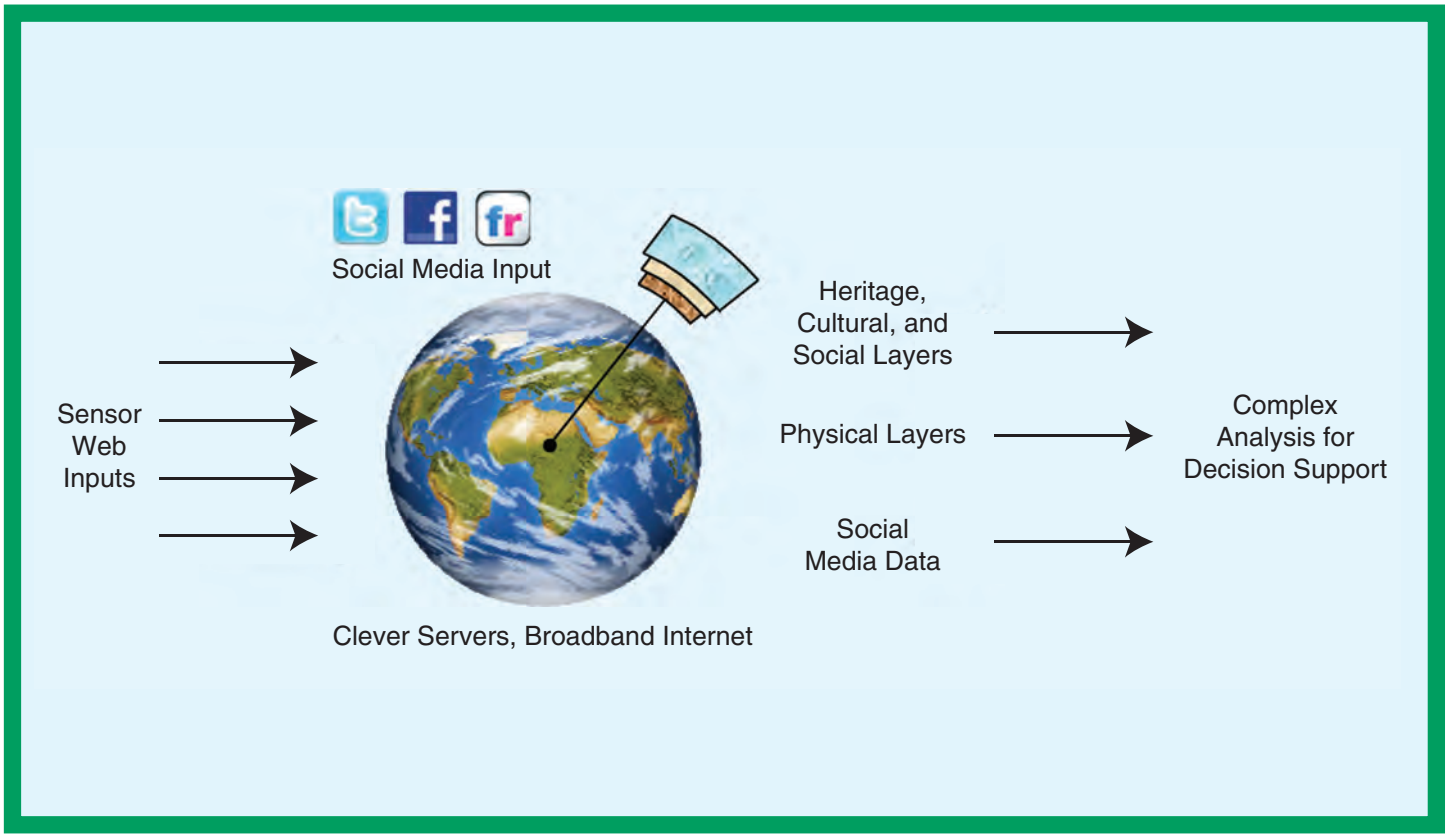
IEEE GEOSCIENCE and REMOTE SENSING Newsletter

*http://www.grss-ieee.org/menu.taf?menu=Publications&detail=newsletter*

**Editor:** Lorenzo Bruzzone




Cumulative Issue #164 September 2012 ISSN 0274-6638

## Table of Contents



## Notice to Potential Advertisers

The IEEE GRSS Newsletter publishes paid advertisements for job openings, short courses, products, and services which are of interest to the GRSS membership.

The Editor reserves the right to reject advertisements. Please address all enquires to:

Ms. Susan Schneiderman
Business Development Manager
IEEE Tech Societies Media
445 Hoes Lane
Piscataway, NJ 08854-1331
Tel: +1 732-562-3946
Fax: +1 732-981-1855
www.ieee.org/ieeemedia

## Newsletter Input and Deadlines

The following is the schedule for the GRSS Newsletter. If you would like to contribute an article, please submit your input according to this schedule. Input is preferred in Microsoft Word, WordPerfect or ASCII for IBM format (please send disk and hard copy) as IEEE now uses electronic publishing. Other word processing formats, including those for Macintosh, are also acceptable, however, please be sure to identify the format on the disk and include the hard copy.

### GRSS Newsletter Schedule

| Month | June | Sept | Dec | March |
|---|---|---|---|---|
| Input | April 15 | July 15 | Oct 15 | Jan 15 |

## IEEE GRSS AdCom, Officers and Committee Chairs – 2012 GRS-29 (Division IX)

*President*
Jon Atli Benediktsson
*Executive Vice President*
Melba M. Crawford
*Vice President for Information Resources*
Steven C. Reising
*Vice President for Meetings and Symposia*
Adriano Camps
*Vice President for Technical Activities*
John Kerekes
*Vice President for Professional Activities*
Kamal Sarabandi
*Vice President for Publications*
Wooil Moon
*Secretary*
Thomas J. Jackson
*Director of Finance*
James A. Gatlin
*Director of Education*
Antonio Plaza
*Major Awards*
Werner Wiesbeck
*Publications Awards*
Martti Hallikainen
*Globalization Initiative*
Anthony K. Milne
*Chapter Activities*
Kun-Shan Chen
*Conference Advisory Committee*
Michael Inggs
*Constitution and Bylaws*
Melba M. Crawford
*Fellow Evaluation Committee*
Leung Tsang
*Fellow and Senior Member Search*
Mahta Moghaddam
*History and Records*
Werner Wiesbeck
*Membership*
Shannon Brown
*Nominations Chair*
David G. Goodenough
*PACE*
Paul Racette
*Public Relations/Publicity*
David Weissman
Shannon Brown
*Specialty Symposia*
Motoyuki Sato
David B. Kunkee
*Standards and Metrics*
Siri Jodha Singh Khalsa
*Strategic Planning*
Andrew Blanchard
Melba M. Crawford
*Student Paper Contest*
Martti Hallikainen
*Web Editor*
Bill Blackwell
*Transactions Editor*
Christopher Ruf
*Letters Editor*
Paolo Gamba
*J-STARS Editor*
Jocelyn Chanussot
*Newsletter Editor*
Lorenzo Bruzzone
*New Publications*
William J. Emery
*IEEE Women in Engineering Representative*
Gail Jackson
*IEEE Life Sciences New Initiative*
James A. Smith
*IGARSS 2011*
Motoyuki Sato
Ya-Qiu Jin
Masanobu Shimada
*IGARSS 2012*
Alberto Moreira
Yves-Louis Desnos
*IGARSS 2013*
Peter Woodgate
Simon Jones
*IGARSS 2014*
Monique Bernier
Josée Lévesque
*IGARSS 2015*
Sebastiano B. Serpico
Vito Pascazion
*2012 AdCom Members*
Adriano Camps
John Kerekes
David Kunkee
David M. LeVine
Wooil M. Moon
Shannon Brown
*2013 AdCom Members*
Jon Atli Benediktsson
William J. Emery
Michael Inggs
Mahta Moghaddam
Kamal Sarabandi
Motoyuki Sato
*2014 AdCom Members*
Lorenzo Bruzzone
Kun-Shan Chen
Melba M. Crawford
Steven C. Reising
Gail Jackson
Antonio J. Plaza
*Past Presidents*
Anthony K. Milne
Alberto Moreira
*Honorary Life Members*
Andrew Blanchard
Keith R. Carver
Martti Hallikainen
Kiyo Tomiyasu
Fawwaz T. Ulaby
Werner Wiesbeck


### Postal Information and Copyright Notice

IEEE Geoscience and Remote Sensing Newsletter (ISSN 0274-6638) is published quarterly by the Geoscience and Remote Sensing Society of the Institute of Electrical and Electronics Engineers, Inc., Headquarters: 3 Park Avenue, 17th floor, New York, NY 10016-5997. $1.00 per member per year (included in Society fee) for each member of the Geoscience and Remote Sensing Soc.. Printed in U.S.A. Periodicals postage paid at New York, NY and at additional mailing offices. Postmaster: Send address changes to IEEE Geoscience and Remote Sensing Society Newsletter, IEEE, 445 Hoes Lane, Piscataway, NJ 08854.

## Editor's Comments

Dr. Lorenzo Bruzzone, Editor
University of Trento
Department of Information Engineering and Computer Science
Via Sommarive 14
I-38123 Povo, Trento
ITALY
Phone: +39 0461 282056
Email: lorenzo.bruzzone@ing.unitn.it

This issue of the IEEE Geoscience and Remote Sensing Newsletter is published after an outstanding IGARSS 2012 in Munich and a summer rich with initiatives of the IEEE Geoscience and Remote Sensing Society (GRSS). Most of these activities are described in this issue, which also includes articles on various technical areas of remote sensing.

One important news item for our community is the recent final approval of the new IEEE Geoscience and Remote Sensing Magazine by the IEEE Technical Activities Board. This is a very important achievement for our society because the magazine will provide a new venue to publish interesting technical articles that by their very nature do not find a home in journals requiring scientific innovation. The idea is that the magazine will publish tutorial papers and technical papers on geoscience and remote sensing topics, as well as papers that describe relevant applications of and projects based on topics addressed by our society. All technical papers will undergo blind review by multiple reviewers. The review process will be managed on the IEEE Manuscript Central site as is already done for the three GRSS journals. The magazine will also publish regular columns on education in remote sensing, remote sensing satellite missions, space agency news, book reviews, etc. Starting with the first issue of the magazine to be published in March 2013, most of the technical content of the GRSS Newsletter will be moved to the new journal. An electronic version of the Newsletter will be still published with the objective of disseminating relevant news to GRSS members. I would like to point out that the new magazine will be published with an appealing layout, and its articles will be included in the IEEE Xplore online archive. I would like to take this opportunity to encourage everyone to prepare and submit articles and technical content for review to be published in the Magazine.

This issue opens with an article honoring the outstanding career of Dr. Hans Joachim Liebe, who passed away on

*(continued on page 4)*

## President's Message

Dr. Jon Atli Benediktsson
University of Iceland
Main Building, Sæmundargata 2
101 Reykjavik, Iceland
Phone: +354 525 4047
Email: benedikt@hi.is

In late July we held a hugely successful IGARSS 2012 in Munich, Germany. The 2012 symposium was the largest IGARSS ever, with over 2700 participants from 68 countries and more than 2500 papers presented. IGARSS 2012 was an excellent platform for knowledge exchange and the exploration and discussion of topics related to the theme of the conference, "Remote Sensing for a Dynamic Earth." At the conference there were excellent plenary and technical sessions and very dynamic interactive poster sessions. For those who are interested, the web stream of technical sessions is now available at http://www.igarss2012.org. Other highlights of IGARSS 2012 included an outstanding Awards Banquet held in a beautiful historic location in downtown Munich, the first Women in Geoscience and Remote Sensing Luncheon, a Technical Committees and Chapters luncheon, a Young Professionals' luncheon, and two very special social events, a Bavarian evening and a reception at the BMW World. The first Women in Geoscience and Remote Sensing Luncheon was very successful, and similar luncheons will be held at future IGARSS symposia. I would like to congratulate the initiator of this event, GRSS AdCom member Gail Skofronik-Jackson, on the excellent success of the first luncheon, and I look forward to attending future luncheons.

At IGARSS, the GRSS celebrated its 50th anniversary. The location for the celebration was excellent since IGARSS was previously held in Munich thirty years ago. Several participants from IGARSS 1982 attended IGARSS 2012 and commented on the previous conference and the development of IGARSS and the GRSS since then during the Awards Banquet. For its 50th anniversary, the GRSS published a commemorative book entitled *A Celebration of the First Fifty*

*(continued on page 7)*

**Cover Information:** The digital earth framework.

(Editor's Comments continued from page 3)

August 2, 2012, after a long and courageous battle with Parkinson's disease. The passing of Dr. Hans Joachim Liebe is a great loss for the GRSS society and our profession.

The issue includes a very interesting *Feature* article, a tutorial paper on data fusion and digital Earth prepared by Professor John Richards, a well-known and respected scientist in the field. The paper provides a review of the main techniques in the literature for addressing the problem of multisource remote sensing data analysis. Moreover, it addresses more general issues, such as the decisions on analysis techniques that the analyst must make and the challenges that the thematic mapping community is expected to face with the proliferation of data types in the open source environment of digital Earth.

The *Book Review* column presents an overview of *Satellite Remote Sensing: A New Tool for Archaeology*, edited by Rosa Lasaponara and Nicola Masini and published by Springer in 2012. The review of this book was written Tom G. Farr, who is with the Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA.

The *Reports* section contains two contributions. The first is an article describing the GRSS Major Awards and Fellow Recognitions at the IGARSS 2012 Plenary Session held on July 23, 2012, in Munich, Germany. The article describes the excellent organization of IGARSS 2012 and provides information on all the Major Awards and Fellow recipients. Congratulations to all of them! The second report addresses the *4th Workshop on Hyperspectral Image and Signal Processing – Evolution in Remote Sensing (WHISPERS 2012)* held on June 4–7, 2012, in Shanghai, China.

The *Technical Committee Corner* column contains two articles. The first is related to the technical interest survey of GRSS members conducted in June 2012. The article reports and discusses the results of the survey, which includes the main technical areas of interest of our society. The second describes the results of the 2012 IEEE GRSS Data Fusion Contest organized by the Data Fusion Technical Committee. After a brief overview of previous contests, the details of the 2012 activity are reported, including the outcome of the contest.

The *Chapters Corner* section contains a contribution that briefly describes the current status and the activities of the GRSS chapters.

*(continued on page 42)*

Errata Corrige for "ENVISAT [2002–2012]" by H. Laur, appeared in IEEE Geoscience and Remote Sensing Newsletter Cumulative Issue #163 June 2012. The city of Bam is in Iran and not in Turkey, as wrongly stated.

## Newsletter Editorial Board Members:

# 2012 ADCOM MEMBERS' NAMES AND ADDRESSES

**Dr. Jon Atli Benediktsson**
President, IEEE-GRSS
University of Iceland
Main Building, Saemundargata 2
Reykjavik ICELAND
E-Mail: benedikt@hi.is
(AdCom 2011–2013)

**Dr. Melba M. Crawford**
Executive VP, IEEE-GRSS
Neil Armstrong Hall of Engineering
Purdue University
701 W. Stadium Dr.
W. Lafayette, IN 47907-2045 USA
E-Mail: mcrawford@purdue.edu
(AdCom 2012–2014)

**Dr. Adriano Camps**
VP of Meetings and Symposia, IEEE-GRSS
Dept. of Signal Theory and Communication
Universitat Politecnica de Catalunya-Barcelona
Tech, Campus Nord, D4-016
08034 Barcelona SPAIN
E-Mail: camps@tsc.upc.edu
(AdCom 2010–2012)

**Dr. John Kerekes**
VP of Technical Activities, IEEE-GRSS
Co-Chair, Conference Advisory Committee
Rochester Institute of Technology
54 Lomb Memorial Dr.
Rochester, NY 14623 USA
E-Mail: kerekes@cis.rit.edu
(AdCom 2010–2012)

**Dr. Wooil M. Moon**
VP of Publications, IEEE-GRSS
University of Manitoba
Geophysics Dept.
Faculty of Environment Earth and Resources
Winnipeg, MB R3T 2N2 CANADA
E-Mail: wmoon@cc.umanitoba.ca
(AdCom 2010–2012)

**Dr. Steven C. Reising**
VP of Information Resources, IEEE-GRSS
Electrical and Computer Engineering Department
1373 Campus Delivery
Colorado State University
Fort Collins, CO 80523-1373 USA
E-Mail: reising@ieee.org; steven.reising@colostate.edu
(AdCom 2012–2014)

**Dr. Kamal Sarabandi**
VP of Professional Activities, IEEE-GRSS
Dept. of Electrical Eng. & Computer Science
Ann Arbor, MI 48109-2122 USA
E-Mail: saraband@eecs.umich.edu
(AdCom 2011–2013)

**Dr. James A. Gatlin**
Chief Financial Officer, IEEE-GRSS
Goddard Space Flight Center (Retired)
Greenbelt, MD 20771 USA
E-Mail: j.gatlin@ieee.org

**Dr. Thomas J. Jackson**
Secretary, IEEE-GRSS
USDA-ARS Hydrology and Remote Sensing Lab
104 Bldg 007 BARC-West
Beltsville, MD 20705 USA
E-Mail: tom.jackson@ars.usda.gov

**Dr. Shannon Brown**
Membership Chair
Jet Propulsion Laboratory M/S 168-314
4800 Oak Grove Drive
Pasadena, CA 91109 USA
E-Mail: Shannon.Brown@jpl.nasa.gov
(AdCom 2011–2012)

**Dr. Lorenzo Bruzzone**
Newsletter Editor
University of Trento
Dept. Information Eng. and Computer Science
Via Sommarive 14, I-38123 TRENTO ITALY
E-Mail: lorenzo.bruzzone@ing.unitn.it
(AdCom 2012–2014)

**Dr. Kun Shan Chen**
Chapters Chair
National Central University
Chungli, TAIWAN
E-Mail: dkschen@csrsr.ncu.edu.tw
(AdCom 2012–2014)

**Dr. Jocelyn Chanussot**
Editor in Chief J-STARS
GIPSA Lab, INP Grenoble
BP-46, 38402 St. Martin d'Heres FRANCE
E-Mail: Jocelyn.chanussot@gipsa-lab.inpg.fr

**Dr. William J. Emery**
Symposia Publications Committee Chair/J-STARS
Steering Committee Chair/New Pubs.
CCAR Box 431
University of Colorado
Boulder, CO 80309-0431 USA
E-Mail: Emery@colorado.edu
(AdCom 2011–2013)

**Dr. Paolo Gamba**
Editor, Geoscience and Remote Sensing Letters
University of Pavia
Dept. of Electronics
Via Ferrata 1
27100 Pavia ITALY
E-Mail: paolo.gamba@unipv.it

**Dr. Michael Inggs**
Conference Advisory Committee Co-Chair
Dept. Electrical Engineering
Univ. Cape Town
Rondebosch 7701 SOUTH AFRICA
E-Mail: michael.inggs@uct.ac.za
(AdCom 2011–2013)

**Dr. Gail Jackson**
Committee on Transportation and Aerospace Policy
Rep.,Women in Engineering Rep.
NASA Goddard Space Flight Center
Code
Greenbelt, Maryland 20771 USA
(AdCom 2012–2014)

**Dr. David B. Kunkee**
Specialty and Small Symposia Co-Chair
The Aerospace Corp.
DWSS Space Systems
P.O. 92957 MS M5-717
Los Angeles, CA 90009-2957 USA
E-Mail: David.Kunkee@aero.org
(AdCom 2010–2012)

**Dr. David M. Le Vine**
Distinguished Speakers Committee Chair
NASA Goddard Space Flight Center
Code 615
Greenbelt, Maryland 20771 USA
E-mail: David.M.LeVine@nasa.gov
(AdCom 2010–2012)

**Dr. Anthony K. Milne**
Past President, IEEE-GRSS. Globalization Chair
University of New South Wales
School of Biological, Earth and Env. Sciences
Sydney, NSW 2052 AUSTRALIA
E-Mail: t.milne@unsw.edu.au

**Dr. Mahta Moghaddam**
GRSS Fellows & Senior Member Search Committee
University of Michigan
Electrical Engineering and Computer Science
1301 Beal Avenue, room 3238
Ann Arbor, MI 48109 USA
E-Mail: mmoghadd@umich.edu
(AdCom 2011–2013)

**Dr. Alberto Moreira**
Immediate Past President, IEEE-GRSS / IGARSS'12 General Co-Chair
German Aerospace Center (DLR)
Microwaves and Radar Institute
82230 Wessling/Oberpfaffenhofen GERMANY
E-Mail: alberto.moreira@dlr.de

**Dr. Antonio J. Plaza**
Director of Education, IEEE GRSS
Department of Technology of Computers and Communications
Escuela Politecnica de Caceres, University of Extremadura
Avda. de la Universidad S/N
E-10071 Cáceres SPAIN
E-Mail: aplaza@unex.es
(AdCom 2012–2014)

**Dr. Christopher Ruf**
Editor TGARS
University of Michigan
1533 Space Research Building
2455 Hayward St.
Ann Arbor, MI 48109-2143 USA
E-Mail: cruf@umich.edu

**Dr. Motoyuki Sato**
Specialty Symposia Co-Chair, IGARSS'11 General Chair
Center for Northeast Asian Studies
Tohoku University
980-8576 Sendai JAPAN
E-Mail: sato@cneas.tohoku.ac.jp
(AdCom 2011–2013)

**Dr. Andrew J. Blanchard**
Honorary Life Member, IEEE-GRSS and Senior Council (Chair)
University of Texas Dallas
MS AD23
Richardson, TX 75083 USA
E-Mail: ablanch@utdallas.edu

**Dr. Keith R. Carver**
Honorary Life Member, IEEE-GRSS
University of Massachusetts
Dept. of Electrical & Computer Engineering
Amherst, MA 01003 USA
E-Mail: kcarver@ecs.umass.edu

**Dr. Martti T. Hallikainen**
Honorary Life Member, IEEE-GRSS & Publications Awards Committee Chair, Senior Council
Aalto University
School of Electrical Engineering, Dept. of Radio Science and Engineering
P. O. Box 13000
FIN 00076 Aalto FINLAND
E-Mail: Martti.Hallikainen@aalto.fi

**Dr. Kiyo Tomiyasu**
Honorary Life Member, IEEE-GRSS
Retired
890 East Harrison Ave., #30
Pomona, CA 91767 USA
E-Mail: k.tomiyasu@ieee.org; ektom3@verizon.net

**Dr. Fawwaz T. Ulaby**
Honorary Life Member, IEEE-GRSS
The University of Michigan
4080 Fleming Building
Ann Arbor, MI 48109-1340 USA
E-Mail: ulaby@eecs.umich.edu

**Dr. Werner Wiesbeck**
Honorary Life Member, IEEE-GRSS, GRSS Major Awards Committee Chair, History Comm. Chair, Senior Council
Karlsruhe Institute of Technology (KIT)
Institute for High Frequency and Electronics
Kaiserstrasse 12
76131 Karlsruhe GERMANY
E-Mail: werner.wiesbeck@kit.edu

**Monique Bernier**
IGARSS'14 General Chair
Institut National de la Recherche Scientifique
Centre Eau, Terre, Environnement
490 rue de la Couronne
Québec, Québec G1K 9A9 CANADA
E-Mail: Monique.Bernier@ete.inrs.ca

**Dr. Bill Blackwell**
GRSS Web Editor and FARS Technical Committee Chair
MIT Lincoln Laboratory
Lexington, MA USA
E-Mail: wjb@ll.mit.edu

