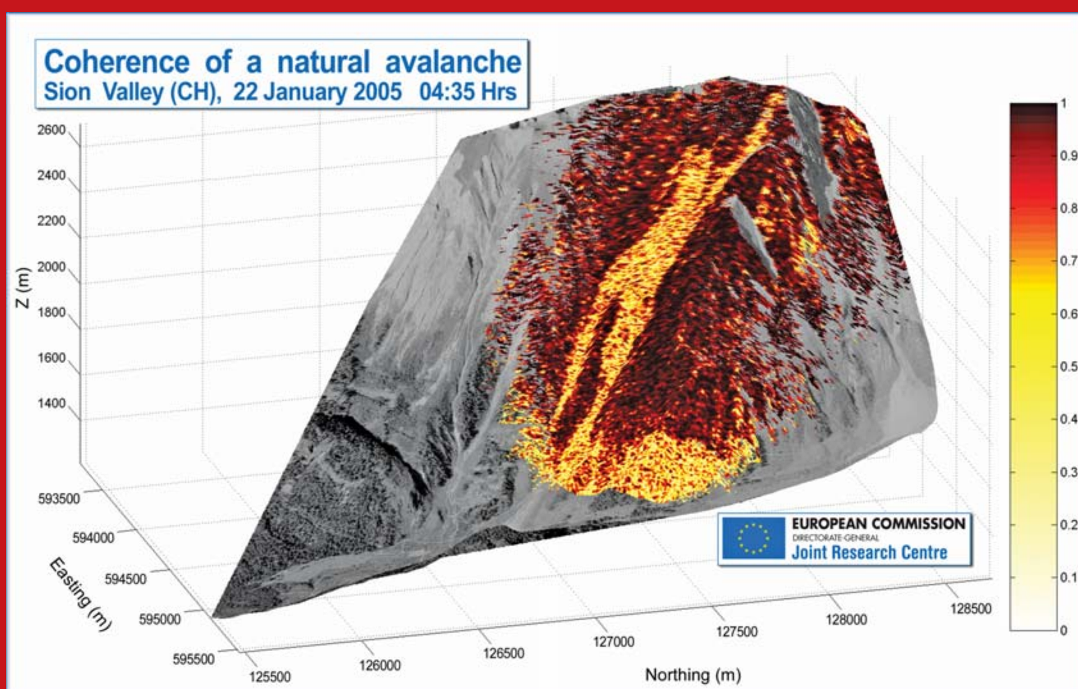
IEEE GEOSCIENCE and REMOTE SENSING Newsletter

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



Cumulative Issue #138 March 2006 ISSN 0161-7869

Table of Contents

Notice to Potential Advertisers

The IEEE GRS-S Newsletter publishes paid advertisements for job openings, short courses, products, and services which are of interest to the GRS-S membership. The rates for advertisements published in the Newsletter are:

Size	Dimensions	Per Insertion
Full page	7" x 10"	$500.00
Half page		$400.00
Vertical	3.375" x 10"	
Horizontal	7" x 4.875"	
Quarter page	3.375" x 4.875"	$300.00

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

Ms. Susan Schneiderman
Advertising Sales Manager
IEEE Magazines/Newsletters
445 Hoes Lane
Piscataway, NJ 08855-1331
Tel: +1 732-562-3946
Fax: +1 732-981-1855

Newsletter Input and Deadlines

The following is the schedule for the GRS-S 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.

