Front Matter: Volume 7664
Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XV

Russell S. Harmon  
John H. Holloway, Jr.  
J. Thomas Broach  
Editors

5–9 April 2010  
Orlando, Florida, United States

Sponsored and Published by  
SPIE

Volume 7664
Contents

SESSION 1 ELECTROMAGNETIC INDUCTION I

7664 02 Kalman filters applied to the detection of unexploded ordnance [7664-01]
T. M. Grzegorczyk, Delpsi, LLC (United States); B. Barrowes, U.S. Army Engineer Research and Development Ctr. (United States); F. Shubitidze, Dartmouth College (United States) and Sky Research, Inc. (United States); J. P. Fernández, I. Shamatava, Dartmouth College (United States); K. A. O’Neill, U.S. Army Engineer Research and Development Ctr. (United States)

7664 03 Combining electromagnetic induction and automated classification in a UXO discrimination blind test [7664-02]
J. P. Fernández, Dartmouth College (United States); B. Barrowes, Dartmouth College (United States) and U.S. Army Engineer Research and Development Ctr. (United States); A. Bijamov, Dartmouth College (United States); T. Grzegorczyk, Delpsi, LLC (United States); K. A. O’Neill, Dartmouth College (United States) and U.S. Army Engineer Research and Development Ctr. (United States); I. Shamatava, Dartmouth College (United States) and Sky Research, Inc. (United States); F. Shubitidze, Dartmouth College (United States), U.S. Army Engineer Research and Development Ctr. (United States), and Sky Research, Inc. (United States)

7664 04 SLO blind data set inversion and classification using physically complete models [7664-03]
I. Shamatava, F. Shubitidze, Sky Research, Inc. (United States) and Dartmouth College (United States); J. P. Fernández, Dartmouth College (United States); B. E. Barrowes, K. O’Neill, Dartmouth College (United States) and U.S. Army Engineer Research and Development Ctr. (United States); T. M. Grzegorczyk, Delpsi, LLC (United States); A. Bijamov, Dartmouth College (United States)

7664 05 Transient electromagnetic responses during the transmitter on-time [7664-04]
G. M. Schultz, J. S. Miller, Sky Research, Inc. (United States); L.-P. Song, The Univ. of British Columbia (Canada); L. Pasion, Sky Research, Inc. (United States) and The Univ. of British Columbia (Canada)

7664 06 Target localization techniques for vehicle-based electromagnetic induction array applications [7664-05]
J. S. Miller, G. M. Schultz, F. Shubitidze, Sky Research, Inc. (United States); J. A. Marble, U.S. Army Night Vision and Electronic Sensors Directorate (United States)

7664 07 Applying a volume dipole distribution model to next-generation sensor data for multi-object data inversion and discrimination [7664-06]
F. Shubitidze, Dartmouth College (United States) and Sky Research Inc. (United States); D. Karkashadze, Tbilisi State Univ. (Georgia); J. P. Fernández, Dartmouth College (United States); B. E. Barrowes, K. O’Neill, Dartmouth College (United States) and Tbilisi State Univ. (Georgia); T. M. Grzegorczyk, Delpsi, LLC (United States); I. Shamatava, Dartmouth College (United States) and Sky Research, Inc. (United States)
Comparison of the physically complete model with a simple dipole model for UXO detection and discrimination [7664-07]
F. Shubitidze, Dartmouth College (United States) and Sky Research, Inc. (United States); J. P. Fernández, Dartmouth College (United States); B. E. Barrowes, K. O’Neill, U.S. Army Engineer Research and Development Ctr. (United States); I. Shamataava, Dartmouth College (United States) and Sky Research, Inc. (United States); A. Bijamov, Dartmouth College (United States)

Source separation using sparse-solution linear solvers [7664-08]
J. T. Miller, D. Keiswetter, J. Kingdon, T. Furuya, B. Barrow, T. Bell, SAIC (United States)

Adapting physically complete models to vehicle-based EMI array sensor data: data inversion and discrimination studies [7664-09]
F. Shubitidze, Dartmouth College (United States) and Sky Research, Inc. (United States); J. S. Miller, G. M. Schultz, Sky Research, Inc. (United States); J. A. Marble, U.S. Army Night Vision and Electronic Sensors Directorate (United States)