**Dr. Wolfgang-Martin Boerner**
GRSS Regional Task Force on Asian/Pacific Affairs
UIC-ECE/CSN, m/c154
900W Taylor St., SEL.W 4210
Chicago, IL 60607-7018 USA
E-Mail: wmb1uic@yahoo.com

**Yves-Louis Desnos**
IGARSS'12 General Co-Chair
ESA/ESRIN ITALY
E-Mail: Yves-Louis.Desnos@esa.int

**Dr. Liping Di**
Center for Spatial Information Science and Systems (CSISS)
George Mason University
4400 University Drive, MS 6E1
Fairfax, VA 22030 USA
E-Mail: ldi@gmu.edu

**Dr. Jenny Q. Du**
Data Fusion Technical Committee Co-Chair
Electrical and Computer Engineering Dept., P.O. 9571
Mississippi State University
Mississippi State, MS 39762 USA
E-Mail: du@ece.msstate.edu

**Dr. William B. Gail**
IEEE GRSS Rep. TAPC & Director Corporate Relations
Microsoft Startup Business Accelerator
1690 38th St.
Boulder, CO 80301 USA
E-Mail: bgail@microsoft.com;
bill.gail@vexcel.com

**Dr. Sonia C. Gallegos**
GRSS Regional Task Force on Latin American Affairs
Naval Research Lab
Code 7333
Stennis Space Center, MS 39529 USA
E-Mail: gallegos@nrlssc.navy.mil

**Dr. Albin J. Gasiewski**
ICEO Representative
Dept. of Electrical and Computer Engineering
University of Colorado at Boulder
0425 UCB/ ECOT 246
Boulder, CO 80309-0425 USA
E-Mail: al.gasiewski@colorado.edu

**Dr. David G. Goodenough**
GRSS Nominations Committee Chair, Senior Council
Pacific Forestry Centre
Natural Resources Canada
506 West Burnside Road
Victoria, BC V8Z 1M5 CANADA
E-Mail: dggoodenough@shaw.ca

**Dr. Alex Held**
International Spaceborne Imaging Spectroscopy Technical Committee Chair
CSIRO Land and Water C.S. Christian Lab
Clunies Ross Street
G.P.O. Box 1666
Canberra, ACT 2601 AUSTRALIA
E-Mail: alex.held@csiro.au

**Dr. Eastwood Im**
Instrumentation and Future Technologies Technical Committee Co-Chair
Jet Propulsion Laboratory, M.S. 180-401
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California 91109 USA
E-Mail: eastwood.im@jpl.nasa.gov

**Dr. Ya-Qiu Jin**
IGARSS'11 TPC Co-Chair
Fudan University
Key Laboratory for Wave Scattering and Remote Sensing Information
Shanghai 200433 CHINA
E-Mail: yqjin@fudan.edu.cn; yqjin@fudan.ac.cn

**Dr. Simon Jones**
IGARSS'13 General Co-Chair
RMIT University, Math and Geospatial Sciences
Bldg. 12 Level 11
GPO Box 2476
Melbourne, Victoria 3001 AUSTRALIA
E-Mail: simon.jones@rmit.edu.au

**Dr. Siri Jodha Singh Khalsa**
IEEE Standards Committee and ISO TC-211 Representative
UCB 449
Boulder CO 80309-0449 USA
E-mail: sjsk@nsidc.org

**Dr. Ellsworth LeDrew**
Deputy Editor J-STARS
University of Waterloo
Dept. of Geography and Env. Management
200 University Ave. West
Waterloo, Ontario N2L 3G1 CANADA
E-Mail: ells@uwaterloo.ca

**Dr. Josée Lévesque.**
IGARSS'14 General Co-Chair
Spectral and Geospatial Exploitation
Defence Research and Development Canada - DRDC Valcartier
2459 boul. Pie-XI Nord
Québec, QC, Canada, G3J 1X5 CANADA
Email: josee.levesque@drdc-rddc.gc.ca

**Mr. Charles A. Luther**
GRSS Regional Task Force on Africa, Senior Council
1113 Villamay Blvd.
Alexandria, VA 22307 USA
E-Mail: chuckluther@aol.com

**Ms. Billene Mercer**
Conference Management Services, Inc
3833 South Texas Ave., Suite 221
Bryan, TX 77802-4015 USA
E-Mail: mercer@cmsworldwide.com

**Dr. Fabio Pacifici**
Chair of Data Fusion Technical Committee
DigitalGlobe
1601 Dry Creek Drive
Suite 260
Longmont, CO 80503 USA
E-Mail: fpacific@digitalglobe.com

**Mr. Shane Pearlman**
Website Contractor
200 West Cliff Drive #14
Santa Cruz, CA 95060 USA
E-Mail: shane@shaneandpeter.com

**Dr. Paul Racette**
GRSS PACE Rep.
NASA/GSFC Code 555
Greenbelt, MD 20771 USA
E-Mail: Paul.E.Racette@nasa.gov

**Dr. H. (Rama) Ramapriyan**
Data Archiving and Distribution Technical Committee Chair
NASA Goddard Space Flight Center
Greenbelt, MD 20771 USA
E-Mail: rama.ramapriyan@nasa.gov

**Dr. R. Keith Raney**
GRSS Rep. to Soc. on Social Implications of Technology
Johns Hopkins Univ. Applied Physics Lab
Space Dept.
Johns Hopkins Rd.
Laurel, MD 20723-6099 USA
E-Mail: keith.raney@jhuapl.edu

**Dr. Gilbert Rochon**
Data Archiving and Distribution Technical Committee Co-Chair
Tuskegee University
308 Kresge Center
Tuskegee AL 36088 USA
E-Mail: rochon@tuskegee.edu

**Dr. Masanobu Shimada**
IGARSS'11 Financial Chair
JAXA
Sengen 2-1-1, Tsukuba, Ibraki,
305-8505 JAPAN
E-Mail: shimada.masanobu@jaxa.jp

**Dr. Karl Staenz**
International Spaceborne Imaging Spectroscopy Technical Committee Co-Chair
Alberta Terrestrial Imaging Center
817 4th Avenue South, Suite 400
Lethbridge, Alberta T1J0P3 CANADA
E-Mail: karl.staenz@imagingcenter.ca

**Ms. Tammy Stein**
GRSS Executive Officer
3020 Pittsburgh St.
West University, TX 77005 USA
Email: steintammy@sbcglobal.net;
ieeegrss@ieee.org

**Mr. Martin Suess**
Instrumentation and Future Technologies Technical Committee Co-Chair
ESA European Space Technology and Research Centre
Kaplerlaan 1 2200 AG
Noordwijk ZH THE NETHERLANDS
E-Mail: martin.suess@esa.int

**Dr. Leung Tsang**
Fellow Evaluation Committee Chair
University of Washington
Box 352500
Seattle, WA 98195 USA
E-Mail: tsang@ee.washington.edu

**Dr. David Weissman**
Publicity Chairman, IEEE GRSS
Hofstra University, Dept. of Engineering
104 Weed Hall
Hempstead, NY 11549 USA
E-Mail: eggdew@hofstra.edu

**Mr. Peter Woodgate**
IGARSS'13 General Co-Chair
Australian Cooperative Research Centre for Spatial Information (CRCSI)
723 Swanston St
Carlton, Victoria, 3053 AUSTRALIA
E-Mail: pwoodgate@crcsi.com.au

**Dr. Karen M. St. Germain**
Spacw and Intelligence Office, OUSD)
Pentagon Room 3C636
Virginia USA
FAX: TBD
E-Mail: Karen.StGermain@osd.mil

## GRSS Chapters and Contact Information

| Chapter Location | Joint with (Societies) | Chapter Chair | E-mail Address |
|---|---|---|---|
| **Region 1: Northeastern USA** | | | |
| Boston Section, MA | GRS | William Blackwell | wjb@ll.mit.edu |
| Springfield Section, MA | AP, MTT, ED, GRS, LEO | Paul Siqueira | siqueira@ecs.umass.edu |
| Western New York | GRS | Jan van Aardt | vanaardt@cis.rit.edu |
| **Region 2: Eastern USA** | | | |
| Washington DC & Northern VA | GRS | Miguel Roman | Miguel.O.Roman@nasa.gov |
| **Region 3: Southeastern USA** | | | |
| Atlanta Section, GA | AES, GRS | Clayton Kerce | clayton.kerce@gtri.gatech.edu |
| Eastern North Carolina Section | GRS | Linda Hayden | haydenl@mindspring.com |
| **Region 4: Central USA** | | | |
| Chicago Section | AES, NPS, GRS, OE | Jack Sherman | j.sherman@ieee.org |
| Southeastern Michigan Section | GRS | Adib Y. Nashashibi | nuha@eecs.umich.edu |
| **Region 5: Southwestern USA** | | | |
| Denver Section, CO | AP, MTT, GRS | Michael Janezic | janezic@boulder.nist.gov |
| Houston Section, TX | AP, MTT, GRS, LEO | Christi Madsen | cmadsen@ee.tamu.edu |
| **Region 6: Western USA** | | | |
| Alaska Section, AK | GRS | Franz Meyer | fmeyer@gi.alaska.edu |
| Metro Los Angeles Section, CA | GRS | Erika Podest | Erika.Podest@jpl.nasa.gov |
| **Region 7: Canada** | | | |
| Ottawa Section | OE, GRS | Yifeng Zhou | yifeng.zhou@crc.gc.ca |
| Quebec Section, Quebec | AES, OE, GRS | Xavier Maldague | maldagx@gel.ulaval.ca |
| Toronto Section, Ontario | SP, VT, AES, UFF, OE, GRS | Sri Krishnan | krishnan@ee.ryerson.ca |
| Vancouver Section, BC | AES, GRS | David G. Michelson<br>Steven McClain | dmichelson@ieee.org<br>stevenmcclain@ieee.org |
| **Region 8: Europe, Middle East and Africa** | | | |
| Central Italy Section | GRS | Simonetta Paloscia | s.paloscia@infaccnrith |
| Croatia Section | AES ,GRS | Juraj Bartolic | juraj.bartolic@fer.hr |
| France Section | GRS | Gregoire Mercier | gregoire.mercier@telecom-bretagne.eu |
| Germany Section | GRS | Irena Hajnsek | irena.hajnsek@dlr.de |
| Islamabad Section | GRS/AES | Muhammad U. Khattak | ukhattak@hotmail.com |
| Russia Section | GRS | Anatolij M. Shutko | ashutko@gmail.com<br>ashutko@ms.ire.rssi.ru |
| Saudi Arabia Section | GRS | Yakoub Bazi | ybazi@ksu.edu.sa |
| South Africa | GRS/AES | Meena Lysko | MLysko@csir.co.za |
| South Italy Section | GRS | Maurizio Migliaccio | maurizio.migliaccio@uninav.it |
| Spain Section | GRS | J. M. Lopez-Sanchez | juanma-lopez@ieee.org |
| Student Branch, Spain Section | GRS | Pablo Benedicto | pablo27@casal.upc.edu |
| Ukraine Section | AP, MTT, ED, AES, GRS, NPS | Kostyantyn V. Ilyenko | k.ilyenko@gmail.com |
| United Kingdom & Rep. of Ireland (UKRI) Section | GRS, OE | Yong Xue | y.xue@londonmet.ac.uk |
| **Region 9: Latin America** | | | |
| Student Branch, Colombia Section | GRS | Leyini Parra Espitia | leyiniparra@ieee.org |
| Student Branch, South Brazil Section | GRS | Sam Murphy | grss@ige.unicamp.br |
| **Region 10: Asia and Pacific** | | | |
| Australian Capital Territory and New South Wales Sections, Australia | GRS | Xiuping Jia | x.jia@adfa.edu.au |
| Beijing Section, China | GRS | Chao Wang | cwang@rsgs.ac.cn |
| Japan Council | GRS | Hiroshi Kimura | hkimura@gifu-u.ac.jp |
| Nanjing Section, China | GRS | Feng Jiao | jiao_feng323@hotmail.com |
| Delhi Section, India | GRS | O.P.N. Calla | opnc06@gmail.com |
| Seoul Section, Korea | GRS | Joong-Sun Won | jswon@yonsei.ac.kr |
| Taipei Section, Taiwan | GRS | Yang-Lang Chang | ylchang@ntut.edu.tw |

## GRSS MEMBER HIGHLIGHTS

# GRSS MEMBERS ELEVATED TO THE GRADE OF SENIOR MEMBER DURING THE PERIOD JUNE–JULY 2012

| | | | |
|---|---|---|---|
| **June:** | Javier | Marcello | Spain Section |
| | Chinnawat | Surussavadee | Thailand Section |
| **July:** | Thomas | Bell | Lehigh Valley Section |
| | Shannon | Brown | Metropolitan Los Angeles Section |
| | Juan Pablo | de Castro-Fernandez | Spain Section |
| | Abdullah | Eroglu | Fort Wayne Section |
| | Erhan | Kudeki | Central Illinois Section |
| | William | Plant | Seattle Section |
| | Victor | Raizer | Northern Virginia Section |
| | Rafael A. | Rodríguez Solís | Western Puerto Rico Section |
| | Arturo | Sanchez-Azofeifa | Southern Alberta Section |
| | Ehsan | Sheybani | Richmond Section |
| | Josaphat | SriSumantyo | Tokyo Section |
| | Alan | Thomas | Atlanta Section |
| | M.G.S.M. | Zaffar Sadiq | Victorian Section |

Senior membership has the following distinct benefits:

- The professional recognition of your peers for technical and professional excellence.
- An attractive fine wood and bronze engraved Senior Member plaque to proudly display.
- Up to $25.00 gift certificate toward one new Society membership.
- A letter of commendation to your employer on the achievement of Senior Member grade (upon the request of the newly elected Senior Member).
- Announcement of elevation in Section/Society and/or local newsletters, newspapers and notices.
- Eligibility to hold executive IEEE volunteer positions.
- Can serve as Reference for Senior Member applicants.
- Invited to be on the panel to review Senior Member applications.
- Eligible for election to be an IEEE Fellow

Applications for senior membership can be obtained from IEEE website: http://www.ieee.org/web/membership/senior-members/index.html

You can also visit the GRSS website: http://www.grss-ieee.org

*(President's Message continued from page 3)*

*Years, 1962–2012*. A copy of the book was included in the registration package for all participants at IGARSS 2012. The response to the book has been excellent. GRSS Executive Director Tammy I. Stein did a great job in compiling and editing the book. I greatly appreciate her outstanding contribution along with editorial board members, GRSS History Chair Werner Wiesbeck and AdCom members Alberto Moreira and Melba Crawford. Copies of the book are still available for GRSS members. GRSS members who are interested in obtaining a copy of the book may contact Tammy I. Stein at steintammy@sbcglobal.net.

IEEE President-Elect Peter Staecker participated in the opening session of IGARSS 2012 and several events associated with the conference, including the AdCom meeting on Friday and Saturday prior to the symposium. We greatly appreciate President-Elect Staecker's presence in Munich. He is also a GRSS member and showed great interest in the activities and operations of the society. He witnessed first-hand how well the IGARSS 2012 symposium was run. I would like to use this opportunity to thank all the colleagues involved in the organization

*(continued on page 44)*

# IEEE GRSS AWARDS: CALL FOR NOMINATIONS

## (http://www.grss-ieee.org/about/awards/)

Nominations for the IEEE GRS Society awards are due December 15. Not only for the Major Awards, but also for the Publication Awards nominations from the members are possible. Below the awards are listed with links to a detailed description and to the nomination forms.

### GRSS Distinguished Achievement Award (DAA)

***Eligibility:*** IEEE membership is not required but is recommended.

The Distinguished Achievement Award was established to recognize an individual who has made significant technical contributions, usually over a sustained period, within the scope of the Geoscience and Remote Sensing Society. In selecting the individual, the factors considered are quality, significance and impact of the contributions; quantity of the contributions; duration of significant activity; papers published in archival journals; papers presented at conferences and symposia; patents granted; advancement of the profession. The award is considered annually and presented only if a suitable candidate is identified. The awardee receives a plaque and a certificate.

Description and Nomination Form: http://www.grss-ieee.org/about/awards/grs-s-distinguished-achievement-award/

### GRSS Education Award (EA)

***Eligibility:*** Member or Affiliate Member of the IEEE GRSS

The purpose of this award is to reward significant educational contributions in the field of remote sensing. The award shall be considered annually, but will only be awarded when an outstanding recipient is identified.

Description and Nomination Form: http://www.grss-ieee.org/about/awards/grs-s-education-award/

### GRSS Outstanding Service Award (OSA)

***Eligibility:*** Must be an IEEE GRSS member.

The Outstanding Service Award was established to recognize an individual who has given outstanding service for the benefit and advancement of the Geoscience and Remote Sensing Society. The award shall be considered annually but not be presented if a suitable candidate is not identified. The following factors are suggested for consideration: leadership, innovation, activity, service, duration, breadth of participation and cooperation. The awardee receives a certificate.

Description and Nomination Form: http://www.grss-ieee.org/about/awards/oss/

### GRSS GOLD Early Career Award (GA)

The GRSS GOLD Early Career Award is to promote, recognize and support young scientists and engineers within the Geoscience and Remote Sensing Society that have demonstrated outstanding ability and promise for significant contributions in the future.

Description and Nomination Form: http://www.grss-ieee.org/about/awards/grs-s-gold-early-career-award/

**Deadline:** Dec. 15. 2012

**Please mail Major Award nominations directly to:**
Prof. Werner Wiesbeck
Chair, GRSS Major Awards Committee
Karlsruhe Institute of Technology (KIT)
Kaiserstrasse 12
76131 Karlsruhe, GERMANY
E Mail: werner.wiesbeck@kit.edu

### GRSS Transactions Prize Paper Award

***Description:*** The GRSS established the GRSS TRANSACTIONS Prize Paper Award (TPPA) to recognize the authors who have published in the IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING (TGARS) during the calendar year an exceptional paper in terms of content and impact on the GRS-Society. If a suitable paper cannot be identified from among those published during the calendar year, papers published in prior years and subsequently recognized as being meritorious may be considered.

Description and Nomination Form: http://www.grss-ieee.org/about/awards/grs-s-transactions-prize-paper-award/

### GRSS Letters Prize Paper Award

***Description:*** The GRSS established the Letters Prize Paper Award (LPPA) to recognize the authors who have published in the IEEE Geoscience and Remote Sensing Letters during the calendar year an exceptional paper in terms of content and impact on the GRS Society. If a suitable paper cannot be identified from among those published during the calendar year, papers published in prior years and subsequently recognized as being meritorious may be considered.

Description and Nomination Form: http://www.grss-ieee.org/about/awards/grs-s-letters-prize-paper-award/

### GRSS JSTARS Prize Paper Award

***Description:*** The GRSS established the JSTARS Prize Paper Award to recognize the author(s) who published in the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing during the calendar year an exceptional paper in terms of content and impact on the GRS Society.

Description and Nomination Form: http://www.grss-ieee.org/about/awards/grs-s-j-stars-prize-paper-award/

**Deadline:** Dec. 15. 2011

**Please mail Publications Award nominations directly to:**
Prof. Martti Hallikainen
Chair, GRS-S Publications Awards Committee
Aalto University
Department of Radio Science and Engineering
P.O. Box 13000
Aalto 00076, Finland
martti.hallikainen@aalto.fi

## IN MEMORIAM

# HANS JOACHIM LIEBE (1934–2012)

*Albin J. Gasiewski and Ed R. Westwater, Department of Electrical, Computing, and Energy Engineering, University of Colorado at Boulder.*

Hans Joaquim Liebe, an internationally recognized expert in radio wave physics and developer of the widely-used Millimeterwave Propagation Model (MPM), passed away peacefully on August 2, 2012, after a long and courageous battle with Parkinson's disease. He was the son of Margarete and Fritz Liebe, and was born in Insterburg, East Prussia, Germany, on January 21, 1934. He married Roswita Borgwardt in 1963 and they were married 49 years. In 1964, he graduated magna cum laude from the Technical University of Berlin where he earned the Ph.D. degree in Electrical Engineering. In 1965, he moved from Germany to the United States with his family.

Dr. Liebe worked for the Institute for Telecommunications Sciences (ITS) in Boulder from 1966 until his retirement in 1995. Dr. Liebe was awarded the Senior U.S. Scientist Humboldt Award (1976), Department of Commerce Silver Medals (1984 and 1991) for meritorious service and outstanding publications, and the IEEE Harry Diamond Memorial Award (2002) for distinguished technical contributions in the field of millimeter wave propagation. Dr. Liebe was a Life Fellow of IEEE and a member of the US National Committee of International Union of Radio Science(USNC/URSI), Commissions A and F.

Dr. Liebe, over many years of continued study, developed reliable expressions for the complex refractivity of moist air that is basic to all millimeter and sub-millimeter wave propagation problems, inclusive of those in communications, navigation, and remote sensing. During the course of this model development, Dr. Liebe overcame many experimental difficulties and, to a large extent, verified the overlap between spectroscopic measurements and field measurements. His publications included basic studies of the absorption by gaseous water vapor and oxygen, as well as absorption by liquid water. In his thirty-year effort to obtain valid data on atmospheric loss and delay properties, he obtained a model that is highly accurate from RF frequencies up to approximately 1000 GHz. This model is in widespread use today in applications as diverse as weather forecasting, satellite broadcasting, and radar. Dr. Liebe's work has been and remains vital to the remote sensing community, where almost all ground- and satellite-based microwave and millimeter radiometric techniques take advantage of his models. His more recent work on cloud absorption is also becoming increasingly important, as will the work on Zeeman splitting of the $O_2$ absorption lines at mesospheric altitudes.

Dr. Liebe's meticulous work and models are widely recognized throughout the global scientific community. He established a reputation for accurate measurements within 20 to 100 GHz well before commercial equipment was widely available in this range. He used spectroscopic theory to extend his estimates up to 1000 GHz, where there were very few reliable measurements available and at a time when very little quantitative knowledge of absorptive and refractive spectra was available in this spectral range. His work is nowadays the basis for remote sensing techniques currently being used for or considered for major airborne and spaceborne campaigns, including the geosynchronous microwave imager/sounder instrument and passive submillimeterwave cloud ice mass sensors. Dr. Liebe's work constituted both outstanding science and a substantial contribution to radio wave propagation practice, as exhibited, for example, by the adoption of his work by the '*International Telecommunication Union Study Group III of ITU-R*'.

Hans' careful attention to the development of the MPM propagation model was only superceded by the warmth of his personality – which was equally well known among his colleagues. In addition to his world-class technical achievements, Hans was a loving father and husband who cherished spending time with his family in the great outdoors. He was an avid swimmer, hiker, skier and tennis player. In addition to his wife of 49 years, Roswita, he leaves behind his two daughters, Christi Liebe (Jon Gilbertson) of Carnation, WA, and Annette Liebe (husband Scott MacLowry), and granddaughter Isabel Rose all of Bend, OR and a sister, Elvira Christians of Berlin, Germany.

FEATURE

# MAKING DECISIONS WITH MULTISOURCE IMAGERY: THE CHALLENGE OF DIGITAL EARTH

*John Richards, Life FIEEE*
*The Australian National University*

## 1. Introduction

When machine classification of satellite and aircraft image data was first used in remote sensing for thematic mapping, attention turned quickly on to how the results might be improved if so-called ancillary sources of spatial data could be included as well. The incorporation of digital terrain (slope, elevation, aspect) was often used as an important additional data source to help refine a classification generated from remote sensing imagery, by providing some form of context [1]. Although not relevant to this article, spatial context, based on texture and neighbourhood relationships, was also, and still is, seen as an important additional source of information with which to supplement spectral or radar imagery.

