide timely information about space objects.

poster presentations

Session Chair, Bernie Klem, Arnold Engineering Development Center

Photon Sieve Space Telescopes, *Geoff Andersen, USAF Academy*

Carbon Fiber Reinforced Polymer (CFRP) Optics Quality Assessment for Lightweight Deployable Optics, *Jonathan Andrews, Naval Research Laboratory*

Maui4: A 24 Hour Haleakala Turbulence Profile, *William Bradford, PDS, LLC*

Characterization of Orbital Debris Photometric Properties Derived from Laboratory-Based Measurements, *Heather Cowardin, ESCG/Jacobs*

Test of Neural Network Techniques using Simulated Dual-band Data of LEO Satellites, *Anthony Dentamaro, Boston College*

Advances in Polarimetric Blind Deconvolution, *Kurtis Engleson, Department of the Air Force*

High Order Curvature Deformable Mirrors, *Christ Faclas, Institute for Astronomy, University of Hawaii*

Small Space Launch: Origins & Challenges, *Thomas Freeman, Launch Test Squadron*

Fabra-ROA Baker-Nunn Camera at Observatori del Montsec: An Instrument Update for Space Debris Observation, *Octavi Fors, Observatori Fabra, Reial Acadèmia de Ciències i Arts de Barcelona, Barcelona, Spain / Departament d'Astronomia i Meteorologia and Institut de Ciències del Cosmos (ICC), Universitat de Barcelona (UB/IEEC)*

SSA Image Quality Modeling, *David Gerwe, Boeing*

HANDS-ION, *Scott Gregory, Oceanit*

Novel Segmentation Technique to Enhance Detection of Fast Moving Objects with Optical Sensors, *Oleg Gussyatin, MIT Lincoln Laboratory*

Advances in Satellite Conjunction Analysis, *Robert Hall, AGI*

Information Theoretic Characterizations of Coded Imaging-based Space Object Identification, *Douglas Hope, University of New Mexico*

The Use of the Taylor "Frozen Flow" Hypothesis for Blind Restoration of Imagery degraded by Atmospheric Turbulence, *Stuart Jefferies, Institute for Astronomy, University of Hawaii*

A High Performance Technique for Blind Deconvolution, *Stuart Jefferies, Institute for Astronomy, University of Hawaii*

A Scalable Visualization System for Improving Space Situational Awareness, *Ming Jiang, Lawrence Livermore National Laboratory*

The Long Wavelength Array (LWA): A Large HF/VHF Array for Solar Physics, Ionospheric Science, and Solar Radar, *Namir Kassim, Naval Research Laboratory*

Discrimination of Closely-Spaced Geosynchronous Satellites-Small Business Innovative Research, *Paul LeVan, AFRL*

ElectroDynamic Debris Eliminator (EDDE): Design, Operation, and Ground Support, *Eugene Levin, STAR, Inc.*

Technical Analysis of Commercially Hosted Optical Payloads for Enhanced SSA, *Jonathan Lowe, AGI*

Dynamic Tasking of Networked Sensors using Covariance Information, *Kim Luu, AFRL*

Pay Me Now or Pay Me MORE Later – When To Start Active Orbital Debris Removal, *Darren McKnight, Integrity Applications Incorporated*

Preliminary Astrometric Results from the PS1 Demo Month and Operational Phase, *David Monet, US Naval Observatory*

The Magdalena Ridge Observatory Interferometer: Towards Sub-Meter Imaging of Geo-Synchronous Targets, *Ifan Payne, Magdalena Ridge Observatory*

Maximizing the Performance of the Weather Research and Forecast Model over the Hawaiian Islands, *Kevin Roe, MHPCC*

Threat Assessment of Small Near-Earth Objects, *Eileen Ryan, New Mexico Institute of Mining and Technology*

High Performance Computing Software Applications Institute for Space Situational Awareness (HSAI-SSA), *Chris Sabol, Air Force Research Laboratory/RDSM*

Cross Strip Readout Detectors for High Time Resolution Imaging in the 120nm to 900nm Wavelength Regime, *Oswald Siegmund, University of California, Space Sciences Lab*

Fawkes Information Management for Space Situational Awareness, *Scott Spetka, ITT Corp. and SUNY Institute of Technology*

Assessment of Spacecraft Operational Status Using Electro-Optical Predictive Techniques, *Dave Swann, Arnold Engineering Development Center*

Sparse-aperture Image Resolution Improvement Technology (SPIRIT), *Mikhail Vorontsov, University of Dayton, LOCI*

Determination of Spin Axis Orientation of Geosynchronous Objects Using a Space-based Sensor: An Initial Feasibility Investigation, *Brad Wallace, Defence Research and Development Canada*

Highly Efficient Screening for Point-like Targets via Concentric Shells, *Jan Wassenberg, Fraunhofer IOSB*

Los Alamos Radiation Hydrocode Models of Asteroid Destruction by an Internal Explosion, *Robert Weaver, Los Alamos National Lab*

Presented by



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