Dual-EMI system for object classification [7664-10]
J. Marble, I. McMichael, U.S. Army Night Vision and Electronic Sensors Directorate (United States)

SESSION 2 ELECTROMAGNETIC INDUCTION II

Upward continuation of EMI data for sensing of subsurface UXO in cluttered, multi-object cases [7664-11]
K. O’Neill, B. E. Barrowes, U.S. Army Engineer Research and Development Ctr. (United States) and Dartmouth College (United States); F. Shubitidze, J. P. Fernandez, Dartmouth College (United States); T. M. Grzegorczyk, Delphi, LLC (United States); I. Shamataava, Dartmouth College (United States)

Sparse model representations of target signatures for improved landmine detection using frequency-domain electromagnetic induction sensors [7664-12]
S. L. Tantum, P. A. Torrione, L. M. Collins, Duke Univ. (United States)

Measured dipole expansion of discrete relaxations to represent the electromagnetic induction response of buried metal targets [7664-13]
W. R. Scott, Jr., G. D. Larson, Georgia Institute of Technology (United States)

Application of $\ell_p$-regularized least squares for $0 < p < 1$ in estimating discrete spectrum of relaxations for electromagnetic induction responses [7664-14]
M.-H. Wei, W. R. Scott, Jr., J. H. McClellan, G. D. Larson, Georgia Institute of Technology (United States)

SESSION 3 OPTICAL AND DISTURBED EARTH I

Comparison of a model of the disturbed soil spectrum to field observations [7664-17]
P. G. Lucey, Univ. of Hawai’i (United States); E. M. Winter, Technical Research Associates, Inc. (United States); K. Horton, Univ. of Hawai’i (United States)
MOMS: a multi-optical sensor system for detection of surface laid mines [7664-18]
D. Letalick, I. Renhorn, O. Steinvall, N. Wadströmer, Swedish Defence Research Agency (Sweden)

Quantifying the benefit of airborne and ground sensor fusion for target detection [7664-93]
A. Zare, Univ. of Florida (United States); M. Silvious, U.S. Army Night Vision and Electronic Sensors Directorate (United States); R. Close, P. Gader, Univ. of Florida (United States)

SESSION 4 OPTICAL AND DISTURBED EARTH II

MidIR and LWIR polarimetric sensor comparison study [7664-21]
K. Gurton, M. Felton, U.S. Army Research Lab. (United States); R. Mack, D. LeMaster, Air Force Research Lab. (United States); C. Farlow, Digital Fusion Inc. (United States); M. Kudenov, College of Optical Sciences, The Univ. of Arizona (United States); L. Pezzaniti, Polaris Sensor Technologies, Inc. (United States)

Disturbed soil characterization workshop: post-meeting summary [7664-22]
J. M. Cathcart, Georgia Institute of Technology (United States)

SESSION 5 SENSING AND DETECTING IN THE MARINE ENVIRONMENT

Neyman Pearson detection of K-distributed random variables [7664-26]
J. D. Tucker, Naval Surface Warfare Ctr. Panama City Div. (United States) and Colorado State Univ. (United States); M. R. Azimi-Sadjadi, Colorado State Univ. (United States)

Image-based ATR utilizing adaptive clutter filter detection, LLRT classification, and Volterra fusion with application to side-looking sonar [7664-27]
T. Aridgides, M. Fernández, Lockheed Martin (United States)

Multichannel imager for littoral zone characterization [7664-28]
Y. Podobna, J. Schoonmaker, J. Dirbas, J. Sofianos, C. Boucher, G. Gilbert, Advanced Coherent Technologies, LLC (United States)

Inspecting the inside of the objects lying on the seafloor [7664-29]
V. Valkovic, R. Kollar, A.C.T.d.o.o. (Croatia); D. Sudac, K. Nad, J. Obhodas, Institut Ruder Boškovic (Croatia)

Performance metrics for state-of-the-art airborne magnetic and electromagnetic systems for mapping and detection of unexploded ordnance [7664-30]