With the advent of the geographic information system in the 1980s the incorporation of auxiliary information sources for thematic mapping was generalised, in that procedures were sought to allow several spatial data sources to be analysed simultaneously, rather than viewing some types as ancillary to others. That is where this treatment commences. The seminal question is: how can we devise techniques that allow us to extract the most meaningful information from a multitude of co-registered spatial data sets?

The problem of multisource or multi-sensor analysis, therefore, is not a new one; it has been around almost as long as remote sensing. Yet, curiously, in some ways it is still not settled. Although many procedures have been advanced for tackling the problem, there remains no standard approach. That may have as much to do with the variety of problem types, as with any implicit complexity of the mixed data domain. Having said that, the data domain is about to become immeasurably more complicated. The digital earth framework noted later, with its inherent spatial flexibility and partly unconstrained data supply, is likely to become the data repository of the future on which multisource analysis, including for thematic mapping, will be conducted.

In the early history of remote sensing, and in other fields, the term data fusion was typically applied to the multisource analysis problem to imply the fusing or merging of information in order to refine decisions. More commonly that term is now employed to indicate means for registering and integrating spatial data types, often to yield new products, and so will not be used here.

In the following we review briefly the range of candidate techniques for multisource analysis. However much of our discussion is concerned with more generic matters, such as the decisions the analyst must make about preferred techniques, and the challenges about to face the thematic mapping community with the proliferation of data types in the open source environment of digital earth.

Our treatment is restricted to class labels for individual pixels, which is perhaps the most commonly encountered. While object based classification methods are available [2] seldom have they been applied to the multisource analysis problem.

## 2. Analysis Outcomes

The first decision facing an analyst, when presented with a thematic mapping task, is to determine what is needed in terms of the class labels of interest, and the degree of classification error tolerable. We will not treat the latter here because the field is well known and comprehensively covered in standard treatments [3]. But class choice is often not straightforward, despite seeming to be so in many instances.

It is helpful to distinguish between *information* classes and *spectral* classes [4]. The former are the classes desired in the final thematic map product, while the spectral classes are those that can be resolved in the remote sensing image data. They were called spectral classes in the early days of remote sensing because the data we were dealing with was usually multi- (or hyper-) spectral. It suits our purpose here to generalize that term to *data* classes, meaning the classes that can be extracted from the data, as against the final information class labels in the thematic map.

It is not unreasonable to expect that the data classes might be different for each different spatial data type. For example, in the case of a soil map they will be the soil types. In the case of radar imagery, they will have labels like smooth (specular) surface, rough (diffuse) surface, volume scatterer, corner reflector, and so on; those are the set of fundamental cover types into which radar imagery is most easily resolved [5]. For optical data the classes most easily extracted will have labels like vegetation type, soil, bare ground, clear water, turbid water, and similar, as is well known, along with any sub-classes.

While the thematic class labels we often seek from multisource analysis will be similar to those we are familiar with when analysing optical image data, greater flexibility is offered if we are prepared to consider that we can generate

information classes from mixed data types that can't be found from the analysis of any individual data source on its own. As a simplistic example, analysis of optical data might show a region to be vegetated. Analysis of radar imagery might show the region to be smooth, so we could conclude from those two pieces of information that the region is grassland or crop (rather than forest or shrubs, as would be indicated if the radar analysis showed volume scattering behavior). If a soil map shows that the underlying soil type is clay, we could go further and conclude that the region is most likely natural pasture, because the soil type is not conducive to cropping. Note from this example that we have information class labels from the analysis of each individual data source, which then give different information classes in combination.

If we wish to exploit the added flexibility given by assuming that the final information classes from multisource analysis can be different from the single source information class labels, then we need analytical procedures that can process label-like tags, as we will see later. First, though, we look briefly at the procedures regularly applied in a multisource context.

## 3. Candidate Techniques

Suppose we have $S$ different sources of spatial data that have been co-registered. It is important that the registration is accurate otherwise misregistration errors will contribute to classification error in the final product. Let the measurement vectors for each of these sources be the column vectors $\mathbf{x}_1, \mathbf{x}_2, \ldots \mathbf{x}_S$. The elements in each vector are the individual measurements in the respective sources: reflectances for calibrated optical data, scattering coefficients for radar data, and so on. We can form the composite column vector, sometimes called a *stacked* vector, by concatenating the measurements

$$\mathbf{X} = [\mathbf{x}_1^{\mathrm{T}}, \mathbf{x}_2^{\mathrm{T}}, \ldots \mathbf{x}_S^{\mathrm{T}}]^{\mathrm{T}}$$

The simplest and oldest of all techniques for multisource analysis treats the composite vector $\mathbf{X}$ as though it were from a single source, and proceeds to analyse it using any of the standard single source techniques [1, 6]. Of course, there are several assumptions in this approach. One concerns the mixing of fundamentally different cover types (optical and radar for example): the algorithm used has to be able to handle such a mixed data space successfully. Another is that the information classes of interest can be derived directly from that single stage approach.

If the different data sources are treated separately then a range of other labeling techniques becomes possible. Perhaps the simplest in concept is to construct a committee of classifiers, with a separate classifier dedicated to the analysis of each data source, such as that illustrated in Fig. 1 [7]. An advantage of such an approach is that each of the component classifiers can be chosen optimally to match the data being analysed. For example, a support vector machine might be used on optical data, and a structural decomposition method might be used with radar data. If, for the moment, we assume each of the classifiers labels the pixels into the same set of information classes then the decision maker shown in Fig. 1 would normally allocate a pixel to the class most recommended by the classifiers – that is a so-called majority vote decision.

Although one would not normally use such a simple committee approach with data sources as disparate as optical and radar, it is a useful method if the data sources are not too dissimilar – such as optical imagery from different sensors, perhaps with differing spatial resolutions. There are, however, more elegant ways of handling the multisource problem when the data vectors $\mathbf{x}_s, s = 1 \cdots S$ can be treated separately. For example, a joint statistical approach can be used.

The classical maximum selection decision rule in pixel labeling is to decide that $\omega_i$ is the correct class for a pixel with measurement vector $\mathbf{X}$, among all available classes, if there is some measure $F$ favouring that class more than the others, i.e.

$$\mathbf{X} \in \omega_i \text{ if } F(\omega_i|\mathbf{X}) > F(\omega_j|\mathbf{X}) \text{ for all } j \neq i \qquad (1)$$

Specifically, $F(\omega_i|\mathbf{X})$ is a measure of how likely it is that class $\omega_i$ is the correct one for the pixel with composite measurement vector $\mathbf{X}$.

Although there are other possibilities, the measure $F(\omega_i|\mathbf{X})$ is often assumed to be the posterior probability of class membership $p(\omega_i|\mathbf{X})$ [8, 9]. Because the set of posterior probabilities is generally not known, Bayes' theorem is used to derive the standard decision rule in statistical classification [10]

$$\mathbf{X} \in \omega_i \text{ if } p(\mathbf{X}|\omega_i)p(\omega_i) > p(\mathbf{X}|\omega_j)p(\omega_j) \text{ for all } j \neq i \quad (2)$$

in which the $p(\omega_i)\, i = 1 \cdots C$ are the prior probabilities of class membership and the $p(\mathbf{X}|\omega_i)\, i = 1 \cdots C$ are the distribution functions for the measurement vectors from each of the $C$ available classes.

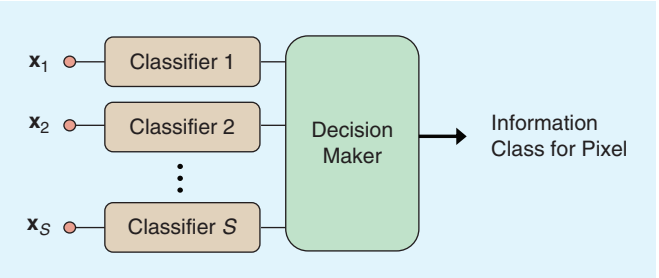



*Figure 1. A committee of classifiers, in which each classifier handles a different data source.*

Most multisource processes that have a statistical basis assume independence among the individual source measurement vectors so that

$$p(\mathbf{X}|\omega_i) = \prod_{s=1}^{S} p(\mathbf{x}_s|\omega_i) \quad i = 1 \cdots C \tag{3}$$

That allows the joint source class conditional distribution function $p(\mathbf{X}|\omega_i)$ to be compiled from the class conditional distribution functions $p(\mathbf{x}_s|\omega_i)$ of the individual sources. It also allows, if required, different sets of data classes to be defined for each data source [9], which is one of the strengths of this approach.

Although heuristic another multisource rule expresses the function $F(\omega_i|\mathbf{X})$ of (1) as a product of source posteriors, weighted by exponents $\alpha_s$ that allow the influences of the sources to be modified according to their perceived reliabilities

$$F(\omega_i|\mathbf{X}) = \prod_{s=1}^{S} p(\omega_i|\mathbf{x}_s)^{\alpha_s} \quad i = 1 \cdots C \tag{4}$$

If we take the logarithm of (4), we get

$$\log\{F(\omega_i|\mathbf{X})\} = \sum_{s=1}^{S} \alpha_s \log\{p(\omega_i|\mathbf{x}_s)\} \quad i = 1 \cdots C$$

which is called a *logarithmic opinion pool* [11, 12]. This has been shown to be a very useful multisource classification tool, which nevertheless still assumes that the information classes are the same for each data source.

A completely different heuristic approach to multisource analysis, and one that incorporates measures of source uncertainty by design, is the Theory of Evidence [13]. In statistical methods, the labeling decision about a pixel is made by choosing the class with the largest of the membership functions, or the highest of the set of posterior probabilities, as expressed in (1) or (2). Evidential theory uses the alternative of the *mass* (or amount) *of evidence* in favour of each in the set of possible labels for a pixel.

Evidential theory commences by assuming that there is a unit of evidential mass to be distributed among the possible labels for a given pixel. That distribution can be based on any analytical process applied to a given data source that leads to a set of relative measures for the correct class for the pixel. They could be the posterior probabilities from a statistical analysis, for example. But, before allocating the available evidential mass over those labeling propositions, some mass is set aside to account for the analyst's uncertainty about the labeling process that brought them to that point. Data quality, or concern about the accuracy of the analysis might contribute to the analyst's being less than confident in knowing the relative amounts of evidential mass to contribute to each labeling possibility.

Suppose, following the analysis of one data source, there are three possible classes for a pixel: $\omega_1, \omega_2$ and $\omega_3$. Then the unit of evidential mass is allocated over those three classes, and to the set as a whole; the last is represented by the symbol $\theta$, which constitutes the analyst's uncertainty. If the three classes had likelihoods in the proportions respectively of 0.7, 0.2 and 0.1, but that we were 20% uncertain about what got us to that point, then we allocate 0.2 units of evidential mass to $\theta$ and the remaining 0.8 units in proportion to the specific classes, i.e. respectively 0.56, 0.16, 0.08. This distribution of the unit mass of evidence is represented symbolically as

$$m(<\omega_1, \omega_2, \omega_3, \theta>) = <0.56, 0.16, 0.08, 0.2>$$

The great advantage of the Theory of Evidence is that it allows this mass distribution generated from the analysis of one data source to be merged with a mass distribution for the same set of classes generated from the analysis of a second data source, and then a third, etc. That is done through the mechanism of the orthogonal sum. While it is convenient to represent the sum operation diagrammatically, it is easy to express it algebraically [8, 9]. If $m_1(z)$ represents the mass distribution over the classes from one source, and $m_2(z)$ represents the distribution from a second source, then after combination, the distribution is given by

$$m_{12}(z) = H^{-1} \sum_{z=x\cap y} m_1(x) m_2(y)$$

in which the normalizing factor is given by

$$H = \sum_{x\cap y \neq \phi} m_1(x) m_2(y)$$

where $\phi$ is the null set. What these equations say is: in the combination rule the mass assigned to class $z$ is the sum of the products of mass assigned to class $z$ in the single source analyses, plus the product of mass assigned to that specific class in one source, and to uncertainty in the other; the latter requires $\theta \cap y = y$. The products of masses assigned to different classes are excluded: they would be contradictory outcomes. The product of the uncertainties, after normalization, is the residual uncertainty, which is smaller than the single source uncertainties. The normalizing factor is the sum of the products of the masses that are not contradictory.

Evidential Theory can cope with mixed classes by using the orthogonal sum as a means for their resolution. The theory also defines the likely minimum and maximum amounts of evidence in favour of the various labels for a pixel from which a decision rule can be devised [9].

Over the years other, less common, methods have been used for multisource processing. When only two sources are involved use of the prior probability term in (2) [14, 15], or a technique known as supervised probabilistic labeling [16], can be used to merge recommendations from the sources.

## 4. Processing Label and Facts

It is now timely to return to the committee structure in Fig. 1 and contemplate what might be possible if the decision maker block is replaced by some general reasoning process, one that can make more complex decisions about the appropriate information class for a pixel from the recommendations of the individual classifiers. As with the traditional committee machine, the inputs to that block are labels and not data, so it has to reason with labels in coming up with a final recommendation. In the simple committee approach, that reasoning involves simple logical decisions, such as a majority vote. However, we would now like the decision maker to reason at a higher level. Suppose we also allow each of the constituent classifiers to be optimized for a particular data type so that it produces data class recommendations relevant to its own data source. We then want the decision making block to be able to accept those mixed recommendations when determining the information class label for the pixel.

For example, if the top classifier in Fig. 1 were a support vector machine operating on optical image data then it will produce labels such as vegetation, soil and water. If the second classifier were optimized for radar analysis it would produce pixel labels such as smooth surface, rough surface, volume scatterer, and so on. What the decision maker has to do is make compound decisions like: **if** the optical classifier says vegetation **and** the radar classifier says smooth surface **then** the pixel is likely to be grassland of some type. Such reasoning is straightforward for expert systems, and is the foundation of knowledge-based classification [17,18].

In many ways the committee just described achieves its ability to make complex, compound decisions about the appropriate information class for a pixel by emulating the sorts of decision processes a human interpreter might use when presented with a multiplicity of co-registered spatial data types. To make it work more generally it may require the evolution of sets of agents knowledgeable about where expertise lies for each data type, and able to do the knowledge based integration step [19].

Although presented above as a simple alternative multisource analysis technique, the expert system approach to pixel labeling lays a foundation for the more complex knowledge processing that will be needed in the emerging era of digital earth.

## 5. Challenges of the Digital Earth Framework

The origins of the digital earth concept are generally traced back to a speech and accompanying paper [20] by the-then US Vice-President Al Gore in 1998, in which the idea was advanced of summarizing what we know about the earth by using the construct of the virtual globe. Its most obvious current manifestation is the publicly available Google Earth, and similar virtual globes, which allow access by anyone with a simple home computer. As a result its evolution has been rapid, and its applications possibilities seem limitless [21, 22].

Fig. 2 shows the digital earth paradigm. At the base level it consists of layers of physical data types, but addressed in a global rather than map sheet or image frame representation. The physical layers include traditional sets of spatial data, including optical, thermal and radar imagery sourced from remote sensing platforms. It will also have physical data provided from the multiplicity of sensors that, with remote sensing instrumentation, constitutes what we now call the sensor web. Ultimately it should contain archival material, and possibly simulations to allow forward predictions. That means it has a temporal dimension to it as well. In some cases it will contain sub-surface information and, depending on the applications envisaged, non-visual data. For example, when used to support studies of the geographical distribution of animals or birds, sound might be an important source of ancillary data for species identification. Data on building interiors can also be included, particularly when digital city models are added.

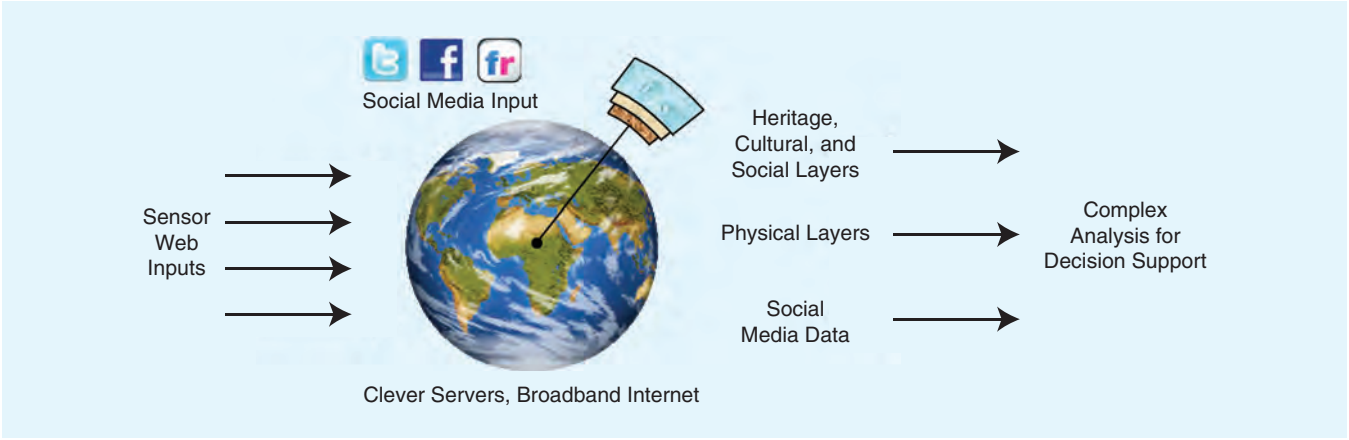



*Figure 2. The digital earth framework.*

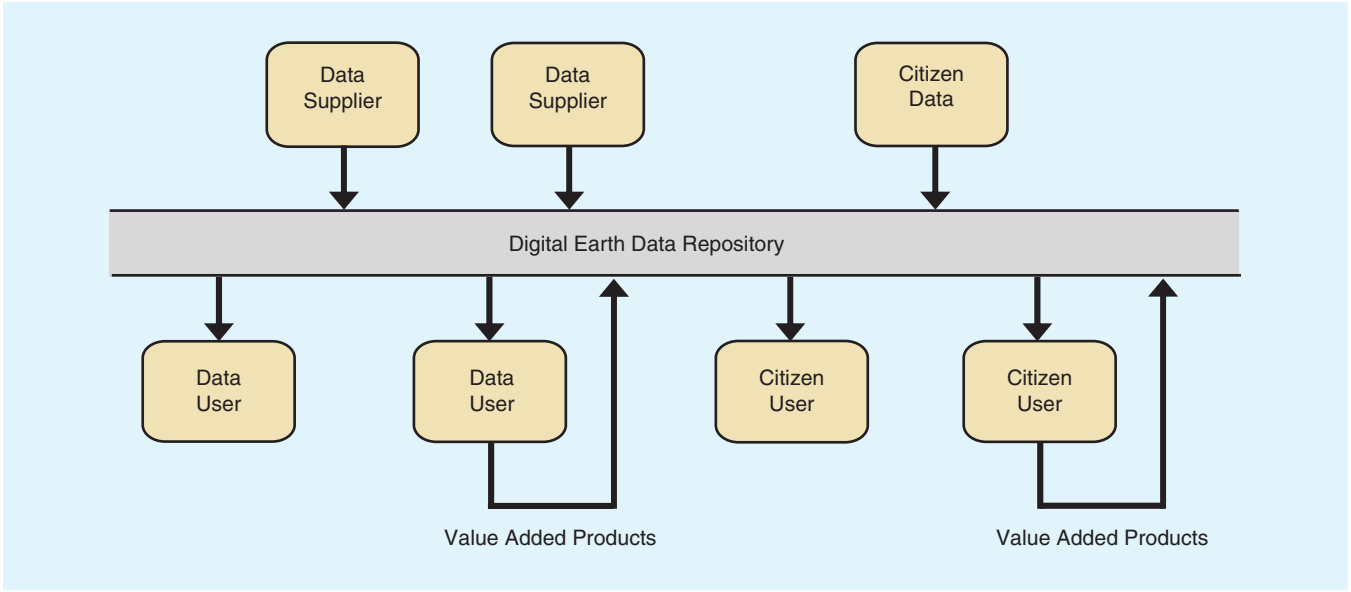



*Figure 3. The digital earth as a data framework linking professional and citizen data users and suppliers.*

It will have cultural and heritage data for certain regions on the earth [23] but, importantly for this discussion, it will have facts at different levels of refinement provided over social networks, because it will be used and added to by the expert and novice alike. That gives the digital earth data estate a fast dynamic characteristic that we have not experienced with remote sensing and GIS to date.

In many ways the concept of digital earth is a natural progression from the GIS, made possible by:

- the ready availability and integration of GNSS positioning information,
- the adoption of the globe, rather than the map sheet, as the repository of spatial information, and
- the rapid development of social networks.

While currently lacking the geometric and radiometric integrity of a GIS, the digital earth paradigm has two special features that will drive it at an increasing pace to become the global mapping base. First, the concept of scale is replaced by the ability to zoom in and out, and pan readily over the surface of the earth. Effectively, that supplants the need for the user to have access to a multiplicity of map sheets or image frames over a range of scales (electronically or otherwise), instead replacing that model with smart servers. Secondly, it has evolved in such a way that the novice (the "citizen" in digital earth terminology) as well as the expert can contribute facts about spatial, social, cultural and similar attributes to the information base available about a given region [24].

Why is social networking likely to be so important? Effectively it connects into our problem domain citizen users (non-professionals) in manner not hitherto possible; that is because social networks

- give the citizen user ready and immediate access to data and results,
- give the citizen user a simple means for communicating, and
- allow the citizen user to contribute their own views to other citizens and to professionals alike.

It is how we use the citizen-provided views that is important, and how seriously we treat them. There have already been instances where citizen data on local conditions communicated via Twitter and Facebook have led to the supplementation of ephemeral maps of flooded regions [25]. Lest there be concern that unskilled or malicious contributors can compromise the ultimate integrity of the information provided in that manner, the social checking and correcting mechanism we see in Wikipedia means that there is convergence to an accepted position with time – via social feedback. The same was the case in the flood situation referred to above. Bogus, or incorrect, tweets were corrected quickly by others, such is the benefit of an open, socially convergent system.

Over the past two decades we have experienced the rapid evolution of the Internet and social sites like Wikipedia, because they have been open to anyone with an interest in making a contribution to their development[1]. That same behaviour will now drive developments in spatial data handling and use. Not only will citizen-provided data be a rich source of information that we have to tap, but the users themselves will drive

[1]See an amusing but telling account of the importance of citizen input to Internet development in R.W. Lucky, Reflections, *IEEE Spectrum*, July 1995, p. 15.

the evolution of the system because they can be much more closely integrated into its development.

What does all this mean for multisource data analysis? Although the linear nature of the data bus representation shown in Fig. 3 belies the flexibility and reach of digital earth, it is a convenient way to view the concept for the purpose of understanding the challenge it presents to the analyst interested in making decisions about the earth's surface from multiple data sources.

As remote sensing data analysis professionals we need to accept that the rigorously controlled standards of the GIS, while important, will not always qualify the data that the emerging user base will want to employ. Instead, the data estate will consist of well-maintained spatial data with high spatial, radiometric and temporal integrity, sitting alongside a range of non-physical data types, both spatial and non-spatial, and added to by sometimes ephemeral facts (not data) generated over social media networks. While we will still need to use well-known classification procedures on the spatial data types to develop thematic maps and other value-added products, we need also to allow the incorporation of other facts and details, to enrich those products and to generate products we may now not even be able to contemplate.

Numerical and statistical methods are unlikely to meet all those challenges, but an analytical framework built on the concept of human reasoning is conceivable, because that is how we currently handle facts and social messages, albeit qualitatively. We have such a framework in the expert systems and other reasoning processes developed in the field of computer science. What is needed now is a significant program of research to demonstrate how reasoning systems can deliver convergent physically and socially generated information. Just as developments in information technology generally are moving at a rate that challenges the legislative and legal frameworks in place worldwide, so rapid developments in digital earth are challenging data analysts.

