

PROCEEDINGS OF SPIE

Next-Generation Analyst V

Timothy P. Hanratty
James Llinas
Editors

10–11 April 2017
Anaheim, California, United States

Sponsored and Published by
SPIE

Volume 10207

Proceedings of SPIE 0277-786X, V. 10207

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Next-Generation Analyst V, edited by Timothy P. Hanratty, James Llinas, Proc. of SPIE Vol.
10207, 1020701 · © 2017 SPIE · CCC code: 0277-786X/17/\$18 · doi: 10.1117/12.2270682

Proc. of SPIE Vol. 10207 1020701-1

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIEDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:

Author(s), "Title of Paper," in *Next-Generation Analyst V*, edited by Timothy P. Hanratty, James Llinas, Proceedings of SPIE Vol. 10207 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510609150

ISBN: 9781510609167 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time) • Fax +1 360 647 1445

SPIE.org

Copyright © 2017, Society of Photo-Optical Instrumentation Engineers.

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/17/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

**SPIE. DIGITAL
LIBRARY**

SPIEDigitalLibrary.org

Paper Numbering: *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

v	<i>Authors</i>
vii	<i>Conference Committee</i>
ix	<i>Introduction</i>

SESSION 1 OPEN SOURCE EXPLOITATION

10207 02	Information flow on social networks: from empirical data to situation understanding [10207-1]
10207 03	From evolution to revolution: understanding mutability in large and disruptive human groups (Invited Paper) [10207-2]
10207 04	Using soft-hard fusion for misinformation detection and pattern of life analysis in OSINT [10207-3]
10207 05	Human-Assisted Machine Information Exploitation: a crowdsourced investigation of information-based problem solving [10207-4]

SESSION 2 ADVANCED CONCEPTS

10207 06	Physics-based and human-derived information fusion for analysts [10207-5]
10207 07	A technology path to tactical agent-based modeling [10207-6]
10207 08	Implementing Internet of Things in a military command and control environment [10207-7]

SESSION 3 HUMAN AND INFORMATION INTERACTION

10207 09	Human/autonomy collaboration for the automated generation of intelligence products [10207-8]
10207 0A	The mixed reality of things: emerging challenges for human-information interaction (Invited Paper) [10207-9]
10207 0B	Human-machine analytics for closed-loop sense-making in time-dominant cyber defense problems (Invited Paper) [10207-10]
10207 0C	Visualizing UAS-collected imagery using augmented reality [10207-11]
10207 0D	An approach to explainable deep learning using fuzzy inference (Invited Paper) [10207-12]

SESSION 4	COMPLEMENTING TECHNOLOGIES
10207 0E	Adaptation of interoperability standards for cross domain usage [10207-13]
10207 0F	Quantity and unit extraction for scientific and technical intelligence analysis [10207-14]
10207 0G	Big data, little security: addressing security issues in your platform (Invited Paper) [10207-15]
SESSION 5	ADVANCED APPLICATIONS
10207 0I	Human-machine interaction to disambiguate entities in unstructured text and structured datasets [10207-17]
10207 0J	Automated evaluation of service oriented architecture systems: a case study (Invited Paper) [10207-18]
10207 0K	Advanced text and video analytics for proactive decision making [10207-25]
10207 0L	RAPID: real-time analytics platform for interactive data-mining in a decision support scenario [10207-20]
SESSION 6	VALUE OF INFORMATION
10207 0M	Requirements for Value of Information (Vol) calculation over mission specifications [10207-21]
10207 0N	Determining the perceived value of information when combining supporting and conflicting data [10207-22]
10207 0O	A research and experimentation framework for exploiting Vol-based methods within analyst workflows in tactical operation centers (Invited Paper) [10207-24]

Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Abdelzaher, Tarek, 02	Nagy, James, 06
Al Amin, Md. Tanvir, 02	Nock, Kristen, 0D
Beidleman, Brittany, 0C	Okoth, Joshua, 06
Blasch, Erik, 06	Petry, Fred, 0D
Bogart, Chris, 0K	Porter, Reed, 0K
Bonanno, David, 0D	Preece, Alun, 03
Borel-Donohue, Christoph C., 0C	Raglin, Adrienne, 08
Bowman, Elizabeth K., 02, 0K	Richardson, John, 0N
Budulas, Peter, 08	Rosé, Carolyn Penstein, 0K
Caylor, Justine, 05, 0N	Rosenberg, Evan Suma, 0A
Choudhari, Samirhdi Shree, 0K	Roy, Heather, 02
Conover, Damon M., 0C	Russell, Stephen M., 08, 0A, 0J
Davenport, Jack, 0I	Sadler, Laurel, 0O
David, Peter, 0F	Schlachter, Jason, 09
DiBona, Phil, 09	Scott, Steve, 06
Elmore, Paul, 0D	Shabarekh, Charlotte, 04
Essendorfer, B., 0E	Shargo, Peter, 0K
Falzon, Lucia, 0L	Smith, Leslie, 0D
Felmlee, Diane, 03	Spicer, Ryan P., 0A
Fouad, Hesham, 0J	Thomas, Steve, 0K
Gao, Yifeng, 0K	Tunison, Paul, 0K
Gilliam, Antonio, Jr., 0J	Turek, Matt, 0K
Gintautas, Vadas, 0K	Vanni, Michelle, 05, 0L
Goldman, Robert, 09	Verma, Dinesh C., 03
Guleyupoglu, Suleyman, 0J	Ward, Kevin, 0I
Hanratty, Timothy P., 07, 0N	Whitaker, Roger M., 03
Harwood, Aaron, 0L	Williams, Grace-Rose, 03
Hawes, Timothy, 0F	Zaschke, Christian, 0E
Heilman, Eric, 0N	
Henry, Matthew H., 0B	
Hinman, Michael, 06	
Hoye, Jeff, 05	
James, Alex, 07	
Karunasekara, Shanika, 0L	
Kase, Sue E., 05, 0L	
Kerth, Christian, 0E	
Kuter, Ugur, 09	
Levchuk, Georgiy, 04	
Li, Qingzhe, 0K	
Li, Xiaosheng, 0K	
Lin, Jessica, 0K	
Macklin, Thomas, 0G	
Maki, Keith, 0K	
Mathews, Joseph, 0G	
McAlinden, Ryan, 0C	
Metu, Somiya, 08	
Michaelis, James R., 0M	
Mittrick, Mark, 0N	
Mittu, Ranjeev, 0K	

Conference Committee

Symposium Chair

Donald A. Reago Jr., U.S. Army Night Vision & Electronic Sensors
Directorate (United States)

Symposium Co-chair

Arthur A. Morrish Raytheon Space and Airborne Systems
(United States)

Conference Chairs

Timothy P. Hanratty, U.S. Army Research Laboratory (United States)
James Linas, University at Buffalo (United States)

Conference Program Committee

Kevin Barry, Lockheed Martin Corporation (United States)
Erik Blasch, Air Force Research Laboratory (United States)
James Fink, U.S. Army Intelligence Center of Excellence
(United States)
Bruce Forrester, Defence Research and Development Canada,
Valcartier (Canada)
Sue E. Kase, U.S. Army Research Laboratory (United States)
Bob Madahar, Defence Science and Technology Laboratory
(United Kingdom)
Sonya A. H. McMullen, Embry-Riddle Aeronautical University
(United States)
Ranjeev Mittu, U.S. Naval Research Laboratory (United States)
Alan Steinberg, Georgia Tech Research Institute (United States)
Edward L. Waltz, BAE Systems (United States)

Session Chairs

- 1 Open Source Exploitation
Timothy P. Hanratty, U.S. Army Research Laboratory (United States)
- 2 Advanced Concepts
Timothy P. Hanratty, U.S. Army Research Laboratory (United States)
- 3 Human and Information Interaction
Sonya A. H. McMullen, Embry-Riddle Aeronautical University
(United States)

- 4 Complementing Technologies
John Richardson, U.S. Army Research Laboratory (United States)
- 5 Advanced Applications
Sue E. Kase, U.S. Army Research Laboratory (United States)
- 6 Value of Information
Timothy P. Hanratty, U.S. Army Research Laboratory (United States)

Introduction

It is unfortunate that Moore's Law does not apply to the processing capacities of the human mind. As a result of more-or-less fixed short-and-long term memory and processing capacities, and in the face of the evolving vast levels of data/information flows for virtually all analysis and decision-making support environments, the human has become the most critical chokepoint in any system architecture. Various strategies have been tried to aid the human (or humans) in modern analyst support prototypes, employing methods for multi-screen or large screen displays, extensive hyperlinking among disparate individual support tools, agent techniques, and yet other methods toward mitigating the throttling effects of human limitations.

This fifth conference on "Next-Generation Analyst" continues the tradition of presenting the latest technologically based and/or architecturally based approaches that researchers across the world are exploring to realize improvements in human-machine symbiosis required for effective sense making. Involving scientists from Australia, Germany, the United Kingdom, Canada, and the United States in six unique sessions, the 2017 conference offers a wide range of new ideas to support improved efficiencies in human-machine dynamics and situational understanding in a variety of application domains.

On behalf of SPIE and the program committee, we welcome you to enjoy and learn from this 2017 conference on Next Generation Analyst.

Timothy P. Hanratty
James Llinas