Assessing EMI noise due to the marine environment to enhance underwater UXO detection and discrimination [7664-31]
A. Bijamov, Dartmouth College (United States); F. Shubitidze, Dartmouth College (United States) and Sky Research, Inc. (United States); J. P. Fernandez, Dartmouth College (United States); I. Shamatava, Sky Research, Inc. (United States) and Dartmouth College (United States); B. E. Barrowes, K. O’Neill, Dartmouth College (United States) and U.S. Army Engineer Research and Development Ctr. (United States)
Adaptive large-scale clutter removal from imagery with application to high-resolution sonar imagery [7664-32]
G. J. Dobeck, Naval Surface Warfare Ctr. Panama City Div. (United States)

A method to simulate synthetic aperture sonar images with parameterized autocorrelation functions [7664-33]
J. T. Cobb, Naval Surface Warfare Ctr. Panama City Div. (United States); K. C. Slatton, J. Principe, Univ. of Florida (United States)

Enhanced ATR using Fisher fusion techniques with application to side-looking sonar [7664-34]
C. M. Ciany, W. C. Zurawski, Raytheon Co. (United States)

SESSION 6 AUTONOMOUS MINE DETECTION SYSTEM I

Autonomous mine detection system (AMDS) neutralization payload module [7664-94]
M. Majerus, DE Technologies Inc. (United States); R. Vanaman, N. Wright, U.S. Army Research, Development and Engineering Command (United States)

NIITEK-NVESD AMDS program and interim field-ready system [7664-37]
M. W. Hibbard, A. Etebari, NIITEK, Inc. (United States)

Autonomous mine detection system (AMDS) incorporating SFCW GPR and CWMD sensors for discrimination [7664-38]
D. O. Carlson, H. A. Duvoisin III, K. L. Johnson, M. Trishaun, L-3 CyTerra (United States)

Trace detection of explosives using an in-line high-volume sampler, preconcentrator, and Fido explosives detector [7664-39]
R. Ingram, J. Sikes, ICx Nomadics, Inc. (United States)

Microcantilever sensor platform for UGV-based detection [7664-40]
T. T. Lawrence, A. E. Hallocke, P. S. Schuler, K. K. Mahmud, Triton Systems, Inc. (United States); D. R. Hicks, U.S. Army Night Vision and Electronic Sensors Directorate (United States)

Remote robotic countermine systems [7664-42]
P. Wells, QinetiQ North America (United States)

Mine detection performance comparison between manual sweeping and tele-operated robotic system [7664-43]
H. Herman, Carnegie Mellon Univ. (United States); T. Higgins, O. Falmier, Lincoln Univ. (United States); J.-S. Viois, J. McMahon, Carnegie Mellon Univ. (United States)

Semi autonomous mine detection system [7664-44]
D. Few, R. Versteeg, Idaho National Lab. (United States); H. Herman, Carnegie Mellon Univ. (United States)

SESSION 7 AUTONOMOUS MINE DETECTION SYSTEM II

CMMAD usability case study in support of countermine and hazard sensing [7664-45]
V. G. Walker, D. I. Gertman, Idaho National Lab. (United States)
Experimental design for assessing the effectiveness of autonomous countermine systems [7664-46]
I. Chappell, M. May, F. L. Moses, Institute for Defense Analyses (United States)

Modular countermine payload for small robots [7664-47]
H. Herman, Carnegie Mellon Univ. (United States); D. Few, R. Versteeg, Idaho National Lab. (United States); J.-S. Valois, J. McMullin, M. Licitra, E. Henciak, Carnegie Mellon Univ. (United States)

Soldier experiments and assessments using SPEAR speech control system for UGVs [7664-48]
J. Brown, C. Blanco, Think-A-Move, Ltd. (United States); J. Czerniak, iRobot Corp. (United States); B. Hoffman, Think-A-Move, Ltd. (United States); O. Hoffman, iRobot Corp. (United States); A. Juneja, L. Ngia, T. Pruthi, D. Liu, Think-A-Move, Ltd. (United States)

Behavior based control of robotic payloads for detection, neutralization, and interrogation of explosive hazards [7664-49]
D. J. Bruemmer, C. W. Nielsen, R. S. Hartley, J. Green, 5D Robotics, Inc. (United States)