It is unreasonable, at least at this stage of our technology, to contemplate a fully developed automated reasoning system for application to the broad data base of a digital earth repository. What we can do is attempt to locate the role of automated analysis on a decision support spectrum, such as shown in Fig. 4. This illustrates the mix of manual and machine interpretation that might be called on when making decisions. Over the past three decades, with simple remote sensing, we have steadily moved to the right as our analytical procedures have become more refined and as expertise has propagated through the user community. By its nature GIS leans more towards the left hand end of the spectrum, since it was designed initially as a mechanism to support management decisions; nonetheless it has been enhanced by a steady injection of quantitative methods.

In the case of digital earth it is difficult at this stage seeing it being located anywhere near the right hand extreme, except in some of its components. There is a role for automated reasoning in handling spatial data components but we have yet to understand how to incorporate facts from social media, particularly when they are contributed by many citizens. While detailed studies are available about the pervasiveness of social messages and what makes one message "go viral" and not others [26], we have yet to develop a theory of convergence of social messages, in the sense of knowing when facts are well enough supported that they become part of the digital earth information base. As with Wikipedia, perhaps that does not require other than a light touch of regulation because the involvement of many citizens will lead to a correction and refinement process of facts seen to be of high importance.

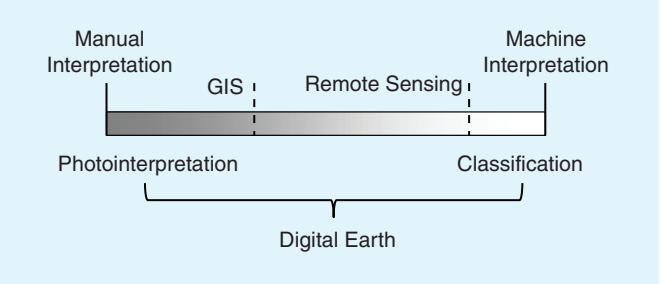



*Figure 4. The decision support spectrum between fully manual and fully automated analysis; the decision maker will depend on technology support somewhere along this spectrum according to application.*

In meeting the analytical challenges posed by the digital earth model it is important that we not be constrained by current or past mind-sets. We will be charting new territory that may require a great deal of imagination in devising new procedures. It is especially important to keep in mind that what might seem unlikely today could be commonplace in the future[2].

## References

[1] M.D. Fleming and R.M. Hoffer, Machine processing of Landsat MSS data and DMA topographic data for forest cover type mapping, LARS Technical Report, 1979, Paper 80. http://docs.lib.purdue.edu/larstech/80

[2] R.L. Kettig and D.A. Landgrebe, Classification of multispectral image data by extraction and classification of

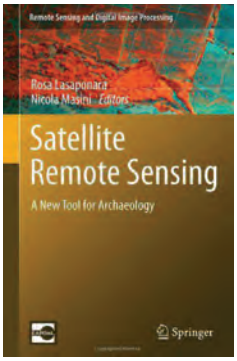
[2]When broadcasting was first proposed in the early 20th century a man, who was later to become one of the most distinguished leaders of the industry, announced that it was very difficult to see uses for public broadcasting. About the only regular use he could think of was broadcasting of Sunday sermons, because that is the only occasion when one man regularly addresses a mass public. See James Martin, *Future Developments in Telecommunications,* Prentice-Hall, N.J., 1971.

homogeneous objects, *IEEE Transactions on Geoscience Electronics*, vol. GE-14, pp. 19–26, 1976.
[3] R.G. Congalton and K. Green, *Assessing the Accuracy of Remotely Sensed Data: Principles and Practices*, 2nd ed., CRC Press Taylor and Francis Group, Boca Raton FL, 2009.
[4] P.H. Swain and S.M. Davis, *Remote Sensing*: *the Quantitative Approach*, McGraw-Hill, N.Y., 1978.
[5] J.A. Richards, *Remote Sensing with Imaging Radar*, Springer, Berlin, 2009.
[6] C.H. Tom and L.D. Miller, Forest site index mapping and modeling, *Photogrammetric Engineering and Remote Sensing*, vol. 46, pp. 1585–1596, 1980.
[7] N.J. Nilsson, *The Mathematical Foundations of Learning Machines*, Morgan Kaufmann, San Francisco, 1990.
[8] T. Lee, Multisource Context Classification Methods in Remote Sensing, *PhD Thesis*, The University of New South Wales, Kensington, Australia, 1986.
[9] T. Lee, J.A. Richards and P.H. Swain, Probabilistic and evidential approaches for multisource data analysis, *IEEE Transactions on Geoscience and Remote Sensing*, vol. GE-25, no. 3, May 1987, pp. 283–293.
[10] J.A. Richards and X. Jia, *Remote Sensing Digital Image Analysis*, 4th ed., Springer, Berlin, 2006.
[11] J.A. Benediktsson, P.H. Swain and O.K. Ersoy, Neural network approaches versus statistical classification of multisource remote sensing data, *IEEE Transactions on Geoscience and Remote Sensing*, vol. 28, no. 4, July 1990, pp. 540–552.
[12] J.A. Benediktsson and P.H. Swain, Consensus theoretic classification methods, *IEEE Transactions on Systems, Man and Cybernetics*, vol. 22, 1992, pp. 688–704.
[13] G. Shafer, *A Mathematical Theory of Evidence*, Princeton UP, N.J., 1976.
[14] A.H. Strahler, The use of prior probabilities in maximum likelihood classification of remotely sensed data, *Remote Sensing of Environment*, vol. 10, 1980, pp. 135–163.
[15] L. Bruzzone, C. Conese, F. Maselli and F. Roli, Multisource classification of complex rural areas by statistical and neural network approaches, *Photogrammetric Engineering and Remote Sensing*, vol. 63, 1997, pp. 523–533
[16] J.A. Richards, P.H. Swain and D.A. Landgrebe, A means of utilising ancillary information in multispectral classification, *Remote Sensing of Environment*, vol. 12, 1982, pp. 463–477.
[17] A. Srinivasan, An Artificial Intelligence Approach to the Analysis of Multiple Information Sources in Remote Sensing. *PhD. Thesis*, The University of New South Wales, Kensington, Australia, 1990.
[18] A. Srinivasan and J.A. Richards, Analysis of GIS spatial data using knowledge-based methods, *Int. J. Geographic Information Systems*, vol. 7, no. 6, 1993, pp. 479–500.
[19] J.A. Richards, Analysis of remotely sensed data: the formative decades and the future. *IEEE Transactions on Geoscience and Remote Sensing*, 43, March 2005, pp. 422–432.
[20] A. Gore, The Digital Earth: Understanding our planet in the 21st Century, *Photogrammetric Engineering and Remote Sensing*, vol. 65, no. 5, 1999, p. 528.
[21] M. Craglia and 16 others, Digital Earth 2020: towards the vision for the next decade, *Int J. Digital Earth*, vol. 5, no. 1, January 2012, pp. 4–21.
[22] M.F. Goodchild and 16 others, Next-generation Digital Earth, *Proceedings of the National Academy of Science,* early edition 2012, 7 pages, www.pnas.org/cgi/doi/10.1073/pnas.1202383109
[23] http://archive.cyark.org
[24] M.F. Goodchild, Citizens as voluntary sensors: spatial data infrastructure in the world of Web 2.0, *Int. J. Spatial Data Infrastructures Research*, vol. 2, 2007, pp. 24–32.
[25] Queensland Police Service, *Disaster Management and Social Media – a case study*, Media and Public Affairs Branch, Queensland Police Service, 2011.
[26] E. Bakshy, J.M. Hofman, W.A. Mason and D.J. Watts, Everyone's an influencer: quantifying influence on twitter, *Proceedings of the Fourth ACM International Conference on Web Search and Data Mining* (WSDM '11). ACM, New York, NY, USA, 2011, pp. 65–74.

## BOOK REVIEW

# REVIEW OF SATELLITE REMOTE SENSING: A NEW TOOL FOR ARCHAEOLOGY

*Tom G. Farr, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA*




Edited by Rosa Lasaponara,
Nicola Masini
Springer, 2012,
ISBN: 978-90-481-8800-0 (hardcover),
-8801-7 (ebook)

In the last few years, the use of remote sensing techniques in archaeology has increased in leaps and bounds. This is due mainly to the introduction of Geographic Information Systems (GIS), which provide a geographic framework for airborne and spaceborne images; new, very high resolution (VHR) satellite images; and global digital topographic data. New processing techniques have also been developed by archaeologists for specific application to their field.

Thus, the appearance of this new book: Satellite Remote Sensing: A New Tool for Archaeology, edited by Rosa Lasaponara and Nicola Masini is very timely inasmuch as it provides both a good basis for analysis as well as several test cases illustrating the use of remote sensing techniques for archaeology. The book begins with an excellent introduction to remote sensing techniques suitable for undergraduate or graduate instruction. The case studies contain more detailed information on applications of diverse data sets in several different environments which working archaeologists should find useful. One remote sensing technique noticeably missing is imaging radar. This is likely because the data are significantly different from visible to near infrared images more commonly used.

The book is well written and organized. The illustrations, important for a book on remote sensing, are of high quality and many are in color. The addition at the end of 3 indexes: for people, places, and topics is welcome and enhances the reader's ability to look up efficiently an author or a site. At times, the fact that English is not the mother tongue of most of the authors becomes apparent, but not so much to make understanding a problem.

The first 4 chapters do a good job of summarizing technology and techniques for archaeologists unfamiliar with remote sensing. Chapter 1 concentrates on basic concepts derived from subjective aerial photograph interpretation such as tone and texture and surveys the current list of VHR satellites. Chapter 2 is more quantitative and describes digital enhancement techniques along with color composites and other analysis techniques suitable for multi-spectral image data. Spatial filtering and analysis is also covered with good examples. Chapter 3 covers multi-dimensional classification and Chapter 4 finishes with a description of various data fusion techniques, in particular pan-sharpening. Throughout these initial chapters, many examples from archaeology are shown and in the following chapters the techniques are applied in other contexts.

Chapter 5, on Geomatic (or GIS) techniques in remote sensing and archeology summarizes the application of topographic and cartographic techniques in archaeology. In particular, the author stresses the value of multi-scale data ranging, for example, from topographic surveys of individual sites to airborne photogrammetric surveys of a neighborhood to satellite images of a region. Emphasis is placed on the need to place all surveys into an absolute cartographic base as this is now possible through the use of GPS receivers and produces a much more useful dataset. Several examples are given of current remote sensing systems and how they can be analyzed in a geographic context.

The following 9 chapters are essentially case studies, applying remote sensing to a particular site, but all derive principles from their studies which can be applied broadly. Chapter 6 is a case study concerning the site of Hierapolis, Turkey. Here, a multi-faceted approach was used to reconstruct the city and its environs. In particular, old declassified satellite images were combined with modern VHR satellites and all of them geometrically corrected into a GIS map base. The base served to integrate higher-resolution topography and field data such as ground-penetrating radar (GPR) as well as lower-resolution multi-spectral satellite images. Significant progress in understanding the region is summarized in the chapter.

Chapter 7 is a synopsis of the activities of NASA with regard to the application of remote sensing in archaeology. NASA supported some of the earliest uses of remote sensing starting with spaceborne photography, both black and white and color-IR. A conference in 1984 sponsored by NASA led to further advances, especially in multi-spectral and thermal infrared applications. Later, VHR and radar systems added to the tools used by archeologists. The chapter ends with a view toward the future, involving ASTER, imaging spectrometers, and the interpretation of vegetation remote sensing signatures for archaeological applications.

Chapter 8 details a successful case of detection and monitoring of site looting in Peru using time series of VHR images. The process has been automated to some extent with the hope it can be used on a routine basis.

Chapter 9 concerns the site of Angkor in Cambodia, where multi-spectral and VHR images have allowed detailed analysis of the history of water use. Both airborne and spaceborne remote sensing techniques were used to expand the site maps and as a GIS base for field data. Emphasis on remote sensing use was on mapping in a vegetated region and enhanced change detection.

Chapter 10 moves to Yemen for a study of ancient silver mines now threatened by expansion of modern mines. Multispectral and VHR images were the main workhorses here as the arid climate provided good exposure of the rocks and minerals of interest.

Chapter 11 shows the use of moderate-resolution multispectral and multi-temporal images to delineate an ancient irrigation system now obscured by modern agriculture and settlements in Burma. In this case, soil and vegetation moisture were the most important indicators of the irrigation system, so a multi-spectral index of vegetation moisture was used. Topographic data of sufficient resolution were not available, but the vegetation maps proved very useful.

Chapter 12 describes a search for underground irrigation tunnels in the extremely dry Nazca area of Peru. As water still passes through the tunnels, multi-spectral vegetation indices were used and a several-year time series developed. The multi-temporal indices showed signatures associated with different types of irrigation features.

Chapter 13 compares multi-spectral and VHR images from satellites and past air photos to show the potential for these various types of images for revealing archeological features in a Romanian test site. The general conclusion was that high resolution multi-spectral satellite data provide a new dimension for discovery.

Chapter 14 returns to the Nazca area of Peru with an extensive effort integrating ground, airborne, and spaceborne remote sensing techniques. Satellite data included topography, multi-spectral, and VHR images. The chapter describes the processing steps, including vegetation indices, pan-sharpening, spatial filtering, principal components, and others described in the initial chapters of the book. In the field, GPR, magnetic, and resistivity surveys were used to delineate buried structures. Fusion of the field data with VHR images in a GIS was a useful way to visualize the integrated data sets.

The background information combined with the range of studies presented in this book provide a well-balanced look at the various remote sensing techniques, ways of processing the data, and emphasizes the use of GIS to integrate the remote sensing data with other types of archeological data. Thus, Satellite Remote Sensing: A New Tool for Archaeology provides a blueprint for future archaeologists seeking to make the most of remote sensing.

**Tom Farr** received BS and MS degrees from Caltech, and a PhD from the University of Washington, all in Geology. After a short time as an engineering geologist, he joined the Radar Sciences Group at the Jet Propulsion Laboratory, where he has been since 1975. At JPL, he helped develop the first geologic applications of imaging radar using aircraft, satellites, and the Space Shuttle. He was the Deputy Project Scientist on the Shuttle Radar Topography Mission, which used interferometric radar to produce a near-global topographic map of the Earth. He has also been a science investigator on European and Japanese satellite programs and has assisted in the interpretation of radar images from Venus and recently from Saturn's moon Titan. His scientific research includes the use of remote sensing and digital topographic data for study of landscapes on Earth and other planets and how they are formed and modified by climate and tectonic or volcanic activity. He is also leading an effort to apply interferometric radar observations to groundwater monitoring.

## REPORTS

# IGARSS IN MUNICH JULY 22–22, 2012, IMPRESSIONS FROM THE FIRST DAYS

*Werner Wiesbeck, Martti Hallikainen, IEEE GRSS Awards Committee Chairs*

IGARSS in Munich set a number of new records regarding papers submitted (3361), papers presented (1419), posters presented (1149) and participants (>2700) from 65 countries.

In the following some highlights from the Plenary Session, held on Monday morning at the International Congress Centre Munich (ICM), are presented. The Plenary Session was held in the large auditorium at the International Congress Centre Munich. Welcome addresses were given from the General Co-Chairs Alberto Moreira and Yves-Louis Desnos, the Delegate of the Bavarian Minister of Economic Affairs, Infrastructure, Transport and Technology, IEEE GRSS President Jón Atli Benediktsson and IEEE President-Elect 2012 Peter W. Staecker. They all stressed the excellent success of IGARSS over the years and especially of IGARSS 2012 in Munich. The IGARSS theme, the selected topics and last, but not least, the city of Munich were the reasons for this success. The IGARSS Co-Chair Alberto Moreira remembered that the second IGARSS 1982 was also in Munich, exactly 30 years ago and how happy we are to host it now again. The Co-Chair Yves-Louis Desnos gave an insight in the conference organization and listed the numbers of success.

Our GRSS President Jón Atli Benediktsson made a short excurse into the history of the Society. Founded in 1962 as a Group on Geoscience Electronics (G-GE) and renamed in 1981 to Geoscience and Remote Sensing Society (GRSS), IGARSS was the event to celebrate the 50th anniversary. Based on the success over the last 30 years the President gave his vision for GRSS in the future: there is no way around GRSS for scientists and engineers in Remote Sensing and the future will be bright.

IEEE President-Elect 2012 Peter W. Staecker was quite impressed about our Society and showed how IEEE as a whole is strengthening its position in the world wide scientific competition. Our Society is one of the most successful in IEEE, although it is one of the smaller ones. (Photos of the IEEE President-Elect 2012 Peter W. Staecker follow below.)

*IGARSS 2012 General Co-Chairs Alberto Moreira and Yves-Louis Desnos stressing the conference highlights.*

*IEEE GRSS President Jón Atli Benediktsson showing the 50th anniversary booklet, which was given to all IGARSS participants.*

### Fellow Recognitions at the Plenary Session

After the welcome addresses the awards and recognitions were presented. Five GRSS IEEE 2012 Fellows were recognized (two of them were unfortunately not able to be present), and two Major GRSS Awards were presented. In addition a high level IEEE publication award was presented. As usual the Plenary Session was chosen for the recognition of the 2012 IEEE GRSS Fellows. We were proud that the IEEE President-Elect 2012 Peter W. Staecker was present for the Fellow Recognition.

### IEEE Fellow Awards

The grade of IEEE Fellow recognizes unusual distinction in the profession and shall be conferred only by invitation of the IEEE Board of Directors upon a person of outstanding and extraordinary qualifications and experience in IEEE designated fields. The IEEE bylaws limit the number of members who can be advanced to Fellow grade in any one year to one per mil, that is 1 in 1 000, of the Institute membership, exclusive of students and affiliates. To qualify, the candidate must be a Senior Member and be nominated by an individual familiar with the candidate's achievements. Endorsements are required from at least five IEEE Fellows and an IEEE Society best qualified to judge. The IEEE Fellow Committee, comprising 50 IEEE Fellows, carefully evaluates all nominations and presents a list of

recommended candidates to the IEEE Board of Directors for the final election.

The following GRSS members were elevated to the Fellow status effective January 1st 2012:

- ***Prof. Jocelyn Chanussot*** from the ***Grenoble Institute of Technology, Grenoble, France***
- ***Prof. Eric L. Miller*** from ***Tufts University, Medford MA, USA***
- ***Dr. Simonetta Paloscia*** from ***Institute of Applied Physics - National Research Council, Florence, Italy***
- ***Prof. John D. Mathews*** from ***The Pennsylvania State University, University Park, PA USA***
- ***Dr. Stephen L. Durden*** from ***Jet Propulsion Laboratory, Pasadena, CA, USA***

***Prof. Jocelyn Chanussot*** received his Fellow Award with the citation:

***"For contributions to data fusion and image processing for Remote Sensing."***

**Jocelyn Chanussot** (M'04–SM'04-F'12) received the M.Sc. degree in electrical engineering from the Grenoble Institute of Technology (Grenoble INP), Grenoble, France, in 1995, and the Ph.D. degree from Savoie University, Annecy, France, in 1998. In 1999, he was with the Geography Imagery Perception Laboratory for the Delegation Generale de l'Armement (DGA - French National Defense Department). Since 1999, he has been with Grenoble INP, where he was an Assistant Professor from 1999 to 2005, an Associate Professor from 2005 to 2007, and is currently a Professor of signal and image processing. He is currently conducting his research at the Grenoble Images Speech Signals and Automatics Laboratory (GIPSA-Lab). His research interests include image analysis, multicomponent image processing, nonlinear filtering, and data fusion in remote sensing.

Dr. Chanussot is the founding Chair of IEEE Geoscience and Remote Sensing French chapter (2007-2010), which received the 2010 IEEE GRS-S Chapter Excellence Award "For excellence as a Geoscience and Remote Sensing Society chapter demonstrated by exemplary activities during 2009". He was the recipient of the 2011 IEEE GRSS Symposium Best Paper Award. He was a member of the IEEE Geoscience and Remote Sensing Society AdCom (2009–2010), in charge of membership development. He was the General Chair of the first IEEE GRSS Workshop on Hyperspectral Image and Signal Processing, Evolution in Remote sensing (WHISPERS). He is the Chair (2009-2011) and was the Co-chair of the GRS Data Fusion Technical Committee (2005–2008). He was a member of the Machine Learning for Signal Processing Technical Committee of the IEEE Signal Processing Society (2006–2008) and the Program Chair of the IEEE International Workshop on Machine Learning for Signal Processing, (2009). He was an Associate Editor for the IEEE GEOSCIENCE AND REMOTE SENSING LETTERS (2005–2007) and for Pattern Recognition (2006–2008). Since 2007, he is an Associate Editor for the IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING. Since 2011, he is the Editor-in-Chief of the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing.

The next on to be recognized was **Eric L. Miller** with the citation:

***"For contributions to inverse problems and physics-based signal and image processing."***

**Eric L. Miller** (S'90, M'95, SM'03, F'12) received the BS in 1990, the MS in 1992, and the Ph.D. degree in 1994 all in Electrical Engineering and Computer Science at the Massachusetts Institute of Technology, Cambridge, MA.

*Jocelyn Chanussot (right) receives his recognition from IEEE President-Elect 2012 Peter W. Staecker (left).*

*Eric L. Miller (right) receives his recognition from IEEE President-Elect 2012 Peter W. Staecker (left).*

He is currently a professor in the Department of Electrical and Computer Engineering at Tufts University with adjunct appointments in the departments of Biomedical Engineering and Computer Science. Since September 2009, Prof. Miller has served as the Associate Dean of Research for Tufts' School of Engineering. Dr. Miller's research interests include physics-based tomographic image formation and object characterization, inverse problems, regularization, statistical signal and imaging processing, and computational physical modeling. This work has been carried out in the context of applications including medical imaging, nondestructive evaluation, environmental monitoring and remediation, landmine and unexploded ordnance remediation, and automatic target detection and classification.

Dr. Miller is a member of Tau Beta Pi, Phi Beta Kappa and Eta Kappa Nu. He received the CAREER Award from the National Science Foundation in 1996 and the Outstanding Research Award from the College of Engineering at Northeastern University in 2002. He is currently serving as an Associate editor for the IEEE Transactions on Geoscience and Remote Sensing and was in the same position at the IEEE Transactions on Image Processing from 1998-2002. Dr. Miller was the co-general chair of the 2008 IEEE International Geoscience and Remote Sensing Symposium held in Boston, MA.