GRS-S Newsletter Schedule

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

IEEE GRS-S AdCom, Officers and Committee Chairs – 2006 GRS-29 (Division IX)

President
Leung Tsang
Executive Vice President
Anthony K. Milne
Vice President for Technical Activities
Paul Smits
Vice President for Meetings and Symposia
Melba M. Crawford
Vice President for Operations and Finance
Karen M. St. Germain
Vice President for Professional Activities
Kamal Sarabandi
Secretary
Thomas J. Jackson
Director of Finance
James A. Gatlin
Director of Education
Granville E. Paules III
Awards
Werner Wiesbeck
Chapter Activities
Diane Evans
Conference Coordination
Melba Crawford, Paul Smits
Constitution and Bylaws
Anthony K. Milne
Fellow Evaluation
David Goodenough
Fellow Search
D. M. LeVine
Membership
Steven C. Reising
Nominations
Martti Hallikainen, C. Luther
Public Relations/Publicity
David Weissman
Standards and Metric
Jon A. Benediktsson
Strategic Planning
Anthony K. Milne, Andrew J. Blanchard
Technical Activities
Paul Smits
Transactions Editor
Jon A. Benediktsson
GRS Letters Editor
William Emery
Newsletter Editor
Adriano Camps
IGARSS 2005
Wooil M. Moon
IGARSS 2006
V. Chandrasekar
A. J. Gasiewski
IGARSS 2007
Ignasi Corbella
IGARSS 2008
John Kerekes
Eric Miller
PACE
Paul Racette
Society on Social Implications of Technology
Keith Raney
2006 AdCom Members
Martti T. Hallikainen
Ellsworth LeDrew
David M. LeVine
Alberto Moreira
Kamal Sarabandi
Leung Tsang
2007 AdCom Members
Andrew J. Blanchard
Albin J. Gasiewski
Thomas J. Jackson
Nahid Khazenie
Anthony K. Milne
Jay Pearlman
2008 AdCom Members
Melba Crawford
Diane Evans
Karen St. Germain
David G. Goodenough
Motoyuki Sato
Paul Smits
Honorary Life Members
Keith R. Carver
Kiyo Tomiyasu
Fawwaz T. Ulaby
Werner Wiesbeck

Postal Information and Copyright Notice
IEEE Geoscience and Remote Sensing Newsletter (ISSN 0161-7869) 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.
© 2006 IEEE. Permission to copy without fee all or part of any material without a copyright notice is granted provided that the copies are not made or distributed for direct commercial advantage, and the title of the publication and its date appear on each copy. To copy material with a copyright notice requires special permission. Please direct all inquiries or requests to the IEEE Copyrights Manager. IEEE Customer Service Phone: +1 732 981 1393, Fax:+1 732 981 9667.

Editor's Comments

Adriano Camps, Editor
Department of Signal Theorty and Communications
Polytechnic University of Catalonia
UPC Campus Nord, D4-016
E-08034 Barcelona, SPAIN
TEL: (34)-934.054.153
FAX: (34)-934.017.232

At the beginning of my fourth year as Editor of this Newsletter, I want to renew the efforts to make it a lively publication, close to the general membership, and specially to the student members. In this sense, you will find in this issue:

- an interesting article on snow cover monitoring by means of ground-based SAR, by Ph. D. student A. Martínez, and Dr. J. Fortuny, from JRC - Ispra, Italy, and
- an educational tutorial on the remote sensing applications of reflectometry using Global Navigation Satellite Signals (GNSS) as signals of opportunity, by Dr. G. Ruffini, from Starlab, Barcelona, Spain.

In addition to two meeting reports:

- the two-day Strategic Plan Meeting conducted by the GRS-S AdCom in Boulder, Colorado, by Prof. Andrew Blanchard, and
- the ESA-EUSC Image Information Mining 2005 Conference, held at ESRIN, Frascati, Italy.

Finally, on behalf of the GRS-S membership, I would like to welcome Prof. Leung as our new Society President. We wish you the best in guiding the GRS Society in the next years.

