Laser Radar Technology and Applications XIX; and Atmospheric Propagation XI

Monte D. Turner
Gary W. Kamerman
Linda M. Wasiczko Thomas
Earl J. Spillar
Editors

6–7 May 2014
Baltimore, Maryland, United States

Sponsored and Published by
SPIE
## Contents

### Part A Laser Radar Technology and Applications XIX

#### SESSION 1 ADVANCED SYSTEMS AND COMPONENTS I

<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>9080 02</td>
<td>Multi-dimensional laser radars (Invited Paper) [9080-1]</td>
<td>V. Molebny, Academy of Technological Sciences of Ukraine (Ukraine); O. Steinvall, Swedish Defence Research Agency (Sweden)</td>
</tr>
<tr>
<td>9080 04</td>
<td>A polarimetric scanning LADAR: system development and performance analysis [9080-3]</td>
<td>Y. Y. Markushin, N. P. Calvano, G. S. Pati, R. Tripathi, Delaware State Univ. (United States)</td>
</tr>
<tr>
<td>9080 05</td>
<td>A long-distance laser altimeter for terrain relative navigation and spacecraft landing [9080-4]</td>
<td>D. F. Pierrottet, Coherent Applications, Inc. (United States); F. Amzajerdian, B. Barnes, NASA Langley Research Ctr. (United States)</td>
</tr>
<tr>
<td>9080 06</td>
<td>1541nm GmAPD LADAR system [9080-5]</td>
<td>M. R. Kutteruf, P. Lebow, U.S. Naval Research Lab. (United States)</td>
</tr>
<tr>
<td>9080 07</td>
<td>Mosaic active imaging: direct physical modelling and image reconstruction [9080-6]</td>
<td>E. Thouin, ONERA (France) and Institut Supérieur l’Aéronautique et de l’Espace, CNRS, Univ. de Toulouse (France); M.-T. Velluet, D. Hamoir, L. Hespel, ONERA (France); F. Malgouyres, Institut de Mathématiques de Toulouse, CNRS, Univ. de Toulouse (France); X. Briottet, ONERA (France)</td>
</tr>
</tbody>
</table>

#### SESSION 2 ADVANCED SYSTEMS AND COMPONENTS II

<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>9080 08</td>
<td>16W average power 2µm Thulium fiber laser with one stage MOPA [9080-9]</td>
<td>W. Wu, Shanghai Institute of Optics and Fine Mechanics (China) and Qufu Normal Univ. (China); T. Yu, Q. Huang, X. Cheng, W. Chen, Shanghai Institute of Optics and Fine Mechanics (China)</td>
</tr>
<tr>
<td>9080 0A</td>
<td>Development of scanning laser sensor for underwater 3D imaging with the coaxial optics [9080-11]</td>
<td>H. Ochimizu, M. Imaki, S. Kameyama, Mitsubishi Electric Corp. (Japan); T. Saito, Mitsubishi Electric Tokki Systems Corp. (Japan); S. Ishibashi, H. Yoshida, Japan Agency for Marine-Earth Science and Technology (Japan)</td>
</tr>
</tbody>
</table>
Outward atmospheric scintillation effects and inward atmospheric scintillation effects comparisons for direct detection ladar applications [9080-13]
D. G. Youmans, Parsons Corp. (United States)

High-fidelity flash lidar model development [9080-14]
G. D. Hines, NASA Langley Research Ctr. (United States); D. F. Pierrottet, Coherent Applications, Inc. (United States); F. Amzajerdian, NASA Langley Research Ctr. (United States)

Doppler lidar system design via interdisciplinary design concept at NASA Langley Research Center: Part I [9080-16]
C. M. Boyer, NASA Langley Research Ctr. (United States); T. P. Jackson, Old Dominion Univ. (United States); J. Y. Beyon, L. B. Petway, NASA Langley Research Ctr. (United States)

Design and performance of a fiber array coupled multi-channel photon counting, 3D imaging, airborne lidar system [9080-8]
G. Huang, R. Shu, L. Hou, M. Li, Shanghai Institute of Technical Physics (China)

Doppler lidar system design via interdisciplinary design concept at NASA Langley Research Center: Part II [9080-900]
A. I. Crasner, Univ. of Michigan (United States); S. Scola, J. Y. Beyon, L. B. Petway, NASA Langley Research Ctr. (United States)