Further ***Dr. Simonetta Paloscia*** was recognized with the citation:

***"For contributions to active and passive microwave Remote Sensing of vegetation and land surfaces."***

**Simonetta Paloscia** received her degree in agricultural sciences in 1979, from the University of Florence. After graduation she joined the National Research Council (C.N.R.) where she worked in agrometeorology and microwave remote sensing studies concerning natural surfaces. Since 1987 she is with IFAC-CNR (Institute of Applied Physics) and her research currently concerns with the study of microwave emission and scattering of soil (both bare and snow-covered) and vegetation. Since January 2004 she is leader of the Microwave Remote Sensing group at IFAC, and scientific responsible of the research line "Microwave Remote Sensing of natural surfaces", within the framework of the Earth Observation Project of CNR. She had participated in various microwave remote sensing campaigns, where she has coordinated the activities of ground truth data collection and data analysis. She was Principal investigator and co-investigator of several national and international projects (ASI, EC, ESA, JAXA). Since 1996 she is Principal Investigators in a Science Team of JAXA, for the use of AQUA/AMSR-E and GCOM/AMSR-2 microwave data in algorithms for measuring soil moisture and vegetation biomass from satellites. She has a temporary teaching contract of "Microwave Remote Sensing Applications" for a Professional Master "Geomatics and Natural Resources Evaluation" at the 'Istituto Agronomico per l'Oltremare' of the Ministry of Foreign Affairs in Florence. She was member of organizing and steering committees of some international meetings, such as the Specialist Meeting on Microwave Radiometry and Remote Sensing Applications and the International Geoscience and Remote Sensing Symposium (IGARSS). She is member of the permanent Steering Committee of MicroRad Meeting and she also was General Co-chair of the MicroRad 1999 and 2008 meetings organized in Florence. She is regular referee of the following international journals: IEEE Transactions on Geoscience and Remote Sensing e International Journal of Remote Sensing. She is also Associate Editor of the International Journal of Remote Sensing. She is Senior member of IEEE and she was nominated Fellow in 2012, treasurer of Associazione Italiana di Telerilevamento (AIT) and Fellow of Electromagnetics Academy of Cambridge (MA, USA). She is author and co-author of more than 60 works published on international

*A real happy Dr. Simonetta Paloscia receives her recognition from IEEE President-Elect 2012 Peter W. Staecker (left).*

*All present 2012 IEEE GRSS Fellows (from left) with GRSS President Jón Atli Benediktsson, Simonetta Paloscia, Jocelyn Chanussot, Eric L. Miller and the IEEE President-Elect 2012 Peter W. Staecker at the right.*

journals and books, of more than 90 papers published on proceedings of international meetings.

The following 2012 IEEE Fellows were not able to attend the IGARSS Plenary Session to be recognized:

***Prof. John D. Mathews,*** citation:
***"For contributions to Radar observations of meteors."***

***Dr. Stephen L. Durden,*** citation:
***"For contributions to microwave Remote Sensing and Radar systems, including space-borne cloud Radar"***

## IEEE W.R.G. Baker Award

The IEEE W.R.G. Baker Award is a very high ranked IEEE award. We were quite happy that for the first time GRSS members receive this award and we were lucky that it could be presented at IGARSS 2012 in Munich to DLR members. The IEEE W.R.G. Baker Award was established in 1956 and is presented by the IEEE Board of Directors for the most outstanding paper reporting original work published in any IEEE archival publications (such as Transactions, Journals and Letters), Magazines, or Proceedings. The paper must have been published during a three to five year window prior to the presentation year of the award on the fundamentals of electrical engineering, electronics, computing, and related arts and sciences as represented by IEEE. No more than one award may be given in any year.

**The 2012 IEEE W.R.G. BAKER AWARD is presented to Gerhard Krieger, Alberto Moreira, Hauke Fiedler, Irena Hajnsek, Marian Werner, Marwan Younis, and Manfred Zink** for their paper titled

***"TanDEM-X: A Satellite Formation for High-Resolution SAR Interferometry," IEEE Transactions on Geoscience and Remote Sensing, vol. 45, no. 11, part 1, November 2007, pp. 3317–3341***

Dr. Gerhard Krieger is an IEEE Senior Member and head of the Radar Concepts Department with the German Aerospace Center's Microwaves and Radar Institute, Oberpfaffenhofen, Germany.

Dr. Alberto Moreira is an IEEE Fellow and the Director of the German Aerospace Center's Microwaves and Radar Institute as well as Full Professor with the Karlsruhe Institute of Technology, Germany, in the field of microwave remote sensing.

Dr. Hauke Fiedler is the head of the Space Situational Awareness Team with the German Aerospace Center's GSOC, Oberpfaffenhofen, Germany.

Dr. Irena Hajnsek is an IEEE Senior Member and Professor at the Institute of Environmental Engineering of the Swiss Federal Institute of Technology Zurich, Switzerland and head of the Polarimetric SAR Interferometry Group at the Microwaves and Radar Institute of the German Aerospace Center.

Mr. Marian Werner is a scientist with the German Aerospace Center's Microwaves and Radar Institute.

An IEEE Senior Member, Dr. Marwan Younis is group leader and research scientist with the German Aerospace Center's Microwaves and Radar Institute.

Dr. Manfred Zink is head of the Satellite SAR Systems Department of the German Aerospace Center's Microwaves and Radar Institute.

## IEEE GRSS Major Awards

The call for nominations for the GRSS Education Award, the GRSS Outstanding Service Award and the GRSS

*Group photo of the 2012 IEEE W.R.G. Baker Award receipients: From left GRSS President Jón Atli Benediktsson, Alberto Moreira, Irena Hajnsek, Marian Werner, Manfred Zink, Hauke Fiedler, Marwan Younis, Gerhard Krieger and the IEEE President-Elect 2012 Peter W. Staecker at the right.*

Distinguished Achievement Award are published in the GRSS Newsletter. The nomination forms are available on the GRSS home page (http://www.grss-ieee.org/about/awards/). Any member, with the exception of GRSS AdCom members, can make nominations to recognize deserving individuals. Typically the lists of candidates comprise three to five names. An independent Major Awards Committee makes the selection, which is approved by the GRSS AdCom.

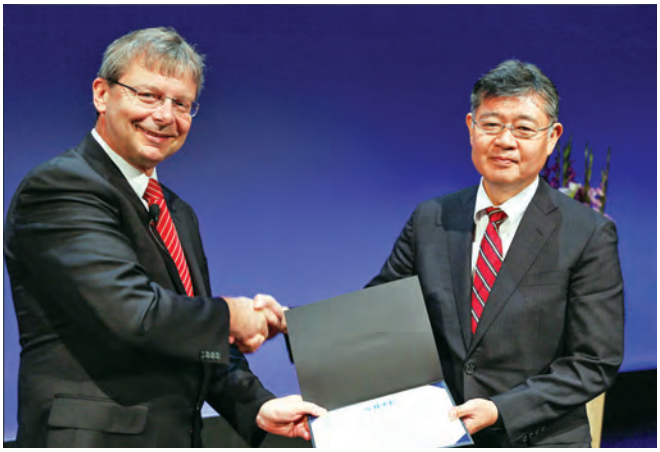
## IEEE GRSS Education Award

The **Education Award** was established to recognize an individual who has made significant educational contributions to the field of GRSS. In selecting the individual, the factors considered are significance of the educational contribution in terms of innovation and the extent of its overall impact. The contribution can be at any level, including K-12, undergraduate and graduate teaching, professional development, and public outreach. It can also be in any form (e.g. textbooks, curriculum development, educational program initiatives). IEEE GRSS membership or affiliation is required. The awardee receives a certificate.

The **2012 Education Award Prof. Motoyuki Sato** from ***Tohoku University Sendai, Japan*** with the citation:

***"In recognition of his significant educational contributions to Geoscience and Remote Sensing."***

**Motoyuki Sato** (S'79-M'80-SM'02-F'10) received the B.E., M.E degrees, and Dr. Eng. degree in information engineering from the Tohoku University, Sendai, Japan, in 1980, 1982 and 1985, respectively. Since 1997 he is a professor at Tohoku University and a distinguished professor of Tohoku University since 2007, and he is the Director of Center for Northeast Asian Studies, Tohoku University since 2009. From 1988 to 1989, he was a visiting researcher at the Federal German Institute for Geoscience and Natural Resources (BGR) in Hannover, Germany. His current interests include transient electromagnetics and antennas, radar polarimetry, ground penetrating radar (GPR), borehole radar, electromagnetic induction sensing, interferometric and polarimetric SAR. He has conducted the development of GPR sensors for humanitarian demining, and his sensor ALIS, which is a hand-held dual sensor, has detected more than 80 mines in mine fields in Cambodia since May 2009. He is a visiting Professor at Jilin University, China, Delft University of Technology, The Netherlands, and Mongolian University of Science and Technology. Dr. Sato is a member of the GRSS AdCom (2006-) where he is responsible for specialty symposia and Asian issues. He is an associate editor of IEEE GRSS Newsletter, and a guest editor of the special issue of GPR2006 and GPR2010 in Transactions on Geoscience and Remote Sensing. He was the chair of the IEEE GRSS Japan Chapter (2006–2007). He served the general chair of IGARSS2011.



*Motoyuki Sato (right) receives the IEEE GRSS Eduction Award from our GRSS President Jon Atli Benediktsson.*

## IEEE GRSS Outstanding Service Award

The **Outstanding Service Award** was not presented in 2012.

## IEEE GRSS Distinguished Achievement Award

The **Distinguished Achievement Award** was established to recognize an individual who has made significant technical contributions, within the scope of GRSS, usually over a sustained period. In selecting the individual, the factors considered are quality, significance and impact of the contributions; quantity of the contributions; duration of significant activity; papers published in archival journals; papers presented at conferences and symposia; patents granted; and advancement of the profession. IEEE membership is preferable but not required. The award is considered annually and presented only if a suitable candidate is identified. The awardee receives a plaque and a certificate.

The **2012 IEEE GRSS Distinguished Achievement Award** is presented to ***Dr. Didier Massonnet*** from ***Centre National d'Etudes Spatiales, Toulouse, France*** with the citation:

***"For contributions to observing earthquake, co-seismic or post-seismic displacements, volcano deformation, natural and artificial subsidence. "***

**Didier Massonnet** spent his entire career within the French Space Agency (CNES). It started with a one-year stay at JPL devoted to the data acquired by the Sir-B mission. Once back and among studies aimed at designing algorithms for Synthetic Aperture Radar image formation or quality measurement on SAR images, he initiated at the end of 1985 a program for developing radar interferometry and differential interferometry. He worked in support of airborne SAR campaigns using the CNES airborne radar (VARAN-S) or the DLR airborne radar (E-SAR), which led to a very fruitful cooperation with DLR. He prepared operational products for the coming ERS-1, notably for ocean studies. At the same time, he prepared investigation programs


*The 2012 IEEE GRSS Distinguished Achievements Award recipient Didier Massonnet (right) receives from the GRSS President Jon Atli Benediktsson a plaque and a certificate.*

and tested differential interferometry and related tools, which were finally applied to all the space borne missions of the time (ALMAZ, ERS1-2, SIR-C, J-ERS). Significant results followed, mostly for the first time, in observing earthquake co-seismic of post-seismic displacements, volcano deformation, natural or artificial subsidence or the key role of atmosphere as the main limitation of the technique. A large effort was then put in organizing many training courses worldwide in order to disseminate the technique among non-radar specialists.

In parallel, Didier Massonnet kept a steady activity in the design of SAR systems, such as the Interferometric Cartwheel. He acted as the General Chairman of IGARSS'03 held in Toulouse.

More recently, as the PHARAO project manager, Didier Massonnet leads the ambitious goal of building and testing the best atomic clock ever put in space, in the frame of ESA's ACES project (Atomic Clock Ensemble in Space). This activity is not unrelated to remote sensing as accurate clocks might become key to mapping the earth gravity potential.

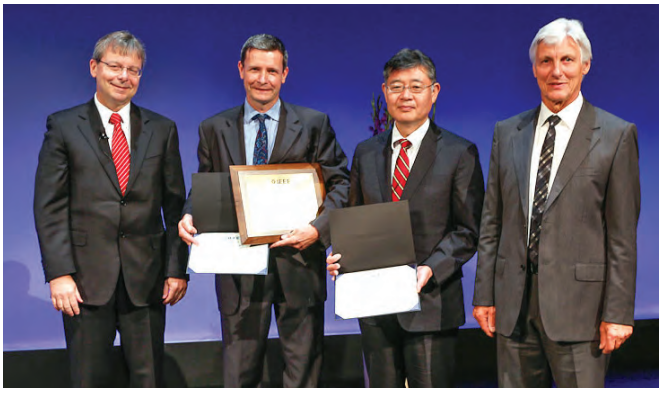
## Special Recognition on the Occasion of the 50th Anniversary of the IEEE GRSS

After the awards a special recognition on the occasion of the 50th anniversary of the IEEE GRSS the Society proudly recognized the following individuals who have made a lasting contribution in technical, educational and leadership aspects of the IEEE GRSS:

- Fawwaz Ulaby, University of Michigan, USA
- Werner Wiesbeck, Karlsruhe Institute of Technology, Germany
- Wolfgang-Martin Boerner, University of Illinois at Chicago, USA

Prof. Kamal Sarabandi introduced the honor recipients and gave each of us a minute to talk about his memories. Each received a Certificate of Recognition and, again the small package. The most significant influence on the Society came for sure from Fawwaz Ulaby. He was the one who initiated the transition from G-GE to GRSS in 1980. Fawwaz explained the situation of G-GE at the end of the 1970ies and the engagement to get GRSS started.

*Fawwaz Ulaby (center) receives the Certificate of Recognition and a handshake from GRSS President Jon Atli Benediktsson, Kamal Sarabandi at the right.*



*The Major IEEE GRSS Award recipients pose with our GRSS President Jon Atli Benediktsson (left) and the Awards Co-Werner Wiesbeck (right).*

*Werner Wiesbeck (center) receives the Certificate of Recognition and a handshake from GRSS President Jon Atli Benediktsson, Kamal Sarabandi at the right.*

*Wolfgang Boerner, replying to the received honor, with his view on the further integration of Remote Sensing in South-East Asia in GRSS.*

*Happy Oldies with GRSS President Jon Atli Benediktsson and Kamal Sarabandi.*

Werner Wiesbeck has as IEEE GRSS President 2000-2001 stimulated the further internationalization and opening of the Society to Europe and Asia Africa and South America. AdCom members from Europe and Asia supported this internationalization and so GRSS became one most international Societies in IEEE.

Wolfgang Börner is a never resting men. For the Society he is active in recruiting members, initiates Chapter foundations and he is the most successful GRSS Award and IEEE Fellow nominator. His activities span all of South-East Asia and India.

The presentation of the Awards and Recognitions was followed after the break by presentations of the distinguished Plenary speakers:

- Johann Dietrich Wörner, since 2007 Chairman of the Executive Board of the German Aerospace Center (DLR).
- Volker Liebig, since 2004 Director of Earth Observation and Head of ESRIN, ESA's Italian Center.
- Ghassem R. Asrar, Director of the World Climate Research Program (WCRP) in Geneva.

The Plenary Session was closed by the Technical Program Committee Co-Chair Irena Hajnsek. She outlined the structure of the conference, the 16 parallel sessions within the International Congress Centre Munich and where to get what. A great program for a great conference.

*Dr. Wörner explaining the vision of DLR on future Remote Sensing.*

*Dr. Asrar, giving a view on the connection of Remote Sensing with World Climate Research.*

*Dr. Liebig discussed the engagement of ESA in Remote Sensing.*

*Irena Hajnsek outlining the conference organization.*

*Start in a "wet evening" for the IGARSS 2012 organizing team (from left): Local Organizer Karl-Heinz Bethke, General Co-Chair Alberto Moreira, Finance Chair Werner Wiesbeck, Technical Co-Chair Irena Hajnsek, Local Organizer Jens Fischer and General Co-Chair Yves-Louis Desnos.*

*We had a lot of exciting shows, but also this one (Goasl Schoizn), where those sitting closer look some what irritated.*

*Close to ten pm half of the attendees were dancing, finally some on the tables, while the others were looking, left IEEE President elect Peter W. Staecker, in front of him Kiyo Tomiyasu and his wife and on the other side Melba Crawford and Jon Atli Benediktsson.*

## Social Program

What should be mentioned here also is the outstanding Social Program of IGARSS 2012. There was not one day without the opportunity to discuss with colleagues and have fun:

- Sunday: Welcome Reception
- Monday: Reception at BMW World
- Tuesday: Young Professionals Lunch and Bavarian Evening
- Wednesday: Technical Committee and Chapter Chairs Lunch, Soccer Game, and Exhibitor Reception
- Thursday: Woman in Geoscience, Remotes Sensing and Engineering Luncheon and IGARSS 2012 Awards Banquet
- Friday: Technical Tour to German Aerospace Center (DLR) in Oberpfaffenhofen, and to EADS Astrium in Ottobrunn

A few photos from the Bavarian Evening should give an impression of a special event of the "Social Program". The Bavarian Evening was held at the Löwenbräu Keller, the Restaurant of one of the oldest breweries in Munich. It could hold 1,000 persons, and, the IGARSS 2012 participants filled it.

For more photos from IGARSS 2012 see igarss12.org and open the Photo Gallery or the Webstreams.

IGARSS 2013 will be held in Melbourne Australia. Melbourne will continue the IGARSS success from Munich; it is a must for us to be there.

# WHISPERS 2012

## 4th Workshop on Hyperspectral Image and Signal Processing – Evolution in Remote Sensing http://www.ieee-whispers.com

*Liangpei Zhang, Wuhan University, China, Jenny (Qian) Du, Mississippi State University, USA, and Jocelyn Chanussot, Grenoble Institute of Technology, France*

The 4th Workshop on Hyperspectral Image and Signal Processing – Evolution in Remote Sensing (WHISPERS) was held on June 4–7, 2012 in Shanghai, China. WHISPERS 2012 received the technical sponsorship of the IEEE Geoscience and Remote Sensing Society (GRSS), and support from Tongji University, State Key Laboratory of Information Engineering in Surveying, Mapping, and Remote Sensing (LIESMARS) in Wuhan University, Center for Earth Observation and Digital Earth (CEODE) of Chinese Academy of Science, Nanjing University, and the WHISPERS Foundation. Organized in two parallel tracks over three days, the workshop was a great success, gathering around 180 researchers from 21 different countries worldwide.

Hyperspectral remote sensing has emerged in the middle of 1980s. Keeping up with the international pace, China has made significant progress in this promising field. During the last ten years, in addition to the technical developments, the applications of hyperspectral imaging in various areas have also been actively conducted in China. Thus, WHISPERS 2012 offers a prestigious but convenient forum for domestic researchers to share their most recent research outcomes with international peers; meanwhile, international experts have this great opportunity to know more about hyperspectral research status in China, and explore the possible collaboration opportunity in the future.

A total of 140 papers were received (both regular and special session submissions), 122 of which were accepted, resulting in a 13 % rejection rate. There were 91 oral presentations and 31 posters. WHISPERS 2012 comprised thirteen carefully arranged regular sessions (five on signal and image processing, three on physical modeling, two on sensor design, and three on applications), covering a wide spectrum of techniques. In addition, two special sessions were organized: spectral unmixing; geology, mineralogy, and mining industry. All the papers published at WHISPERS 2012 will be available on IEEE Xplore.

As the first time in WHISPERS, tutorials were offered, including:

- Spectral Unmixing of Hyperspectral Data, by Dr. Anotonio Plaza from University of Extremadura, Spain
- Feature Mining from Hyperspectral Data, by Dr. Xiuping Jia from The University of New South Wales, Australia


*WHISPERS 2012 gathered around 180 attendees from 21 different countries worldwide.*

*The banquet was held in a revolving restaurant of the Oriental Pearl Tower, at the tip of the famous Lujiazui financial district in Pudong by the side of Huangpu River. It is opposite of the Bund, making it a perfect location of enjoying the splendid night view of Shanghai.*

*Our warmest thanks to our three prestigious plenary speakers: Qingxi Tong, Jean-Pierre Bibring, and Susan Ustin.*


*The representative of the winning team from France (second left) received the certificate and trophy from the WHISPERS 2012 Chairs.*


*The winning team from Zhejiang University, China (center and second right) received the certificate and trophy from the WHISPERS 2012 Chairs.*

and Dr. Mingyi-He from Northwestern Polytechnical University, China

About 50 students and researchers attended these two well-accepted tutorials.

The technical program also featured three outstanding plenary talks delivered by prestigious and highly recognized experts worldwide:

- Professor Qingxi Tong, from Peking University, China, delivered a talk entitled "The Progress of Hyperspectral Remote Sensing in China."
- Professor Jean-Pierre Bibring, from University of Paris, France, delivered the talk "Planetary Hyperspectral Imagery: from remote characterizations down to microscopic *in situ* analysis."
- Professor Susan L. Ustin, from University Of California, Davis, USA, delivered the talk "Monitoring Canopy Chemistry with Next Generation Imaging Spectrometer from Satellites."

Three papers were selected to receive a Best Paper Award, in no specific order. The authors received one copy of the greatly sought-after "golden whispers" trophy, and a certificate of recognition. Congratulations go to:

- Geoffrey S. Quinn, Fabio Visintini, and K.Olaf Niemann (from University of Victoria, Canada) for their paper entitled "Considering the implications of species on pigment estimation from leaf spectroscopy."
- Minchao Ye and Yuntao Qian (from Zhejiang University, China) for their outstanding contribution "Mixed Poisson-Gaussian noise model based sparse denoising for hyperspectral imagery."
- Said Moussaoui, Jerome Idier (from L'UNAM Université, France), and Emilie Chouzenoux (from Université Paris, France) for their outstanding contribution "Primal dual interior point optimization for penalized least squares estimation of abundance maps in hyperspectral imaging."

It is worth mentioning that a special issue of the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (IEEE-JSTARS) associated to WHISPERS 2012 (but open to everyone working on hyperspectral image

and signal processing) will be published in April 2013. The Guest Editors of the special issue are:

- Liangpei Zhang, Wuhan University, China
- Jenny Q. Du, Mississippi State University, USA
- Jocelyn Chanussot, Grenoble Institute of Technology, France
- Bing Zhang, Chinese Academy of Sciences
- Xiaohua Tong, Tongji University, China
- Peijun Du, Nanjing University, China

WHISPERS is also a venue for cross-fertilization between industrial partners and researchers from the academic world. We would like to thank the companies sponsoring and/or exhibiting their latest products during the event (HySpex, ASD, ENVI, Itres, Golden Way Scientific, EXELIS, NBL, and ZhongDi Instruments). Some of them are WHISPERS' long-term sponsors, and we truly appreciate their continued support!

In addition to the technical program, the workshop included some remarkable social events, such as a welcome dinner supplied with delicious Shanghai cruisine, one of the most popular Chinese cruisine. The banquet was held in a revolving restaurant of the Oriental Pearl Tower, at the tip of the famous Lujiazui financial district in Pudong by the side of Huangpu River. This distinct landmark is opposite of the Bund, making it a perfect location of enjoying the splendid night view of Shanghai.

Shanghai is internationally well-known for its charm as a global city. It is the commercial and financial center of mainland China with the largest population (over 23 million as of 2010). Shanghai is also a popular tourist destination renowned for its historical landmarks such as The Bund, City God Temple and Yuyuan Garden, as well as the extensive and growing Pudong skyline, which has been described as the "showpiece" of the booming economy of mainland China. There are so many things to see and do in and near Shanghai: visiting the reconstituted traditional Shanghai-style architecture called Shikumen ("Stone Gate") in Xintiandi ("New Heaven and Earth"), enjoying Chinese tea on a boat traveling around the scenic Water Village called Zhou Zhuang, or doing some shopping in Nanjing road, which is the world's busiest and longest shopping street.

The success of WHISPERS 2012 would be impossible without the hardworking of our technical program committee members. We are very grateful for their detailed reviews, which is the key to maintaining WHISPERS as the most prestigious meeting in hyperspectral remote sensing. We would also like to thank the local organizing committee and volunteers to help with many tedious but important duties. Last but not least, we would like to thank our loyal WHISPERS attendees, who travelled thousands of miles to attend and support this meeting. Their presence is always great encouragement to organizing teams.

*The winning team from University of Victoria, Canada (left and right) received the certificate and trophy from the WHISPERS 2012 Chairs.*


*WHISPERS is a venue for cross-fertilization between industrial partners and researchers from the academic world. We would like to thank the companies sponsoring and/or exhibiting their latest products during the event.*

After the first four successful WHISPERS meetings, we are very happy to announce that the 5th WHISPERS will move to USA and be hosted by Dr. Paul Gader at University of Florida.