SESSION 8 EXPLOSIVES DETECTION

Utilizing upconverting phosphors for the detection of TNT [7664-50]
G. Glaspell, U.S. Army Engineer Research and Development Ctr. (United States); J. S. Tabb, Agave BioSystems (United States); A. Shearer, Authentix (United States); J. Wilkins, C. Smith, R. Massaro, U.S. Army Engineer Research and Development Ctr. (United States)

Xsense: using nanotechnology to combine detection methods for high sensitivity handheld explosives detectors [7664-51]
M. S. Schmidt, N. Kostesha, F. Bosco, J. K. Olsen, Technical Univ. of Denmark (Denmark); C. Johnsen, K. A. Nielsen, J. O. Jeppesen, Univ. of Southern Denmark (Denmark); T. S. Alstrøm, J. Larsen, M. H. Jakobsen, Technical Univ. of Denmark (Denmark); T. Thundat, Oak Ridge National Lab. (United States); A. Boisen, Technical Univ. of Denmark (Denmark)

Feasibility of bulk explosives detection using photoneutron spectroscopy [7664-52]
J. E. McFee, A. A. Faust, K. A. Pastor, Defence Research and Development Canada (Canada)

Advances in standoff detection of trace explosives by infrared photo-thermal imaging [7664-53]
C. A. Kendziora, R. Furstenberg, M. Papantonakis, V. Nguyen, U.S. Naval Research Lab. (United States); J. Stepnowski, Nova Research, Inc. (United States); R. A. McGill, U.S. Naval Research Lab. (United States)

Explosives standoff detection using Raman spectroscopy: from bulk towards trace detection [7664-54]
Fusing chlorophyll fluorescence and plant canopy reflectance to detect TNT contamination in soils [7664-56]
J. C. Naumann, U.S. Army Engineer Research and Development Ctr. (United States); K. Rubis, D. R. Young, Virginia Commonwealth Univ. (United States)

Liquid explosives detection in transparent containers [7664-58]
M. Gaft, Laser Distance Spectrometry (Israel); L. Nagli, Laser Distance Spectrometry (Israel) and Tel Aviv Univ. (Israel)

High-resolution soil moisture mapping using operational optical satellite imagery [7664-91]
J. M. H. Hendrickx, B. J. Harrison, B. Borchers, G. Rodríguez-Marín, New Mexico Institute of Mining and Technology (United States); S. Howington, J. Ballard, U.S. Army Corps of Engineers (United States)

Evaluation test of ALIS in Cambodia for humanitarian demining [7664-59]
M. Sato, Tohoku Univ. (Japan)

Development of dual sensor hand-held detector [7664-60]
M. Sezgin, TÜBİTAK UEKAÉ (Turkey)

Fusion techniques for hybrid ground-penetrating radar: electromagnetic induction landmine detection systems [7664-61]
M. Laffin, M. A. Mohamed, A. Etebari, M. Hibbard, NIITEK, Inc. (United States)

Fusion of ground-penetrating radar and electromagnetic induction sensors for landmine detection and discrimination [7664-62]
M. P. Kolba, P. A. Torrione, L. M. Collins, Duke Univ. (United States)

Feature extraction and object recognition in multi-modal forward looking imagery [7664-63]
G. Greenwood, S. Blakely, Portland State Univ. (United States); D. Schartman, B. Calhoun, J. M. Keller, Univ. of Missouri-Columbia (United States); T. Ton, D. Wong, U.S. Army Night Vision and Electronic Sensors Directorate (United States); M. Soumekh, Univ. at Buffalo (United States)

Improved detection and false alarm rejection using FLGPR and color imagery in a forward-looking system [7664-64]
T. C. Havens, C. J. Spain, K. C. Ho, J. M. Keller, Univ. of Missouri-Columbia (United States); T. T. Ton, D. C. Wong, U.S. Army Night Vision and Electronic Sensors Directorate (United States); M. Soumekh, Univ. at Buffalo (United States)

Dual sensor platforms for UXO/landmine detection using GPR and EMI [7664-66]
J. Marble, U.S. Army Night Vision and Electronic Sensors Directorate (United States); K. Hong, Defence Science and Technology Organisation (Australia)