Doppler lidar system design via interdisciplinary design concept at NASA Langley Research Center: Part III [9080-901]
B. W. Barnes, NASA Langley Research Ctr. (United States); A. M. Sessions, The Univ. of Arizona (United States); J. Y. Beyon, L. B. Petway, NASA Langley Research Ctr. (United States)

SESSION 3 SIGNAL PROCESSING

Improving waveform lidar processing toward robust deconvolution of signals for improved structural assessments [9080-17]
K. Cawse-Nicholson, J. van Aardt, S. Hagstrom, P. Romanczyk, Rochester Institute of Technology (United States); C. Schaaf, Univ. of Massachusetts Boston (United States); A. Strahler, Z. Li, Boston Univ. (United States); K. Krause, National Ecological Observatory Network (United States)

Online waveform processing for demanding target situations [9080-18]
M. Pfennigbauer, C. Wolf, J. Weinkapf, A. Ullrich, RIEGL Laser Measurement Systems GmbH (Austria)

Range resolution improvement of eyesafe ladar testbed (ELT) measurements using sparse signal deconvolution [9080-19]
S. E. Budge, J. H. Gunther, Utah State Univ. (United States)

High-speed on-board data processing for science instruments [9080-21]
J. Y. Beyon, T.-K. Ng, B. Lin, Y. Hu, W. Harrison, NASA Langley Research Ctr. (United States)
SESSION 4 DATA PROCESSING AND ANALYSIS I

9080 ON Algorithm for detecting important changes in lidar point clouds [9080-23]
D. Korchev, Y. Owechko, HRL Labs., LLC (United States)

9080 OO Improved registration for 3D image creation using multiple texel images and incorporating low-cost GPS/INS measurements [9080-24]
S. E. Budge, X. Xie, Utah State Univ. (United States)

9080 OP Estimating sampling completeness of lidar datasets using voxel-based geometry [9080-25]
S. Hagstrom, D. Messinger, K. Salvaggio, Rochester Institute of Technology (United States)

9080 OQ Graph segmentation and support vector machines for bare earth classification from lidar [9080-26]
N. S. Shorter, O. Smith, P. Smith, M. Rahmes, Harris Corp. (United States)

9080 OR Comparison of lidar and stereo photogrammetric point clouds for change detection [9080-27]
P. L. Basgall, National Geospatial-Intelligence Agency (United States); F. A. Kruse, R. C. Olsen, Naval Postgraduate School (United States)

SESSION 5 DATA PROCESSING AND ANALYSIS II

9080 OS Uncertainty assessment and probabilistic change detection using terrestrial and airborne lidar [9080-28]
A. Jalobeanu, Univ. of Texas at Austin (United States) and Naval Postgraduate School (United States); A. M. Kim, S. C. Runyon, R. C. Olsen, F. A. Kruse, Naval Postgraduate School (United States)

9080 OT Lidar change detection using building models [9080-29]
A. M. Kim, S. C. Runyon, Naval Postgraduate School (United States); A. Jalobeanu, Univ. of Texas at Austin (United States) and Naval Postgraduate School (United States); C. H. Esterline, F. A. Kruse, Naval Postgraduate School (United States);

9080 OU Correlation between lidar-derived intensity and passive optical imagery [9080-30]
J. P. Metcalf, A. M. Kim, F. A. Kruse, R. C. Olsen, Naval Postgraduate School (United States)

9080 OV A calibration method of the multi-channel imaging lidar [9080-31]
W. Xu, Shanghai Institute of Technical Physics (China); J. Liu, Zhengzhou Institute of Surveying and Mapping (China); R. Shu, Shanghai Institute of Technical Physics (China)
SESSION 6 ATMOSPHERIC SENSING

9080 0W  Using an eyesafe military laser range finder for atmospheric sensing [9080-32]
O. Steinvall, R. Persson, F. Berglund, O. Gustafsson, F. Gustafsson, Swedish Defence Research Agency (Sweden)