Looking forward to seeing you in Florida, USA in June 2013 for this GRSS premier event!

Liangpei Zhang, Wuhan University, China

Jenny Q. Du, Mississippi State University, USA

Joceyn Chanussot, GIPSA-Lab, Grenoble Institute of Technology, France

## TECHNICAL COMMITTEES CORNER

# TECHNICAL INTEREST SURVEY RESULTS

*John Kerekes, GRSS Vice President for Technical Activities*

### 1. Introduction

The Geoscience and Remote Sensing Society (GRSS) attracts engineers and scientists who are involved in a broad range of activities. Anyone who glances at one of our journals or has attended a recent IGARSS meeting can see the breadth and diversity of interests of those that are attracted to our field. However, participation in the journals or our symposia is not limited to GRSS members, and it is an appropriate question to inquire regarding the particular interests of our *members* as we strive to provide relevant activities and services to them. This was the motivation behind a recent online survey conducted among members to gather quantitative statistics on the technical areas of interest in our society.

In June of this year, an e-mail survey invitation was sent to over 3000 members who have agreed to receive electronic communication from IEEE GRSS. The invitation included a link to an online survey consisting of five questions and a solicitation of open-ended comments. In total, 406 responses were received yielding a response rate just over 13%. This article summarizes the results of the survey.

### 2. Technical Areas of Interest

There are many ways to categorize the fields of interest of our members, but in the recent past the themes and topics used for abstract submission to IGARSS have evolved to a reasonable

**Table 1. Number of respondents selecting topics of interest. 399 respondents selected at least one topic, with each selecting on average 9.7 topics.**

| Theme – Topic | Count | Theme – Topic | Count |
|---|---|---|---|
| Analysis Techniques – Electromagnetic Modeling | 110 | Land – Land Use and Land Cover Change | 142 |
| Analysis Techniques – High Resolution SAR and InSAR | 165 | Land – Forests and Vegetation | 140 |
| Analysis Techniques – Polarization SAR and POLInSAR | 151 | Land – Agriculture | 97 |
| Analysis Techniques – Bistatic SAR | 73 | Land – Urban and Built Environment | 89 |
| Analysis Techniques – High Resolution Optical | 107 | Land – Topography, Geology and Geomorphology | 92 |
| Analysis Techniques – Hyperspectral | 152 | Land – Soils and Soil Moisture | 114 |
| Analysis Techniques – Optical and Infrared Modeling | 75 | Land – Wetlands | 57 |
| Analysis Techniques – Image Processing | 230 | Land – Inland Waters | 40 |
| Analysis Techniques – Information Extraction/ Classification | 164 | Oceans – Biology (Color) and Water Quality | 25 |
| Analysis Techniques – Tomography and 3D Mapping | 106 | Oceans – Surface Winds and Currents | 63 |
| Analysis Techniques – Geographic Information Science | 89 | Oceans – Temperature and Salinity | 42 |
| Analysis Techniques – Subsurface Sensing | 86 | Oceans – Coastal Zones | 50 |
| Atmosphere – Precipitation and Clouds | 59 | Oceans – Altimetry | 40 |
| Atmosphere – NWP and Data Assimilation | 25 | Sensors – SAR Instruments | 137 |
| Atmosphere – Atmospheric Sounding | 46 | Sensors – Active Microwave Instruments | 96 |
| Atmosphere – Aerosols and Atmospheric Chemistry | 27 | Sensors – Microwave Radiometers | 80 |
| Cryosphere – Snow Cover | 66 | Sensors – Lidar | 93 |
| Cryosphere – Ice Sheets and Glaciers | 66 | Sensors – Passive Optical and Hyperspectral | 102 |
| Cryosphere – Sea Ice | 56 | Sensors – UAV and Airborne Platforms | 119 |
| Cryosphere – Permafrost | 34 | Sensors – Ground-Based Systems | 89 |
| Data – Management and Systems | 53 | Other, please specify... | 27 |
| Data – Remote Sensing Data and Policy Decisions | 75 | (e.g., Ionospheric Radar, GIS, Sensors – GNSS Reflectometry, Geodesy, GPR, | – |
| Data – Remote Sensing Education | 104 | Oil Slick Observation, Community Remote Sensing, RFI & Frequency Allocation) | – |

set of topics. So the first two survey questions listed the 43 topics across 7 themes common to the most recent IGARSS events and asked our members to check off all that were of interest, as well as which one theme was most aligned to their interests. Tables 1 and 2 presents the results.

As can be seen, our members have broad interests with each member checking on average 9.7 topics of interest! The results are summarized by the top-level themes as shown in Table 2. It was interesting to note that fully one-half of the respondents felt most aligned with the Analysis Techniques theme.

**Table 2. Alignment of interests within each major IGARSS theme. Entries are percentage of respondents who selected a topic of interest within each theme as well as which theme the respondent feels aligns most with their interests.**

| Theme | Topic is of Interest | Topic Most Aligned |
|---|---|---|
| Analysis Techniques | 39% | 50% |
| Atmosphere | 4% | 5% |
| Cryosphere | 6% | 5% |
| Data Management, Dissemination, Education & Policy | 6% | 3% |
| Land | 20% | 14% |
| Oceans | 6% | 5% |
| Sensors | 18% | 18% |
| Other | 1% | – |

**Table 3. Alignment and participation in GRSS Technical Committees.**

| Technical Committee | Participate | Most Aligned |
|---|---|---|
| Data Archiving & Distribution Technical Committee (DAD TC) | 2% | 6% |
| Data Fusion Technical Committee (DFTC) | 6% | 23% |
| Frequency Allocations in Remote Sensing Technical Committee (FARS TC) | 2% | 4% |
| Instrumentation Future Technologies Technical Committee (IFT TC) | 3% | 30% |
| International Spaceborne Imaging Spectroscopy Technical Committee (ISIS TC) | 1% | 8% |
| None of the above | 86% | 29% |

## 3. Technical Committees

The remaining questions dealt with our members' awareness and involvement in the technical committees of the society. GRSS currently has 5 active technical committees that were established to provide a gathering point for members around emerging technology areas. These are briefly described in the following.

- *Data Archiving and Distribution* – The DAD TC mission is to provide recommendations and responses to issues related to the archiving and distribution of remotely sensed geospatial and geotemporal data, and on how new media, transmission means, and networks will impact the archiving, distribution, and format of remotely sensed data.
- *Data Fusion* – The DFTC serves as a global, multidisciplinary, network for geospatial data fusion, connecting people and resources. It aims at educating students and professionals, and at promoting best practices in data fusion applications.
- *Frequency Allocations in Remote Sensing* – The FARS TC mission is to provide technical assessments, guidance and recommendations regarding matters of frequency sharing and interference between remote sensing and other uses of the radiowave spectrum.
- *Instrumentation and Future Technologies* – The IFT committee's mission is to facilitate, engage and coordinate GRSS members and the communities-at-large to: assess the current state-of-the-art in remote sensing instruments and technology, identify new instrument concepts and relevant technology trends, and recognize enabling technologies for future instruments. The committee actively promotes and provides insight to institutions and industry on remote sensing instrument and technology development. This TC has several working groups on specific focused technologies.
- *International Spaceborne Imaging Spectroscopy* – The ISIS technical committee provides a forum for technical and programmatic discussion and consultation among national space agencies, research institutions and other spaceborne IS data providers. Goals of the ISIS are to share information on current and future spaceborne imaging spectroscopy ("hyperspectral") missions, and to seek opportunities for new international partnerships to the benefit of the global user community.

Additional information on these technical committees can be found at the GRSS web site – http://www.grss-ieee.org/community/technical-committees/.

Two questions were asked in the survey regarding members' interests in the technical committees. The first was "do you participate in?" and the second was "with which one do you feel most aligned?" Table 3 provides a summary of the

responses. One observation here is while only 14% of the respondents participate in a TC, 71% feel aligned with one.

An open response question soliciting ideas for new technical committees yielded 120 responses with the largest category (about 25%) being in the general area of signal/data/image processing & analysis. The next largest group of ideas (about 10%) were ones related to geoscience applications. Other ideas that were suggested multiple times included ones related to geospatial information science, calibration/validation, and hyperspectral imaging. In total over 30 independent topics were suggested for new technical committees.

## 4. Summary

The survey results confirm the wide interests of our members, both in the sense of the diversity of technical interests across our members as well as the breadth of interests of each individual member. GRSS attracts engineers and scientists who are much more than signal processing algorithm experts or instrument builders; it attracts members whose interests span these aspects as well as the underlying geoscience. It is truly a society of renaissance men and women!

While the current set of technical committees effectively serve the interests of those engaged, the survey also indicates there is the opportunity to serve many more members whose interests go beyond the current TC topics. It is worth considering now whether new committees should be initiated, or current ones evolved, to expand their role as gathering points for all members. A set of TCs which span the fields of interest of the society would serve to establish groups of experts who could serve as resources for society operations as well as provide identifiable entry points for outside communities looking for expertise in certain areas. This new direction for our technical committees is currently under consideration by society leadership and the input of interested members is actively sought. Please send comments to John Kerekes, VP of Technical Activities, at kerekes@cis.rit.edu.

Thank you to everyone who took the time to complete the survey and especially to those who provided additional comments and suggestions. Many were supportive of the Society and several offered valuable directions for consideration. It is heartening to see the engagement of our members in our Society's activities.

# 2012 IEEE GRSS DATA FUSION CONTEST: MULTI-MODAL/MULTI-TEMPORAL FUSION

*Fabio Pacifici[1] and Qian Du[2]*
*[1]DigitalGlobe, U.S.A.*
*[2]Mississippi State University, U.S.A.*

The Data Fusion Contest is organized by the Data Fusion Technical Committee of the Geoscience and Remote Sensing Society (GRSS). The Committee serves as a global, multi-disciplinary, network for geospatial data fusion, with the aim of connecting people and resources, educating students and professionals, and promoting the best practices in data fusion applications.

The Contest has been annually held since 2006. It is not open only to IEEE members, but to everyone, with the aim of evaluating existing methodologies at the research or operational level to solve remote sensing problems using data from different sensors.

## 1. Overview on the Previous Data Fusion Contests

The focus of the 2006 Contest was on the fusion of multispectral and panchromatic images [1]. Six simulated Pleiades images were provided by the French National Space Agency (CNES). Each data set included one very high spatial resolution panchromatic image (80 cm) and the corresponding multi-spectral image (3.2 m resolution). A multi-spectral airborne image was available as ground reference which was used by the organizing committee for evaluation, but was not distributed to the participants.

In 2007, the Contest theme was urban mapping using synthetic aperture radar (SAR) and optical data, and 9 ERS amplitude data sets and 2 Landsat multi-spectral images were made available [2]. The task was to obtain a classification map as accurate as possible with respect to the unknown (to the participants) ground reference, depicting land cover and land use patterns for the urban area under study.

The 2008 Contest was dedicated to the classification of very high spatial resolution (1.3 m) hyper-spectral imagery [3]. The data set was distributed to every participant, and the task was again to obtain a classification map as accurate as possible with respect to the unknown (to the participants) ground reference. The data set was collected by the Reflective Optics System Imaging Spectrometer (ROSIS-03) optical sensor with 115 bands covering the 0.43–0.86 μm spectral range.

In 2009–2010, the aim of Contest was to perform change detection using multi-temporal and multi-modal data [4]. Two pairs of data sets were available over Gloucester, UK, before and after a flood event. The data set contained SPOT and ERS images (before and after the disaster). The optical and SAR images were provided by CNES. As for the previous editions of the Contest, the ground truth used to assess the results was not provided to the participants. Singular results were tested and ranked a first time using the Kappa coefficient. The best 5 results were used to perform decision fusion with majority voting. Then, re-ranking was carried out after evaluating the improvement level with regard to the fusion results.

A set of WorldView-2 multi-angular images was provided by DigitalGlobe for the 2011 Contest [5]. This unique set was composed of five Ortho Ready Standard multi-angular acquisitions, including both 16 bit panchromatic and multispectral 8-band images. The data was collected over Rio de Janeiro (Brazil) in January 2010 within a three minute time frame with satellite elevation angles of 44.7°, 56.0°, and 81.4° in the forward direction, and 59.8° and 44.6° in the backward direction. Since there were a large variety of possible applications, each participant was allowed to decide the research topic to work with, exploring the most creative use of optical multi-angular information. At the end of the Contest, each participant was asked to submit a paper describing in detail the problem addressed, the method used, and the final result.

## 2. 2012 Data Fusion Contest and Its Data Set

The 2012 Contest was designed to investigate the potential of multi-modal/multi-temporal fusion of very high spatial resolution imagery in various remote sensing applications. As shown in Figure 1, three different types of data sets (optical, SAR, and LiDAR) over downtown San Francisco were made available by DigitalGlobe, Astrium Services, and the United States Geological Survey (USGS), which included QuickBird, WorldView-2, TerraSAR-X, and LiDAR imagery. The image scenes covered a number of large buildings, skyscrapers, commercial and industrial structures, a mixture of community parks and private housing, and highways and bridges.

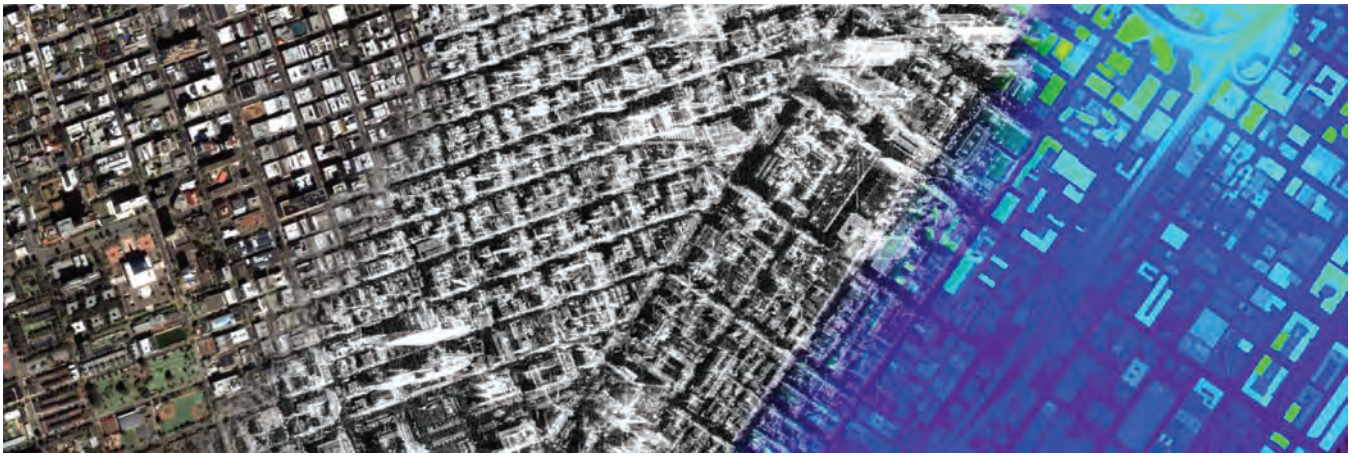


*Figure 1. Composition of the optical, SAR, and LiDAR data sets over the downtown of San Francisco.*

Optical and SAR data sets were composed of eight images acquired in 2007 and 2011, as shown in Table 1.

Following the success of the multi-angular Data Fusion Contest, again this year, each participant was asked to submit a paper at the end of the Contest describing in detail the problem addressed, method used, and final result. The papers submitted were automatically formatted to hide names and affiliations of the authors to favor the neutrality and impartiality of all reviews.

The Data Fusion Award Committee consisted of eight independent judges from universities, government institutions, and industries:

- Jocelyn Chanussot, Grenoble Institute of Technology, France
- Curt Davis, University of Missouri, USA
- Jenny Q. Du, Mississippi State University, USA
- Paolo Gamba, University of Pavia, Italy
- Karl Heidemann, USGS, USA
- Oliver Lang, Astrium Services, Germany
- Fabio Pacifici, DigitalGlobe, Inc., USA
- Uwe Sörgel, Leibniz Universität Hannover, Germany

Papers were judged in terms of sound scientific reasoning, problem definition, methodology, validation, and presentation.

**Table 1. Sensors and acquisition dates for the images distributed during the Contest.**

| Sensor | Acquisition 1 | Acquisition 2 |
|---|---|---|
| QuickBird/ WorldView-2 | 11 November 2007 | 9 October 2011 |
| TerraSAR-X | 5 December 2007<br>16 December 2007<br>27 December 2007 | 2 October 2011<br>13 October 2011<br>24 October 2011 |
| LiDAR | June 2010 | |

## 3. Outcome of the Contest

More than 1150 researchers across the globe registered to the Contest, corresponding to an increment of more than 51% with respect to the previous year. This demonstrates the great interest from the Earth observation scientific research and application community. The data set was downloaded from 78 different countries, with a large number from less developed areas. Figure 2 shows the geographical distribution of the subscribers, where *other* indicates the countries with less than 16 participants. Also, as illustrated in Figure 3, about 20% of participants were from corporations or government agencies.

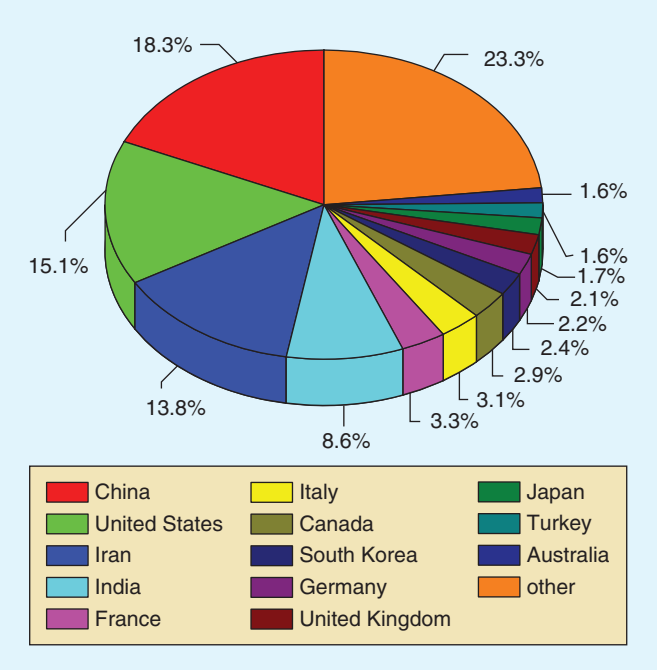



*Figure 2. Geographical distribution of the registered users for countries with more than 16 participants.*

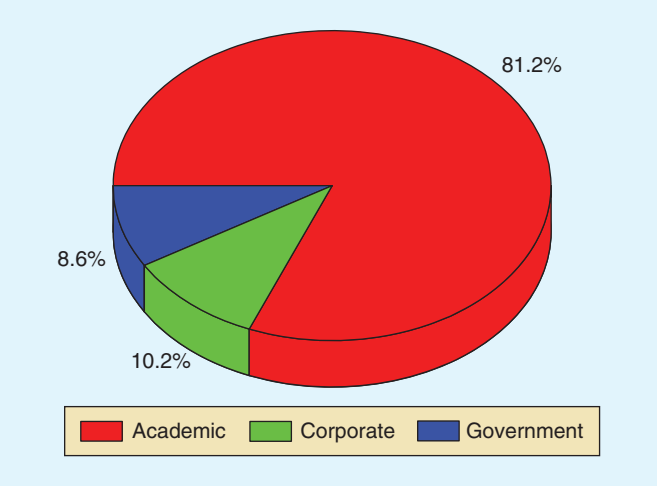



*Figure 3. Affiliation of the registered users.*

Several interesting research topics were submitted, demonstrating numerous possibilities and a variety of applications that multi-modal/multi-temporal remote sensing images can offer, such as, change detection, land cover classification, road extraction, moving object detection, information fusion, and image superresolution.

Final results were announced at the 2012 IEEE International Geoscience and Remote Sensing Symposium held in Munich, Germany. The winners of the 2012 Data Fusion Contest are:

1) **C. Berger, M. Voltersen, R. Eckardt, J. Eberle, T. Heyer, N. Salepci, S. Hese, and C. Schmullius,** from the University of Jena, Germany, with a paper entitled "FUSION OF HIGH-RESOLUTION OPTICAL IMAGERY AND OBJECT HEIGHT INFORMATION FOR AN INTEGRATED ASSESSMENT OF URBAN DENSITY (UD)"
2) **J. Tao[1], S. Auer[2], R. Bamler[1]**, from (1) German Aerospace Center (DLR), (2) Technische Universität München, Germany, with a paper entitled "COMBINATION OF LIDAR AND SAR DATA WITH SIMULATION TECHNIQUES FOR IMAGE INTERPRETATION AND CHANGE DETECTION"
3) **K. Ewald[1], M. Gartley[2], J. Jacobson[3], and A. Buswell[1],** from (1) Ball Aerospace & Technologies Corp., (2) Rochester Institute of Technology, (3) National Air and Space Intelligence Center, United States, with a paper entitled "RADIOSITY TECHNIQUE FOR REFLECTANCE RETRIEVAL APPLIED TO WORLDVIEW-2 DATA"

*Congratulations to the winners whose papers were judged to be superior in terms of sound scientific reasoning, problem definition, methodology, validation, and presentation!!!*

The winning teams were awarded with an IEEE Certificate of Appreciation during the Chapters and Technical Committees Luncheon (Figure 4). Additionally, this year the Data Fusion Technical Committee was pleased to offer a monetary prize to the winning teams as follows:

- First Prize: $800
- Second Prize: $500
- Third Prize: $300

As tradition, a manuscript summarizing the Contest outcomes will be submitted to a GRSS Journal for peer-review. To further enhance its impact in the community, the Data Fusion Technical Committee will support its open-access publication cost with the funding being provided by the IEEE Geoscience and Remote Sensing Society and DigitalGlobe, Inc.

At the end of the Contest, K. Ewald, M. Gartley, J. Jacobson, and A. Buswell have communicated to the Data Fusion Technical Committee the intention to donate their monetary prize to United Way, a non-profit, charitable organization

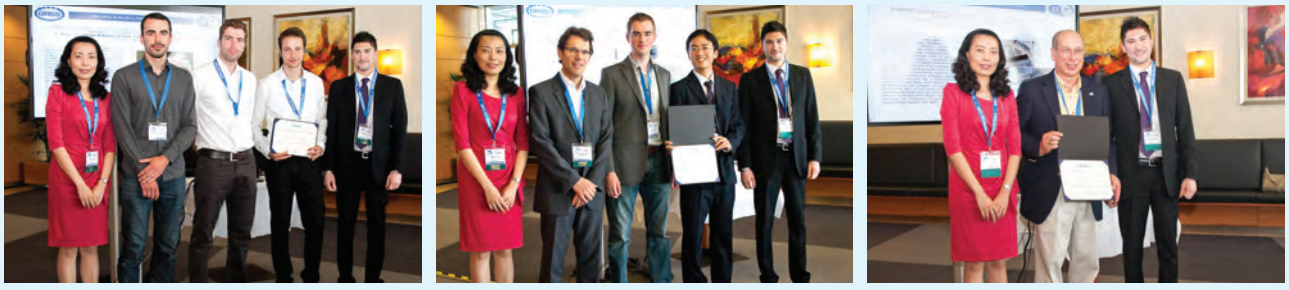



*Figure 4. The Data Fusion Technical Committee congratulates the winners of the 2012 Contest during the Chapters and Technical Committees Luncheon at IGARSS 2012. From left to right: (a) M. Voltersen, R. Eckardt, and C. Berger; (b) R. Bamler, S. Auer, and J. Tao; (c) J. Kerekes (on behalf of K. Ewald, M. Gartley, J. Jacobson, and A. Buswell).*

that supports education, income, and health (www.unitedway.org).