Carrier tracking and tunable passband filters for TDM-LDV mine detection [7664-67]
R. Burgett, J. M. Sabatier, V. Aranchuk, The Univ. of Mississippi (United States)
Outdoor synthetic aperture acoustic ground target measurements [7664-68]
S. Bishop, U.S. Army Night Vision and Electronic Sensors Directorate (United States); T.-A. Ngaya, J. Vignola, J. Judge, The Catholic Univ. of America (United States); J. Marble, P. Gugino, U.S. Army Night Vision and Electronic Sensors Directorate (United States); M. Soumekh, Soumekh Consultant (United States); E. Rosen, Institute of Defense Analyses (United States)

Comparison of indoor robot localization techniques in the absence of GPS [7664-69]
R. Vincent, B. Limketkai, M. Eriksen, SRI International (United States)

SESSION 11 SENSING POTPOURRI II

Development of an integrated soils laboratory for modeling and detection applications [7664-70]
W. R. Folks, Bevilacqua Research Corp. (United States); R. E. North, L. D. Wakeley, S. S. Jackson, J. R. Kelley, R. M. Castellane, J. R. McKenna, U.S. Army Corps of Engineers (United States)

Common IED exploitation target set ontology [7664-71]
D. J. Russomanno, J. Qualls, The Univ. of Memphis (United States); Z. Wowczuk, P. Franken, W. Robinson, ARES Systems Group, LLC (United States)

Development of x-ray and gamma-ray CZT detectors for homeland security applications [7664-73]
K. Lee, J. W. Martin, A. B. Garson III, M. Beilicke, Q. Guo, Q. Li, Washington Univ. in St. Louis (United States); G. De Geronimo, Brookhaven National Lab. (United States); M. Groza, A. Burger, Fisk Univ. (United States); H. Krawczynski, Washington Univ. in St. Louis (United States)

SESSION 12 SIGNAL PROCESSING I

Automatic forest canopy removal algorithm for underneath obscure target detection by airborne lidar point cloud data [7664-74]
L.-D. Chang, K. C. Slatton, V. Anand, P.-W. Liu, H. Lee, Univ. of Florida (United States); M. V. Campbell, U.S. Army Engineer Research and Development Ctr. (United States)

Forward looking anomaly detection via fusion of infrared and color imagery [7664-75]
K. Stone, J. M. Keller, M. Popescu, T. C. Havens, K. C. Ho, Univ. of Missouri-Columbia (United States)

Exploiting spatial distributions for minefield detection in cluttered environment [7664-76]
A. Trang, S. Agarwal, T. Broach, T. Smith, U.S. Army Night Vision and Electronic Sensors Directorate (United States)

GPU-based processing for airborne detection [7664-77]
D. Singiresu, S. Agarwal, S. Vulli, H. Ramakrishnan, Missouri Univ. of Science and Technology (United States)
<table>
<thead>
<tr>
<th>Session 13</th>
<th>SIGNAL PROCESSING II</th>
</tr>
</thead>
</table>
| **7664 28** | Multiple instance feature learning for landmine detection in ground-penetrating radar data [7664-78]  
J. Bolton, P. Gader, Univ. of Florida (United States); H. Frigui, Univ. of Louisville (United States) |
| **7664 29** | Information-based sensor management for the intelligent tasking of ground-penetrating radar and electromagnetic induction sensors in landmine detection pre-screening [7664-79]  
M. P. Kolba, L. M. Collins, Duke Univ. (United States) |