9080 0X  Development of a fluorescence lidar for measurement of atmospheric formaldehyde [9080-33]
A. Radhakrishnan Mylapore, MassTech Inc. (United States); M. Yakshin, A. Achey, I. H. Hwang, S. Lee, N. Mehta, G. K. Schwemmer, C. R. Prasad, Science and Engineering Services, Inc. (United States); T. F. Hanisco, NASA Goddard Space Flight Ctr. (United States)

9080 0Y  A three-beam aerosol backscatter correlation lidar for three-component wind profiling [9080-34]
A. Radhakrishnan Mylapore, MassTech Inc. (United States); G. K. Schwemmer, C. R. Prasad, S. Lee, A. Achey, I. H. Hwang, N. Mehta, M. Yakshin, Science and Engineering Services, Inc. (United States); K. Novoselov, MassTech Inc. (United States); N. S. Prasad, NASA Langley Research Ctr. (United States)

9080 0Z  Laser remote sensing of species concentrations and dynamical processes [9080-35]
C. R. Philbrick, H. D. Hallen, North Carolina State Univ. (United States)

9080 10  Remote aerosol species-identification using IR scattering spectroscopy [9080-36]
S. Niu, C. R. Philbrick, H. D. Hallen, North Carolina State Univ. (United States)

9080 11  Offshore wind measurements using Doppler aerosol wind lidar (DAWN) at NASA Langley Research Center [9080-37]
J. Y. Beyon, G. J. Koch, M. J. Kavaya, NASA Langley Research Ctr. (United States)

9080 12  Clipping of TE-CO₂ laser pulse using gas breakdown technique for high spatial resolution gas plume detection [9080-38]
T. Gasmi, Saint Louis Univ., - Madrid Campus (Spain)

Part B Atmospheric Propagation XI

SESSION 7 PROPAGATION THEORY AND VALIDATION

9080 13  Scintillation fluctuations of optical communication lasers in atmospheric turbulence [9080-39]
M. G. Panich, J. T. Coffaro, S. B. Belichki, L. J. Splitter, R. L. Phillips, L. C. Andrews, Kennedy Space Ctr. (United States) and CREOL, The College of Optics and Photonics, Univ. of Central Florida (United States); W. Fountain, Wayne Analytics LLC (United States); F. M. Tucker, U.S. Army RDECOM/STTC (United States)

9080 14  Internal anisotropy of the turbulent scintillations [9080-40]
M. Chamotskii, Zel Technologies, LLC (United States) and National Oceanic and Atmospheric Administration (United States)
Simulation of partially spatially coherent laser beam and comparison with field test data for both terrestrial and maritime environments [9080-41]
N. Mosavi, Johns Hopkins Univ. Applied Physics Lab., LLC (United States) and Univ. of Maryland, Baltimore County (United States); C. Nelson, U.S. Naval Academy (United States); B. S. Marks, B. G. Boone, Johns Hopkins Univ. Applied Physics Lab., LLC (United States); C. R. Menyuk, Univ. of Maryland, Baltimore County (United States)

SESSION 8  MITIGATION TECHNIQUES I

Atmospheric turbulence effects on a monostatic and bistatic retroreflecting link [9080-43]
R. Mahon, M. S. Ferraro, P. G. Goetz, C. I. Moore, J. Murphy, W. S. Rabinovich, U.S. Naval Research Lab. (United States)

Demonstrating capacity-approaching FSO communications [9080-44]
M. P. Fitz, T. R. Halford, C. Kose, J. Cromwell, S. Gordon, TrellisWare Technologies, Inc. (United States)

Implementation and performance of stochastic parallel gradient descent algorithm for atmospheric turbulence compensation [9080-45]
G. A. Finney, C. Persons, S. Henning, IERUS Technologies Inc. (United States); J. Hazen, D. Whitley, The Univ. of Alabama in Huntsville (United States)

Image processing techniques for laser propagation through atmospheric turbulence [9080-46]

SESSION 9  MITIGATION TECHNIQUES II

Diversity effects in modulating retro-reflector links [9080-47]
W. S. Rabinovich, R. Mahon, M. S. Ferraro, P. G. Goetz, J. Murphy, U.S. Naval Research Lab. (United States)