## 5. Acknowledgment

The IEEE GRSS Data Fusion Technical Committee would like to express its great appreciation to DigitalGlobe, Astrium Services, and USGS/CLICK for donating data sets to the scientific community and for their continuous support in providing resources for this initiative.

## References

[1] L. Alparone, L. Wald, J. Chanussot, C. Thomas, P. Gamba, L. M. Bruce, "Comparison of pansharpening algorithms: Outcome of the 2006 GRS-S data fusion contest", IEEE Transactions on Geoscience and Remote Sensing, vol. 45, no. 10, pp. 3012–3021, Oct. 2007.

[2] F. Pacifici, F. Del Frate, W. J. Emery, P. Gamba, J. Chanussot, "Urban mapping using coarse SAR and optical data: outcome of the 2007 GRS-S data fusion contest", IEEE Geoscience and Remote Sensing Letters, vol. 5, no. 3, pp. 331–335, July 2008.

[3] G. Licciardi, F. Pacifici, D. Tuia, S. Prasad, T. West, F. Giacco, J. Inglada, E. Christophe, J. Chanussot, P. Gamba, "Decision fusion for the classification of hyperspectral data: outcome of the 2008 GRS-S data fusion contest", IEEE Transactions on Geoscience and Remote Sensing, vol. 47, no. 11, pp. 3857–3865, November 2009.

[4] N. Longbotham, F. Pacifici, T. Glenn, A. Zare, M. Volpi, D. Tuia, E. Christophe, J. Michel, J. Inglada, J. Chanussot, Q. Du, "Multi-modal Change Detection, Application to the Detection of Flooded Areas: Outcome of the 2009–2010 Data Fusion Contest", IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 5, no. 1, pp. 331–342, February 2012.

[5] F. Pacifici, Q. Du, "Foreword to the Special Issue on Optical Multiangular Data Exploitation and Outcome of the 2011 GRSS Data Fusion Contest", IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 5, no. 1, pp. 3–7, February 2012.

You can contact the Committee Chairs by email at: dftc -at- ieee.org

If you are interested in joining the Data Fusion Technical Committee, please send an email with:

- **Name and Last Name**
- **Institution/Company**
- **Country**
- **GRSS Membership Number (if available)**
- **Email**

Members receive information regarding Data Fusion research and applications, and update on the annual Data Fusion Contest. The subscription to the Data Fusion Technical Committee is free!

Join the LinkedIn IEEE GRSS Data Fusion Discussion Forum:
http://www.linkedin.com/groups/IEEE-GRSS-Data-Fusion-Discussion-3678437

## CHAPTERS CORNER

# RECENT GRSS CHAPTER STATUS AND ACTIVITIES

*Kun-Shan Chen, Chapter Coordinator*

This article describes the recent chapter status and activities of GRSS. As well aware to IEEE community, technical chapter is one of the core programs within IEEE. As defined in IEEE, "A Chapter is the technical subunit of one or more IEEE Sections. Society Chapters are your local link to the valuable resources available from IEEE and its 38 technical Societies. Chapter activities may include guest speakers, workshops, and seminars, as well as social functions. Chapters provide Society members with valuable opportunities to network at a local level - enabling both personal and professional growth." Currently, GRSS has 39 technical chapters; among them, 16 are joint chapters with other IEEE technical societies, AES, MTT, AP, OE, LEO, etc. Two student chapters are from Latin America, Colombia and Brazil sections. Geographic distribution of all GRSS chapters is shown in Fig. 1. In the past three years, growth in Region8 has been significant. For the first time, GRSS chapter in Middle East in Saudi Arabia Section has been established and well operated. A milestone establishment of GRSS chapter in India was happen in last November. The GRSS is truly a global society severing local members and prompting geosciences and remote sensing research and applications worldwide. Broad joint chapters with relevant IEEE societies see persistently mutual benefit. Remote sensing represents a unique and valuable source of information to monitor changing conditions in both the atmosphere and on the Earth's surface at a variety of spatial and temporal scales. The application of remote sensing science and technologies for natural disasters is a broad, interdisciplinary area of research. Many techniques permit all-weather observations and remote sensing is able to provide either needed reconnaissance or quantitative and sustained measurements, even under challenging situations.

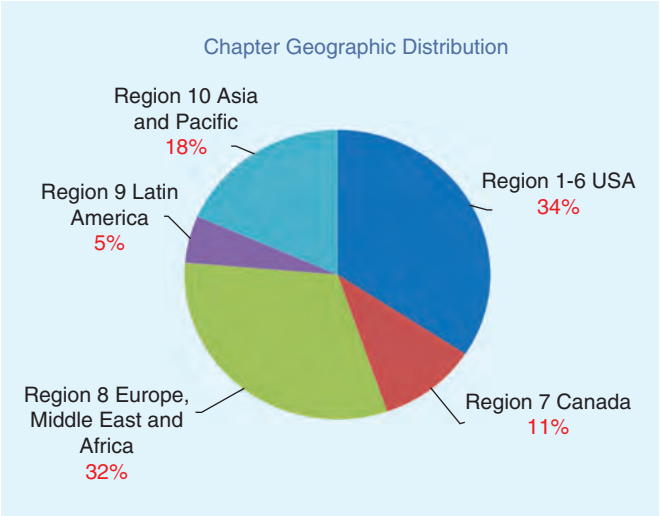



*Figure 1. GRSS Chapter Geographic Distribution as of July 2012.*

To further improve GRSS's aim at "global reach, local service" chapter function, Chapters are requested and encouraged to establish a chapter website, as many societies did. This definitely will enhance our member connection, prompting chapter activities, and remote sensing applications. To recognie the effort, prize up to $1500 and a certificate will be awarded. Competition is starting from June to end of October this year.

The GRSS has established an excellent distinguished speaker program. It is very advantagous to book a specific speaker of your interest topics to come to your chapter for a seminar, mini-workshop and social connections. Current list of distinguished speaker and their expertise is given below. More details and contact can be found at GRSS website.

**Professor Ya-Qiu Jin**, Modeling, simulation, inversion and Chang E data validation for microwave observation in China's lunar project

**Dr. Keith Raney**, Catching the Bottom of the Sea from Space

**Dr. David Goodenough**, Methods and Systems for Applications (Forest applications)

**Dr. Ricardo Lanari**, Differential SAR inteferometry

**Dr. Melba Crawford**, Advanced Methods for Classification of Hyperspectral Data

**Dr. Yann Kerr**, SMOS First Successes and Related Issues

**Dr. Werner Weisbeck**, Digital Beam-Forming in Remote Sensing

**Dr. Lorenzo Bruzzone**, Current scenario and challenges in the analysis of multitemporal remote sensing images.

In case the above topics are out of your area of interest, suggestions are encouraged to submit to Program chair: David Le Vine (d.levine@ieee.org).

As a reminder, the IEEE GRSS has established an annual IEEE GRSS Chapter Excellence Award. This award (which consists of $1000 and a certificate) is aimed at recognizing a chapter that promoted outstanding activities during the previous year. All the chairs that would like to submit the candidature of their chapters to this prize should send a short report (no more than 3 pages) related to activities of the past year to Dr. Kun-Shan Chen (dkschen@csrsr.ncu.edu.tw) and in cc to Dr. Jón Atli Benediktsson (benedikt@hi.is). Report submissions for 2012 activities will be due in early 2013.

## EDUCATION CORNER

# OUTCOME OF THE FIRST IEEE GRSS REMOTE SENSING SUMMER SCHOOL

*Antonio J. Plaza, Education Director, IEEE Geoscience and Remote Sensing Society*
*Hyperspectral Computing Laboratory, University of Extremadura, Cáceres, Spain*
*E-mail: aplaza@unex.es – URL: http://www.umbc.edu/rssipl/people/aplaza*

### Overview

This article provides a summary of the activities carried out in the first IEEE Geoscience and Remote Sensing Society (GRSS) Remote Sensing Summer School, held in Munich, Germany, on July 19–20, 2012 in conjunction with the IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2012). The school (called RSSS12) offered international students the opportunity to interact with renowned specialists and experts in the field of remote sensing. It was organized by Technische Universitaet Muenchen (TUM), one of the leading Universities in Germany. The school was a great success, with 116 applications from 25 countries and a total of 70 accepted participants (from 20 different countries).

### Introduction

The organization of a series of international summer schools has been a desired objective discussed by the Administrative Committee (AdCom) of the IEEE Geoscience and Remote Sensing Society (GRSS) as part of the Education portfolio of the society [1]. GRSS AdCom agreed to organize summer schools that will take place in conjunction with the society's flagship international event, the IEEE Geoscience and Remote Sensing Symposium (IGARSS), are are mainly intended for BS, MS and PhD students.

The first IEEE GRSS summer school (RSSS12)[1] [2] was organized in conjunction with IGARSS 2012 by Prof. Uwe Stilla and his team at Technische Universitaet Muenchen (TUM)[2]. Other members of the organizing team were Ludwig Hoegner (local organizing committee chair), Michael Schmitt, Dorota Iwaszczuk, Oliver Maksymiuk and Tessio Novack. The organization, for the first time, of a summer school in conjunction with IGARSS represented a significant advance and step forward towards fostering education-oriented activities in our society.

This article describes the activities carried out in the first IEEE GRSS summer school held in Munich, Germany, on July 19–20, 2012 and its outcome. The summer school was a great success, with a total of 70 international students from 20 different countries and an exciting technical program comprising presentations from IEEE GRSS distinguished speakers [3] and other lecturers.

### Technical Program of the Summer School

The technical program of the summer school is available online[3]. Figure 1 summarizes the schedule of lectures. The presentations covered a wide variety of topics in geoscience and remote sensing, including methods and systems for forest applications, analysis of multitemporal images, hyperspectral image and signal processing and advanced classification, multispectral and synthetic aperture radar (SAR) urban remote sensing, SAR interferometry and tomography, and morphological and attribute profiles for remote sensing data classification. The speakers of the summer school were:

- Prof. Richard Bamler (DLR & Technische Universität München, Germany)
- Prof. Lorenzo Bruzzone (University of Trento, Italy)
- Prof. Jocelyn Chanussot (Grenoble Institute of Technology, France)
- Prof. Melba Crawford (Purdue University, USA)
- Dr. Mauro Dalla Mura (University of Trento, Italy)
- Prof. Paolo Gamba (University of Pavia, Italy)
- Prof. David Goodenough (University of Victoria, Canada)
- Dr. Prashanth Marpu (Masdar Institute of Science and Technology, UAE)
- Prof. Antonio Plaza (University of Extremadura, Spain)
- Prof. Uwe Stilla (Technische Universität München, Germany)

### Outcome and Main Achievements

The RSSS12 summer school attracted 116 applications from 25 countries, with a total of 70 accepted participants (from 20 different countries) on a first-come first-serve basis. Fig. 2 shows the geographical distribution of participating students. As Fig. 2 shows, the school was a truly international event, with a majority of students coming from Germany but with the attendance of students from many other different locations. It is remarkable that several of the participants in

[1]http://www.igarss2012.tum.de/
[2]http://www.igarss2012.tum.de/rsss12_ven.html
[3]http://www.igarss2012.tum.de/rsss12_prg.html

| Morning Session (Thursday, July 19) | | Afternoon Session (Thursday, July 19) | |
|---|---|---|---|
| 9:00–10.30 | 11:00–12.30 | 13:30–15:00 | 15:30–17:00 |
| D. Goodenough "Methods and systems for forest applications" | L. Bruzzone "Analysis of multitemporal remote sensing images" | M. Grawford "Advanced classification of hyperspectral data" | J. Chanussot & A. Plaza "Hypersspectral image and signal processing" |
| **Morning Session (Friday, July 20)** | | **Afternoon Session (Friday, July 20)** | |
| 9:00–10.30 | 11:00–12.30 | 13:30–15:00 | 15:30–17:00 |
| U. Stilla "SAR urban remote sensing" | P. Gamba "Multispectral urban remote sensing" | R. Bamler "SAR interferometry and tomography" | P. Marpu & M. Dalla Mura "Morphological profiles and attribute profiles" |

*Figure 1. Schedule of lectures given at RSSS12: the First IEEE GRSS Remote Sensing Summer School held in conjunction with IGARSS 2012 in Munich, Germany.*

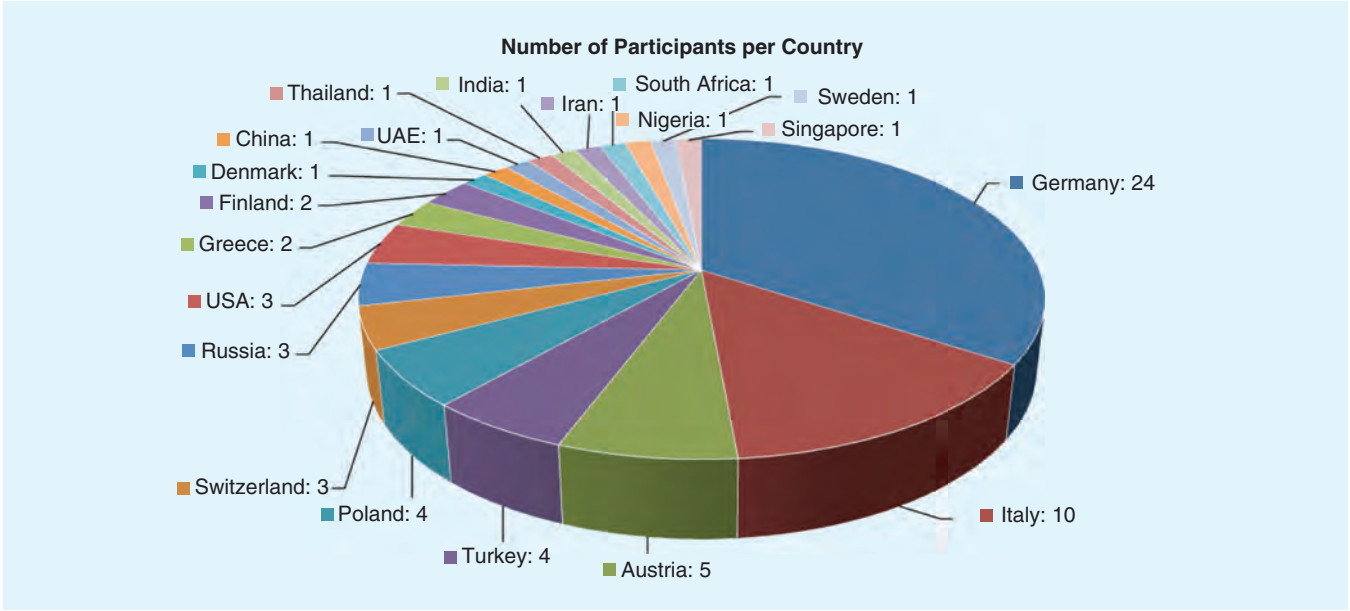



*Figure 2. Geographical distribution of students participating in the First IEEE GRSS Remote Sensing Summer School (RSSS12).*

the summer school also requested a travel grant to attend IGARSS and received an award, while many other students attended only the summer school. This is an indication of the quality of the technical program. The registration costs for the summer school have been only 50 Euros per participant, and were entirely used to support the summer school. The school was mostly self-financed, while GRSS offered one free IGARSS registration to lecturers and four free registrations to local organizing committee members. The school included an icebreaker event (held on Thursday, July 19) and a social event (held on Friday, July 20, at Hofbräuhaus München). Coffee breaks were provided to school participants. Each participant received a certificate of attendance to the school. Fig. 3 shows some pictures[4] taken during different activities organized in the framework of the summer school.

In order to receive feedback from students about the activities organized in the summer school, and with the ultimate goal of improving any possible aspect in future editions, a questionnaire of satisfaction was delivered to students in order to assess the following aspects: 1) announcement of RSSS12 and connection with IGARSS; 2) quality of lectures; 3) positive

[4]http://www.igarss2012.tum.de/rsss12_gal.html


*Figure 3. Pictures taken during different activities organized in the framework of the summer school. (a) Local organizing committee. (b) Welcome by Prof. Uwe Stilla. (c) Participants. (d) Social event.*

aspects; and 4) aspects which could be improved in future editions of the summer school. Overall, the students were highly satisfied by this first edition. Some of the aspects emphasized in the responses given by students are summarized below.

1) Regarding the announcement of RSSS12, the students emphasized that RSSS12 was properly advertised, with announcements that appeared early and visible enough to be seen by everyone interested. In this regard, the announcement of the summer school in the IGARSS 2012 website was considered a very important and positive aspect. Other students found the announcement for the summer school through other sources, such as the LinkedIn event calendar or via communication with colleagues.
2) Regarding the quality of lectures, the students emphasized the appropriate balance between topics covered in the summer school. Students were overall satisfied with a diverse technical program covering different topics and emphasized that it should remain like that in future editions, although other students indicated that perhaps it is difficult to assimilate many different aspects of remote sensing in a short time and that it would perhaps be better to have future editions specialized in a given topic and increase the number of days devoted to the summer school. Overall, the students considered the quality of lectures very high and were extremely satisfied with the different lectures given at the summer school. They also emphasized the availability of the lecturers for interactions and discussions.
3) Regarding the positive aspects, many students emphasized the flawless and outstanding organization of the event and the high quality of the lectures. Students also outlined the friendly environment created between organizers and participants, and the high quality of the lecture notes that were delivered to school participants during the summer school. Other students also emphasized the very nice icebreaker and social events organized, which allowed them to meet people from all over the world. Quoting one of the students, "Everything was great, lectures were useful and with clear understanding. Social events helped to meet new friends and have some relax."


*Figure 4. Group picture taken during the celebration of the summer school.*

4) Regarding the aspects that could be improved, many students indicated their satisfaction with the current configuration of the summer school, while others emphasized that it would be nice to integrate practical training in future editions. They also outlined that this probably requires more days and a more precise focus for the summer school. Other students also suggested restricting the number of participants and placing some more practical courses with exercises on the computer. Other students suggested including a poster session in the technical program, so that they can present their most recent research work to other students and to the lecturers and organizers of the summer school. It was also recommended by students to increase the number of days for the summer school and the time allocated to each lecture if the number and diversity of topics is to be maintained.

Overall, the organization of the First IEEE GRSS Summer School has been widely regarded by students, organizers and lecturers involved as a great success and as a very important education-oriented activity for GRSS. This activity will continue taking place in combination with upcoming editions of IGARSS. Fig. 4 shows a group picture taken during the celebration of the summer school.

To conclude this article, we would like to take this opportunity to gratefully thank the local organizers, the lecturers and all the participating students for making this first edition of the GRSS Remote Sensing Summer School a success. Last but not least, we would like to take this opportunity to gratefully thank Prof. Jon Atli Benediktsson, President of GRSS, for inspiring and encouraging this important education-oriented initiative in our society.

## Summary

In this article we have described the outcome of the first IEEE Geoscience and Remote Sensing Society (GRSS) Remote Sensing Summer School (RSSS12) that was organized in Munich, Germany, on July 19–20, 2012. GRSS has witnessed the potential of summer schools intended for young students in the area in order to provide high-quality training to a new generation of scientists in geoscience and remote sensing. The first edition of the summer school has been a great success, with a total of 110 applications received and 70 accepted students (from 20 different countries). The society looks forward to a continued success of this important activity within the GRSS Education portfolio, through the active participation of international students and distinguished lecturers in future editions of the summer school. The feedback given by students will be used to define and strategically plan the Second Edition of the Summer School, that will take place in Melbourne, Australia, in conjunction with IGARSS 2013.

## References

[1] A. Plaza, "An Overview of Education Activities in the IEEE Geoscience and Remote Sensing Society," *IEEE Geoscience and Remote Sensing Newsletter*, no. 161, pp. 59–61, December 2011.

[2] A. Plaza, "Overview of the First GRSS Summer School," *IEEE Geoscience and Remote Sensing Newsletter*, no. 163, pp. 31–36, June 2012.

[3] D. M. Le Vine, "2012 GRSS Distinguished Speakers Program," *IEEE Geoscience and Remote Sensing Newsletter*, no. 162, pp. 34–40, March 2012.

# RECENT PH.D. THESES IN GEOSCIENCE AND REMOTE SENSING

For publishing the PhD thesis information you can contact Dr. Antonio Plaza (aplaza@unex.es) or Dr. Lorenzo Bruzzone (bruzzone@ing.unitn.it). Ph.D. dissertations should be in the fields of activity of IEEE GRSS and should be recently completed. Please provide us with the following: title of the dissertation, the student's and advisor's names, the date of the thesis defense and a link for downloading the electronic version of the thesis.

| | |
|---|---|
| **Author: Bradley Isom** | **Supervisors:** Robert Palmer |
| **Title:** The Atmospheric Imaging Radar for High Resolution Observations of Severe Weather | |
| **Institution:** University of Oklahoma | |
| **Date:** August 2012 | **Link:** http://arrc.ou.edu/pdf/isom2012_dissertation_AIR_high_res_obs.pdf |
| | |
| **Author: Thales Sehn Korting** | **Supervisors:** Dra. Leila Maria Garcia Fonseca and Dr. Gilberto Câmara |
| **Title:** GeoDMA: A toolbox for data mining, object-based and multi-temporal analysis of remote sensing imagery | |
| **Institution:** Brazil's National Institute for Space Research (INPE) | |
| **Date:** August, 2012 | **Link:** http://mtc-m19.sid.inpe.br/col/sid.inpe.br/mtc-m19/2012/07.31.18.22/doc/thesis.pdf |
| | |
| **Author: Antonio Natale** | **Supervisors:** Prof. Antonio Iodice |
| **Title:** Electromagnetic Models for the Retrieval of Surface Parameters through SAR Images | |
| **Institution:** Università di Napoli Federico II | |
| **Date:** 31 January 2012 | **Link:** http://www.fedoa.unina.it/8920/ |
| | |
| **Author: Ivana Zinno** | **Supervisors:** Prof. Daniele Riccio |
| **Title:** Fractal Models for SAR Images | |
| **Institution:** Università di Napoli Federico II | |
| **Date:** 31 January 2012 | **Link:** http://www.fedoa.unina.it/8946/ |

*(Editor's Comments continued from page 4)*

The *Education Corner* column includes two contributions. The first is a report on the GRSS Remote Sensing Summer School 2012 (RSSS12) held on July 19–20, 2012, in Munich, Germany. The article provides a summary of the activities of this very successful school. The second contribution continues the initiative established this year of presenting a list of the recently completed Ph.D. dissertations in the remote sensing and geoscience fields. I encourage you to contact Antonio Plaza, Director of Education for IEEE GRSS, or me for information on submitting recently completed Ph.D. dissertations in the technical areas of GRSS.

The *Open Access Papers* column informs the reader of the open-access articles published in the three GRSS journals in the period of June–August 2012. We publish the titles, authors, publication name, volume, issue and pages of the papers that can be can be downloaded from the IEEE Xplore online archives by anyone free of charge.

Finally, I would like to draw your attention to the various calls for nominations and calls for papers in this issue.

I wish everyone an enjoyable and productive autumn.