President's Message

Dr. Leung Tsang
President, IEEE GRS-S
University of Washington
Box 352500
Seattle, WA 98195, USA
E-Mail:
tsang@ee.washington.edu

At the third Earth Observation Summit held in Brussels in February 2005, participating governments accepted Global Earth Observation System of Systems (GEOSS) 10-year implementation plan. The plan states that the purpose of GEOSS is "to achieve comprehensive, coordinated & sustained observations of the Earth system, and to improve monitoring of the state of the Earth, increase understanding of Earth processes, and enhance predication of the behavior of the Earth system". In 2005, the U.S. National Research Council (NRC) released a report by the Committee on Earth Science and Applications from Space, and identified some urgent needs and opportunities. The committee "supports continuation of a line of explorative missions directed toward advancing understanding of Earth and developing new technologies and observation capabilities". These reports, together with the recent disasters of tsunami in 2004 and hurricanes in 2005, present new challenges for remote sensing and geosciences to scientists and engineers.

To place GRS-S in a strategic position to meet these challenges, in November 2005 the AdCom conducted a two day strategic planning session in Boulder, Colorado. In this issue of the Newsletter, Dr. Andrew Blanchard, Chair of the GRS-S Strategic Planning Committee, summarizes the key points discussed during the session. One recommendation was that GRS-S be more responsive to the remote sensing users' community. Accordingly, we have revised the statement of the GRS-S vision to now read "to be the leading professional society in science, engineering, applications, and education for the remote sensing and geospatial information community". In addition, there will be new initiatives relating to Membership Development on how to attract new and affiliate members and to improve services to our members. Regarding educational efforts, recommendations were made to strengthen our commitment to K-12 outreach and provide continuing education for professionals in the field of remote sensing. We are also looking into a new business model and how to utilize the Internet to connect to the transnational community. We will examine how to make IGARSS even better by boosting attendance, reducing "no shows" and improving upon the organization of the interactive papers sessions. We will publish a formal document with these and other specific recommendations for implementation after the February 2006 AdCom meeting in San Juan, Puerto Rico.

continued on page 4

Cover Information: Coherence map of a big natural avalanche the 22nd of January, 2005, at 4:35h local time. The path length is 2 km, starting in two different points at different levels, joining in the middle of the slope (achieving a maximum width of 200 m) and then dividing again through two corridors up to the lowest level in the valley. The radar image has been co-registered over an ortho-photo and over a Digital Elevation Model of the mountain (see feature article for more details).

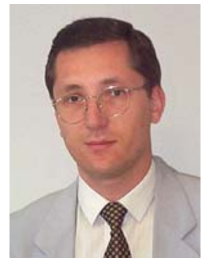
The IEEE is well known for its highly ranked journals. Thus, an important goal for GRS-S is to be the frontrunner in information dissemination at the leading edge of science, technology, and applications of remote sensing. With the continuing success of the IEEE Transactions of Geoscience and Remote Sensing and the IEEE Geoscience and Remote Sensing Letters, along with the increasing number of special issues of these publications, the AdCom recognized a need to consider the creation of a new journal. A Publications subcommittee co-chaired by Dr. Ellsworth LeDrew and Jon Benediktsson has been formed to study this issue. Possibilities for new journals include one on “Selected Topics of Remote Sensing”, or one on “Remote Sensing Applications”, or both. The Publications subcommittee will also look into working with the IEEE Press to publish books in remote sensing. We welcome your suggestions and opinions on this important effort.

The IEEE is a transnational organization and as such a goal of the GRS-S is to broaden its international participation. Every other year, we hold IGARSS outside of United States. Between 2001 and 2005, we have held IGARSS in Sydney, Toronto, Toulouse, and Seoul. IGARSS 2007 and 2009 will be held in Barcelona and Cape Town, respectively. In recent years, with the hard work of our subcommittee on Meetings and Symposia, we have co-sponsored numerous technical conferences and workshops in many different parts of the world. The GRS-S AdCom makeup reflects this diversity, with members from Canada, Europe, Australia, Japan, and the U.S.