Integration of a concentric five element InAlAs/InGaAs avalanche photodiode array in a stabilized bi-static optical assembly [9080-49]
M. S. Ferraro, R. Mahon, W. S. Rabinovich, J. L. Murphy, U.S. Naval Research Lab. (United States); W. T. Freeman, S. Frawley, Smart Logic, Inc. (United States); P. G. Goetz, H. R. Burris, L. M. Thomas, U.S. Naval Research Lab. (United States); W. R. Clark, W. D. Waters, K. Vaccaro, B. D. Krejca, OptoGration Inc. (United States); B. M. Mathieu, Barry Design, LLC (United States)

SESSION 10  CHARACTERIZATION SYSTEMS AND APPLICATIONS

The integrated atmospheric characterization system (IACS) [9080-50]
Control of a small robot using a hybrid optical modulating retro-reflector/RF link [9080-52]
J. L. Murphy, M. S. Ferraro, W. S. Rabinovich, P. G. Goetz, M. R. Suite, U.S. Naval Research Lab. (United States); S. H. Uecke, NovaSol (United States)

POSTER SESSION

Detecting binary non-return-to-zero data in free-space optical communication systems using FPGAs [9080-53]
V. Bui, L. Tran, E. El-Araby, N. Namazi, The Catholic Univ. of America (United States)

Author Index
Conference Committee

Symposium Chair
David A. Whelan, Boeing Defense, Space, and Security (United States)

Symposium Co-chair
Nils R. Sandell Jr., Strategic Technology Office, DARPA (United States)

Part A Laser Radar Technology and Applications XIX

Conference Chairs
Monte D. Turner, Air Force Research Laboratory (United States)
Gary W. Kamerman, FastMetrix, Inc. (United States)

Conference Program Committee
Philip Gatt, Lockheed Martin Coherent Technologies (United States)
Dominique Hamoir, ONERA (France)
Richard M. Heinrichs, Defense Advanced Research Projects Agency (United States)
Robert T. Hintz, Naval Air Warfare Center Weapons Division (United States)
Norman A. Lopez, FastMetrix, Inc. (United States)
Vasyl Molebny, National Taras Shevchenko University of Kyiv (Ukraine)
C. Russell Philbrick, North Carolina State University (United States)
Upendra N. Singh, NASA Langley Research Center (United States)
Ove K. Steinvall, Swedish Defence Research Agency (Sweden)
Douglas G. Youmans, SPARTA Inc./Parsons Corporation (United States)

Session Chairs
Advanced Systems and Components I
Monte D. Turner, Air Force Research Laboratory (United States)

Advanced Systems and Components II
Gary W. Kamerman, FastMetrix, Inc. (United States)
Part B  Atmospheric Propagation XI

Conference Chairs

Linda M. Wasiczko Thomas, U.S. Naval Research Laboratory (United States)
Earl J. Spillar, Air Force Research Laboratory (United States)

Conference Program Committee

Ammar Al-Habash, Raytheon Space & Airborne Systems (United States)
Gary Baker, Lockheed Martin Space Systems Company (United States)
Harris R. Burris Jr., U.S. Naval Research Laboratory (United States)
Gary G. Gimmestad, Georgia Tech Research Institute (United States)
Ken J. Grant, Defence Science and Technology Organisation (Australia)
Juan C. Juarez, Johns Hopkins University Applied Physics Laboratory (United States)
Christopher I. Moore, U.S. Naval Research Laboratory (United States)
William S. Rabinovich, U.S. Naval Research Laboratory (United States)
Jonathan M. Saint Clair, The Boeing Company (United States)
Douglas G. Youmans, SPARTA Inc./Parsons Corporation (United States)
David H. Tofsted, U.S. Army Research Laboratory (United States)
Morio Toyoshima, National Institute of Information and Communications Technology (Japan)
Cynthia Y. Young, University of Central Florida (United States)
Session Chairs

Propagation Theory and Validation
Ammar Al-Habash, Raytheon Space & Airborne Systems  
(United States)

Mitigation Techniques I
Linda M. Wasiczko Thomas, U.S. Naval Research Laboratory  
(United States)

Mitigation Techniques II
Harris R. Burris Jr., U.S. Naval Research Laboratory (United States)  
Christopher I. Moore, U.S. Naval Research Laboratory (United States)

Characterization Systems and Applications
Juan C. Juarez, Johns Hopkins University Applied Physics Laboratory  
(United States)