***Lorenzo Bruzzone***
***Editor, IEEE GRSS Newsletter***

# OPEN ACCESS ARTICLES

## OPEN ACCESS ARTICLES PUBLISHED IN THE PERIOD JUNE–SEPTEMBER 2012

### IEEE Transactions on Geoscience and Remote Sensing

**Cross-Validation of Scatterometer Measurements via Sea-Level Pressure Retrieval**
*by Patoux, J.; Foster, R.C.*
Vol. 50, No. 7, Part 1, July 2012, pp. 2507–2517
DOI: 10.1109/TGRS.2011.2172620
Link: http://dx.doi.org/10.1109/TGRS.2011.2172620

**On the Use of Doppler Shift for Sea Surface Wind Retrieval From SAR**
*by Mouche, A.A.; Collard, F.; Chapron, B.; Dagestad, K.; Guitton, G.; Johannessen, J.A.; Kerbaol, V.; Hansen, M.W.*
Vol. 50, No. 7, Part 2, July 2012, pp. 2901–2909
DOI: 10.1109/TGRS.2011.2174998
Link: http://dx.doi.org/10.1109/TGRS.2011.2174998

**IASI Retrievals Over Concordia Within the Framework of the Concordiasi Program in Antarctica**
*by Vincensini, A.; Bouchard, A.; Rabier, F.; Guidard, V.; Fourrie, N.; Traulle, O.*
Vol. 50, No. 8, August 2012, pp. 2923–2933
DOI: 10.1109/TGRS.2011.2177467
Link: http://dx.doi.org/10.1109/TGRS.2011.2177467

**The Emissivity of the Ocean Surface Between 6 and 90 GHz Over a Large Range of Wind Speeds and Earth Incidence Angles**
*by Meissner, T.; Wentz, F. J.*
Vol. 50, No. 8, August 2012, pp. 3004–3026
DOI: 10.1109/TGRS.2011.2179662
Link: http://dx.doi.org/10.1109/TGRS.2011.2179662

**The TropiSAR Airborne Campaign in French Guiana: Objectives, Description, and Observed Temporal Behavior of the Backscatter Signal**
*by Dubois-Fernandez, P. C.; Le Toan, T.; Daniel, S.; Oriot, H.; Chave, J.; Blanc, L.; Villard, L.; Davidson, M. W. J.; Petit, M.*
Vol. 50, No. 8, August 2012, pp. 3228–3241
DOI: 10.1109/TGRS.2011.2180728
Link: http://dx.doi.org/10.1109/TGRS.2011.2180728

**Multiyear Arctic Sea Ice Classification Using QuikSCAT**
*by Swan, A. M.; Long, D. G.*
Vol. 50, No. 9, September 2012, pp. 3317–3326
DOI: 10.1109/TGRS.2012.2184123
Link: http://dx.doi.org/10.1109/TGRS.2012.2184123

### IEEE Geoscience and Remote Sensing Letters

**Increasing the Accuracy of MODIS/Aqua Snow Product Using Quantitative Image Restoration Technique**
*by Gladkova, I.; Grossberg, M.; Bonev, G.; Romanov, P.; Shahriar, F.*
Vol. 9, No. 4, July 2012, pp. 740–743
DOI: 10.1109/LGRS.2011.2180505
Link: http://dx.doi.org/10.1109/LGRS.2011.2180505

**A Method to Rebuild Historical Satellite-Derived Soil Moisture Products Based on Retrievals from Current L-Band Satellite Missions**
*by Jinyang Du; Jiancheng Shi*
Vol. 9, No. 5, September 2012, pp. 910–914
DOI: 10.1109/LGRS.2012.2185922
Link: http://dx.doi.org/10.1109/LGRS.2012.2185922

## IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing

**Method for Detecting Snow Lines From MODIS Data and Assessment of Changes in the Nianqingtanglha Mountains of the Tibet Plateau**
*by Liping Lei; Zhaocheng Zeng; Bing Zhang*
Selected Topics in Applied Earth Observations and Remote Sensing, IEEE Journal of
Vol. 5, No. 3, June 2012, pp. 769–776
DOI: 10.1109/JSTARS.2012.2200654
Link: http://dx.doi.org/10.1109/JSTARS.2012.2200654

**Image Based Characterization of Formal and Informal Neighborhoods in an Urban Landscape**
*by Graesser, J.; Cheriyadat, A.; Vatsavai, R. R.; Chandola, V.; Long, J.; Bright, E.*
Vol. 5, No. 4, August 2012, pp. 1164–1176
DOI: 10.1109/JSTARS.2012.2190383
Link: http://dx.doi.org/10.1109/JSTARS.2012.2190383

*(President's Message continued from page 7)*

and running of IGARSS 2012. A special note of thanks goes to the excellent IGARSS 2012 team, led by General Co-Chairs Alberto Moreira and Yves-Louis Desnos, and Technical Program Committee Co-Chairs Irena Hajnsek and Helmut Rott. The IGARSS 2012 team did a truly outstanding job.

Prior to IGARSS 2012, the first GRSS Remote Sensing Summer School (RSSS12) took place in Munich, July 19-20, 2012. The school offered BS, MS and PhD students the opportunity to meet and learn from outstanding international specialists and experts in the field of remote sensing. The school was a great success, with 116 applicants from 25 countries and a total of 70 admitted students from 20 different countries who were selected on a first-come, first-served basis. The feedback from the students on RSSS12 has been very positive, and the GRSS will continue to hold RSSS in future years. I greatly appreciate the hard work of GRSS Education Director Antonio Plaza, Uwe Stilla, the local organizing committee and the speakers in making RSSS12 a success.

As the readers of the GRSS Newsletter know, it is a great success under the outstanding leadership of its Editor, Lorenzo Bruzzone. The GRSS has now decided to turn the Newsletter into the GRSS Magazine which will be published quarterly, starting in 2013. An electronic version of the Magazine will be included in the annual GRSS membership. The GRSS Magazine provides an additional venue to communicate topical ideas to a wide audience. The Magazine will publish reviewed technical papers that provide important information to the community but are not appropriate for publication in our journals. Lorenzo Bruzzone and Bill Emery have been instrumental in preparing for the Magazine and have done a fantastic job. It will be exciting for us to see the first issue in the first quarter of 2013.

IEEE Transactions on Geoscience and Remote Sensing (TGRS) Editor Chris Ruf has decided to step down at the end of the year because he is the PI of an extremely large grant from NASA. I am greatly impressed with Chris' tenure as Editor. TGRS has grown significantly under his terrific leadership during the last three-and-a-half years. On behalf of the GRSS, I thank Chris for his outstanding service to the society. The AdCom has selected Antonio Plaza to replace Chris at the beginning of next year, and I wish Antonio the best as TGRS Editor.

During the IGARSS Awards Banquet, Alberto Moreira and Yves-Lois Desnos handed off the responsibility for IGARSS to the next General Co-Chairs, Peter Woodgate and Simon Jones. IGARSS 2013 will be held in Melbourne, Australia, July 21–26, 2013. I wish the IGARSS 2013 team all the best, and I am very much looking forward to seeing you in Melbourne next year. The abstract submission deadline for IGARSS 2013 is January 10, 2013. More information is available online at www.igarss2013.org

***Sincerely,***
***Jón Atli Benediktsson***
***President IEEE GRSS***
***benedikt@hi.is***

# CALL FOR PAPERS

## IEEE Transactions on Geoscience and Remote Sensing

*Special Issue on "Geoscience Data Provenance"*

Today, there is an increasing demand to capture provenance in the whole life cycle of remotely sensed geoscience data from acquisition, archival, processing, distribution, to applications and make the provenance information available to user community. The complete and accurate provenance information can bring transparency to data sharing and geoscientific processing, give credit to data and algorithm contributors, make scientific results reproducible and trustworthy, and support advanced data quality analysis. Motivation for capturing and sharing provenance also comes from the distributed data and information infrastructure that has been benefitting the Earth science community in the last decade, such as Spatial Data and Information Infrastructure, e-Science, and Cyberinfrastructure. Traditionally, Earth science data products are produced in the scientific data centers with preestablished processing steps or workflows. In the distributed information infrastructure, data and high-level information products are generated, transformed, published, and disseminated frequently by a broad community of scientific users. In such a data-rich production environment, provenance information is even more important, since scientists rely on the provenance to understand and determine the reliability and usability of a scientific product generated from distributed services and inputs provided by various providers.

Contributions for this special issue are welcome from the research community. The technology covered by this special issue will include latest developments of provenance awareness in all aspects of remote sensing data archiving, information management, search and access, and specialized services for data users, such as on-demand processing and visualization. Enabling technologies such as data management, Cyberinfrastructure, workflow, high performance computing, error propagation, Semantic Web, evolving standards, security, and Web services will be involved. The emphasis will be on the approaches using those technologies to address such issues as provenance capture, representation, storage, query, and usage for understanding, management, traceability, and quality analysis of the diverse Earth remote sensing data and processing flow. The special issue will include, but not be limited to, the following set of topics:

### List of topics

- Provenance-aware geoscientific data system architecture;
- Geospatial provenance models for heterogeneous geoscientific data;
- Provenance and geospatial metadata;
- Provenance and geoscientific workflow;
- Provenance and Geo-Cyberinfrastructure;
- Provenance capturing in Earth science data and sensor systems;
- Geoscience data provenance management including storage, query, and dissemination of the provenance;
- Interoperability approaches for sharing geoscience data provenance;
- Geoscience data provenance visualization and navigation;
- Provenance applications in geoscience such as geoscientific data quality evaluation and trust analysis;

**Paper submission deadline:** 30 September 2012

**Submission guidelines**

Prospective authors should follow the regular guidelines of TGRS, and should submit their manuscripts electronically to ***http://mc.manuscriptcentral.com/tgrs***. Please indicate during your submission that the paper is intended for this Special Issue. Inquiries with respect to the special issue should be directed to the Guest Editors.

**Guest Editors**


**Liping Di**
Center for Spatial Information Science and Systems (CSISS)
George Mason University, USA
ldi@gmu.edu

**Peng Yue**
State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing (LIESMARS)
Wuhan University, China
geopyue@gmail.com

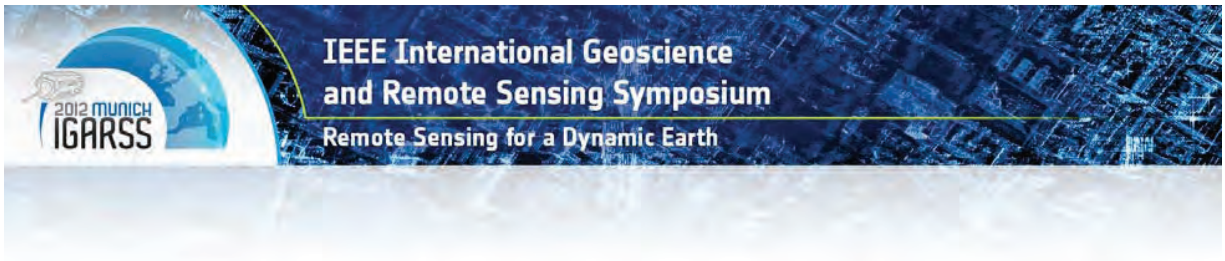
**Hampapuram K. Ramapriyan**
NASA Goddard Space Flight Center
USA
hampapuram.k.ramapriyan@nasa.gov

**Roger King**
Center for Advanced Vehicular Systems (CAVS)
Mississippi State University, USA
rking@cavs.msstate.edu

**IEEE JOURNAL OF**
SELECTED TOPICS IN APPLIED EARTH OBSERVATIONS AND REMOTE SENSING

# Call for Papers

## Special Issue after IGARSS 2012: Remote Sensing for a Dynamic Earth




It is our pleasure to announce a SPECIAL ISSUE of the IEEE JOURNAL OF SELECTED TOPICS IN APPLIED EARTH OBSERVATIONS AND REMOTE SENSING (JSTARS) dedicated to papers presented at IGARSS 2012 in Munich. Under the main symposium's theme REMOTE SENSING FOR A DYNAMIC EARTH we would like to invite interested participants to submit a full, high-quality paper (6-12 pages).

**Submission Deadline: September 30, 2012**
**Publication Date: June 2013 (vol. 6, n. 3) Guest Editors: Prof. Irena Hajnsek and Prof. Helmut Rott**
**New Impact Factor of JSTARS: 1.49**

Your contribution should NOT have the same title as your IGARSS paper and must be an extended version of it with at least 6 pages, including more details about the state of the art, a substantial new contribution, a more thorough experimental study and in-depth analysis of the achieved results as well as a conclusion and discussion section.

The submission is done online at the following web address: http://mc.manuscriptcentral.com/jstars. When preparing your manuscript, please use the same guidelines and templates as for your TGRS papers. Important: When submitting your paper, please select "IGARSS 2012" under manuscript type so that your paper is assigned to the IGARSS special issue.

Inquiries concerning the special issue should be directed to the Guest Editors:

Irena Hajnsek
Institute of Environmental Engineering
ETH Zürich, Switzerland
Email: hajnsek@ifu.baug.ethz.ch
Microwaves and Radar Institute
DLR Oberpfaffenhofen, Germany
Email: irena.hajnsek@dlr.de

Helmut Rott
Institute of Meteorology and Geophysics
University of Innsbruck, Austria
Email: Helmut.Rott@uibk.ac.at

# IGARSS 2013

## INTERNATIONAL GEOSCIENCE AND REMOTE SENSING SYMPOSIUM

21-26 July 2013
MELBOURNE

IEEE GRSS

Building a Sustainable Earth through Remote Sensing • 21-26 July 2013 • www.igarss2013.org

## Welcome Message

On behalf of the IEEE Geoscience and Remote Sensing Society and the IGARSS 2013 Local Organising Committee, we are delighted to invite you to Melbourne, Australia for IGARSS 2013. We are looking forward to welcoming leading scientists, engineers and educators from the diverse disciplines that make up the Geoscience and Remote Sensing community. We also hope to attract new delegates from the Asia-Pacific and Oceania regions.

We will be offering a world class technical program encompassing traditional IGARSS topics and new topics reflecting the theme of the 2013 Conference, "Building a Sustainable Earth through Remote Sensing". This theme was selected to emphasize the issues that most affect the Earth's environment, and the human impact on the planet. We welcome both seasoned and new delegates to Melbourne in July 2013.

With best wishes

Peter Woodgate and Simon Jones, General Co-Chairs, IGARSS 2013

## Themes

The Technical Program will include the following themes:

- Analysis Techniques and studies of Atmosphere, Cryosphere, Oceans and Land
- Sensors and Platforms
- Data Management, Dissemination Education and Policy
- Data Assimilation
- Emerging Space Programs
- Data Fusion and Integration
- In situ Observation and Data Scaling
- Advances in Analysis Techniques

In addition, the following special scientific themes will be addressed:

- Dynamics of Earth Processes and Climate Change
- Integrated Earth Observing Systems
- New Satellite Missions
- Remote Sensing in Carbon Accounting
- Disaster Management
- Calibration and Validation of Satellite Imagery

| Key Dates | |
|---|---|
| Invited session proposal deadline | September 14 2012 |
| Invited session notification | November 9 2012 |
| Abstract submission system open | November 13 2012 |
| Tutorial proposal deadline | November 30 2012 |
| Abstract submission deadline | December 11 2012 |
| Travel support application deadline | December 11 2012 |
| Student competition full paper application deadline | December 11 2012 |
| Abstract acceptance announcement & registration open | March 2013 |
| Full papers (4 pages) submission deadline | June 25 2013 |
| IGARSS 2013 | Sunday 21 - Friday 26 July 2013 |

*refer to website for further information

Building a Sustainable Earth through Remote Sensing • 21-26 July 2013 • www.igarss2013.org

## Sponsorship and Exhibition

Sponsorship and exhibition will be an integral element of the Symposium. Valuable opportunities are available to meet face to face with leading scientists, engineers and educators from the diverse disciplines that make up the Geoscience and Remote Sensing community. Visit the Symposium website for further information.

## For Further Information Contact:

IGARSS 2013 Symposium Office
119 Buckhurst Street
South Melbourne VIC 3205 Australia

T +61 3 9645 6311
F +61 3 9645 6322
E igarss2013@wsm.com.au

## Discover Melbourne

Voted many times over as one of the world's most liveable cities, Melbourne is celebrated for its friendly locals, laid-back atmosphere, fine wine and dining and world-class meeting facilities.

The city of four million people is set on the shores of Port Phillip Bay, with its beauty enhanced by the meandering Yarra River, immaculate parks and gardens, public art and classical buildings.

But it's within Melbourne's hidden laneways that the city comes to life. Here you will experience Melbourne's contagious passion for coffee at chic cafés and sample award-winning local beer and wine at boutique bars.

And what's more, just an hour's drive from the city takes you to regional Victoria, home to stunning surf-coasts, picturesque vineyards, quaint townships and wildlife reserves.

MELBOURNE AUSTRALIA

Building a Sustainable Earth through Remote Sensing • 21-26 July 2013 • www.igarss2013.org

## *GIWRM2012:*

## *International Symposium on Geomatics for Integrated Water Resources Management*

October 19-21, 2012
Lanzhou, Gansu (China)
**Lanzhou Jiaotong University**

**GIWRM2012 Chair:**
Haowen Yan, Lanzhou Jiaotong University
**Paper submission:**
March 1, 2012~May 31, 2012
**Email:**
giwrm2012@gmail.com; giwrm2012vip@gmail.com
**Registration:**
US$400/paper/author
**Web Address:**
http://giwrm.org/

## *2012 International Conference on Indoor Positioning and Indoor Navigation (IPIN)*

13-15th November, 2012, Sydney, Australia
**University of New South Wales**

**Chair:**
Prof. Chris Rizos (UNSW); Dr. Rainer Mautz (ETH)

**Abstract submission:**
Before 15 of May 2012

**Register**:
Open on 1 May

**Registration fees (**early bird before 10 September 2012**):**
Students *330 AUD*
IEEE, FIG, IAG, SSSI NSW members *495 AUD*
Other delegates *660 AUD*

**Web Address:**
http://www.surveying.unsw.edu.au/ipin2012/

## *GNSS+R 2012: Workshop on Reflectometry using GNSS and Other Signals of Opportunity*

**October 10-11, 2012**

**Purdue University, West Lafayette, IN, USA**

**For Updates Visit: http://www.gnssr2012.org/**

GNSS+R 2012 will provide a peer-reviewed forum for the technical interchange of new findings in reflectometry theory, experiments, techniques, applications and mission concepts. It will also be an opportunity to meet as a community to define development roadmaps and make the broader Earth sciences community aware of the potential of reflectometry measurements.

**Chair:** Prof. James L. Garrison, Purdue University
**Abstract submission (online):** June 23, 2012
**Registration**: Opens August 13, 2012
**Contact**: info@gnssr2012.org

## *PRRS 2012*
## *7th IAPR Workshop on Pattern Recognition in Remote Sensing*
**(In conjunction with ICPR 2012)**

November 11, 2012
Tsukuba Science City, Japan

**PRRS 2012 Chairs:**
Jenny Q. Du, Mississippi State University, USA
Eckart Michaelsen, Fraunhofer IOSB, Germany
Peijun Du, Nanjing University, China

**paper submission:**
Before April 30, 2012
4-page full paper
Email: du@ece.msstate.edu

**Register**:
Before July 15, 2012

**Registration fees:**
IAPR/IEEE Member: 10,000 JPY
Non-member: 12,000 JPY
Student: 7,000 JPY

**Web Address:**
http://www.iapr-tc7.org/prrs12

**6th International Conference on**

**Recent Advances in Space Technologies**

## RAST2013

***"New Ways of Accessing Space for Benefit of Society"***

**12-14 June 2013, Istanbul, TURKEY**

**Organized by**
Turkish Air Force Academy, Aeronautics and Space Technologies Institute

**Important Dates:**

| | |
|---|---|
| Submission of extended summaries | **15 December 2012** |
| Notification of acceptance | **25 January 2013** |
| Camera-ready submission of full papers | **15 March 2013** |

***www.rast.org.tr***

***7th GRSS/ISPRS Joint Workshop on Remote Sensing and Data Fusion over Urban Areas***

***9th International Symposium on Remote Sensing of Urban Areas***

## *URBAN REMOTE SENSING JOINT EVENT 2013*

**19-21 April 2013**
**São Paulo, BRAZIL**

**Abstract submission:**
Before September 30, 2012
2-pages abstract, no less than 600 words
Email: jurse2013@dpi.inpe.br

**Web Address:** http://www.inpe.br/jurse2013/

## *APSAR 2013:*
## *The Asia-Pacific Conference on Synthetic Aperture Radar*

Tsukuba International Congress Center
EPOCHAL TSUKUBA
September 23-27, 2013, Tsukuba, Japan

**IEEE GRSS Japan Chapter& IEICE-ES**

**Technical Co-sponsors:** IEEE GRSS, IEEE AESS Japan Chapter, IEEE APS Japan Chapter, IEICE EMT, IEICE SANE, URSI-F, RSSJ, JSPRS, Radar Society of KIEES

**General Chair:**
Akira Hirose Dept. EE & IS, Univ. Tokyo
**Important dates:**
Feb. 22, 2013: Abstract (2p) submission deadline
May 10, 2013: Acceptance notification
June 28, 2013: Final Paper (4p) submission deadline
June 28, 2013: Preregistration deadline

**Web Address:**
http://www.apsar2013.org/


The Institute of Electrical and Electronic Engineers, Inc.
445 Hoes Lane, Piscataway, NJ 08854

# UPCOMING CONFERENCES

See also http://www.techexpo.com/events or http://www.papersinvited.com

Name: Workshop on Reflectometry using GNSS and Signals of Opportunity
Dates: October 10–11, 2012
Location: West Lafayette, IN, United States

Name: International Symposium on Geomatics for Integrated Water Resources Management (GIWRM2012)
Dates: October 19–21, 2012
Location: Lanzhou, Gansu Province, China
Contact: Dr. Tao Liu
E-mail: giwrm2012@gmail.com
URL: giwrm.org

Name: 9th International Conference African Association of Remote Sensing of the Environment (AARSE)
Dates: October 29–November 2, 2012
Location: Eljadida, Morocco
URL: http://www.aarse2012.org/

Name: 21st IAPR International Conference on Pattern Recognition (ICPR 2012)
Dates: November 11–15, 2012
Location: Tsukuba Science City, Japan
E-mail: secretary@icpr2012.org
URL: http://www.icpr2012.org

Name: 7th IAPR Workshop on Pattern Recognition in Remote Sensing (PRRS 2012)
Dates: November 11, 2012
Location: Tsukuba Science City, Japan
Contact: Jenny Q. Du, Eckart Michaelsen
E-mail: du@ece.msstate.edu, Eckart.Michaelsen@iosb.fraunhofer.de
URL: http://www.iapr-tc7.org/prrs12

Name: 2012 International Conference on Indoor Positioning and Indoor Navigation (IPIN2012)
Dates: November 13–15, 2012
Location: Sydney, Australia
E-mail: ipin2012@unsw.edu.au
URL: http://www.surveying.unsw.edu.au/ipin2012/

Name: International Conference on Computer Vision in Remote Sensing (CVRS 2012)
Dates: December 6–8, 2012
Location: Xiamen, China
E-mail: CVRS2012@gmail.com
URL: http://cvrs2012.xmu.edu.cn

Name: 7th GRSS/ISPRS Joint Workshop on Remote Sensing and Data Fusion over Urban Areas
9thInternational Symposium on Remote Sensing of Urban Areas
Dates: April 19–21, 2013
Location: São Paulo, Brazil
E-mail: jurse2013@dpi.inpe.br
URL: http://www.inpe.br/jurse2013/

Name: 6th International Conference on Recent Advances in Space Technologies (RAST2013)
Dates: June 12–14, 2013
Location: Istanbul, Turkey
E-mail: rast2013@rast.org.tr
URL: http://www.rast.org.tr/

Name: 7th International Workshop on the Analysis of Multi-Temporal Remote Sensing images (MultiTemp 2013)
Dates: June 25–27, 2013
Location: Banff, Canada

Name: 5th Workshop on Hyperspectral Image and Signal Processing
Dates: June 25–27, 2013
Location: Florida