| **SESSION 13 SIGNAL PROCESSING II** |
| **7664 2A** | Effect of radar undesirable characteristics on the performance of spectral feature landmine detection technique [7664-80]  
K. C. Ho, Univ. of Missouri-Columbia (United States); P. D. Gader, J. N. Wilson, Univ. of Florida (United States); H. Frigui, Univ. of Louisville (United States) |
| **7664 2B** | Anomaly detection in forward looking infrared imaging using one-class classifiers [7664-81]  
M. Popescu, K. Stone, T. Havens, D. Ho, J. Keller, Univ. of Missouri-Columbia (United States) |
| **7664 2C** | Depth estimation of buried objects using wavelet transform and statistical hypothesis testing [7664-82]  
A. B. Yoldemir, M. Sezgin, TÜBITAK UEKAE (Turkey) |
| **7664 2D** | Detection of bulk explosives using the GPR only portion of the HSTAMIDS system [7664-83]  
J. Tabony, D. O. Carlson, H. A. Duvoisin III, J. Torres-Rosario, L-3 CyTerra (United States) |
| **7664 2E** | Locally adaptive detection algorithm for forward-looking ground-penetrating radar [7664-84]  
T. C. Havens, K. C. Ho, J. Farrell, J. M. Keller, M. Popescu, Univ. of Missouri-Columbia (United States); T. T. Ton, D. C. Wong, U.S. Army Night Vision and Electronic Sensors Directorate (United States); M. Soumekh, Univ. at Buffalo (United States) |

| **SESSION 14 | SIGNAL PROCESSING III** |
| **7664 2F** | Preprocessing of GPR data for syntactic landmine detection and classification [7664-85]  
A. O. Nasif, K. J. Hintz, N. Peixoto, George Mason Univ. (United States) |
| **7664 2G** | Upper bound on false alarm rate for landmine detection and classification using syntactic pattern recognition [7664-86]  
A. O. Nasif, B. L. Mark, K. J. Hintz, N. Peixoto, George Mason Univ. (United States) |
| **7664 2H** | Nonparametric Bayesian time-series modeling and clustering of time-domain ground penetrating radar landmine responses [7664-87]  
K. D. Morton, Jr., P. A. Torrione, L. Collins, Duke Univ. (United States) |
| **7664 2I** | Context-dependent feature selection using unsupervised contexts applied to GPR-based landmine detection [7664-88]  
C. R. Ratto, P. A. Torrione, L. M. Collins, Duke Univ. (United States) |
7664 2J  Landmine detection using ensemble discrete hidden Markov models with context dependent training methods [7664-89]
A. Hamdi, O. Missaoui, H. Frigui, Univ. of Louisville (United States); P. Gader, Univ. of Florida (United States)

7664 2K  Comparison of different classification algorithms for landmine detection using GPR [7664-90]
A. Kareem, A. Fadeev, H. Frigui, P. Gader, Univ. of Louisville (United States)

Author Index
Conference Committee

Symposium Chair

Michael T. Eismann, Air Force Research Laboratory (United States)

Symposium Cochair

William Jeffrey, HRL Laboratories, LLC (United States)

Conference Chairs

Russell S. Harmon, U.S. Army Research Office (United States)
John H. Holloway, Jr., Naval Surface Warfare Center Panama City Division (United States)
J. Thomas Broach, U.S. Army Night Vision and Electronic Sensors Directorate (United States)

Program Committee

Leslie M. Collins, Duke University (United States)
Gerald J. Dobeck, Naval Surface Warfare Center (United States)
Paul D. Gader, University of Florida (United States)
John E. McFee, Defence Research and Development Canada (Canada)
James M. Sabatier, The University of Mississippi (United States)
Motoyuki Sato IV, Tohoku University (Japan)
Miranda A. Schatten, U.S. Army Night Vision and Electronic Sensors Directorate (United States)
Waymond R. Scott, Jr., Georgia Institute of Technology (United States)
Miranda Silvious, U.S. Army Night Vision and Electronic Sensors Directorate (United States)
Richard C. Weaver, U.S. Army Night Vision and Electronic Sensors Directorate (United States)

Session Chairs

1 Electromagnetic Induction I
Fridon Shubitidze, Dartmouth College (United States)
Benjamin E. Barrowes, U.S. Army Engineer Research and Development Center (United States)

2 Electromagnetic Induction II
Waymond R. Scott, Jr., Georgia Institute of Technology (United States)
12 Signal Processing I
James M. Keller, University of Missouri-Columbia (United States)
Sanjeev Agarwal, Missouri University of Science and Technology (United States)

13 Signal Processing II
James M. Keller, University of Missouri-Columbia (United States)
Sanjeev Agarwal, Missouri University of Science and Technology (United States)

14 Signal Processing III
Paul D. Gader, University of Florida (United States)
Peter A. Torrione, Duke University (United States)