Our Society also actively participates in GEO, thanks in large part to Dr. Jay Pearlman, Chair of the IEEE Committee on Earth Observations. The GEOSS 10 year implementation plan states that “The success of GEOSS will depend on data and information providers accepting and implementing a set of interoperability arrangements, including technical specifications for collecting, processing, storing, and disseminating shared data, metadata, and products”. To address this need, we have held two GEOSS workshops, entitled “The Users and the GEOSS Architecture” in Seoul, Korea in July 2005 and Pretoria, South Africa in October 2005. The next two IEEE GEOSS Workshops will be held in Beijing, China, May 22 to 23, 2006 and in Corsica, France, July 8 to 9, 2006. At the GEOSS Workshop in Seoul, we hosted speakers from Korea, Japan, China, Thailand, Australia, Canada, and USA. We are delighted to see major advances in remote sensing technology and applications occurring within the Pacific Rim nations. Through the Seoul workshop, we learned of the ambitious satellite remote sensing plans and GEOSS activities of Asian countries like Korea, Japan and China etc. For example, Thailand will be launching a remote sensing satellite named THEOS in 2007 to enhance their capability for natural resource, environment, and disaster management. In 2005, we saw the inauguration of

continued on page 31

Newsletter Editorial Board Members:



Adriano Camps, Editor
Department of Signal Theory and Communications
Polytechnic University of Catalonia
UPC Campus Nord, D4-016
E-08034 Barcelona, SPAIN
TEL: (34)-934.054.153
FAX: (34)-934.017.232
E-mail: camps@tsc.upc.edu

David B. Kunkee, Associate Editor for Organizational and Industrial Profiles
Radar and Signal Systems Department
The Aerospace Corporation
PO Box 92957 MS M4-927
Los Angeles, CA 90009-2957
TEL: 310-336-1125
FAX: 310-563-1132
E-mail: David.B.Kunkee@aero.org

Sandra Cruz-Pol, Associate Editor University Profiles
Electrical and Computer Engineering Dept.
University of Puerto Rico Mayaguez, PR. 00681-9042
TEL: (787) 832-4040 x2444 x3090
FAX: (787) 831-7564
E-mail: SandraCruzPol@ieee.org

Yoshio Yamaguchi, Associate Editor for Asian Affairs
Dept. of Information Engineering
Faculty of Engineering, Niigata University
2-8050, Ikarashi, Niigata 950-2181 JAPAN
TEL: (81) 25-262-6752
FAX: (81) 25-262-6752
E-mail: yamaguch@ie.niigata-u.ac.jp

Sonia C. Gallegos, Associate Editor for Latin American Affairs
Naval Research Laboratory
Ocean Sciences Branch, Oceanography Division
Stennis Space Center, MS 39529, USA
TEL: 228-688-4867
FAX: 228-688-4149
E-mail: gallegos@nrlssc.navy.mil

Tariro Charakupa-Chingono, Associate Editor for African Affairs
Institute for Environmental Studies, University of Zimbabwe
Box 1438, Kwekwe, Zimbabwe
TEL: 263 04 860321/33
FAX: 263 4 860350/1
E-mail: tcharaku@sird.icon.co.zw

2006 ADCOM MEMBERS' NAMES AND ADDRESSES

Dr. Leung Tsang
President, IEEE GRSS
University of Washington
Box 352500
Seattle, WA 98195, USA
E-Mail: tsang@ee.washington.edu
(AdCom 2004-2006)

Dr. Anthony K. Milne
Exec. VP, IEEE-GRSS
University of New South Wales
School of Biological, Earth and Env. Sciences
Sydney, NSW 2052, AUSTRALIA
E-Mail: t.milne@unsw.edu.au
(AdCom 2005-2007)

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: tjackson@hydrolab.arsusda.gov
(AdCom 2005-2007)

Dr. Karen M. St. Germain
VP for Operations and Finance, IEEE-GRSS
NPOESS Integrated Program Office
8455 Colesville Road, Suite 1450
Silver Spring, MD 20910, USA
E-Mail: Karen.StGermain@noaa.gov
(AdCom 2006-2008)

Dr. Kamal Sarabandi
VP for Professional Activities, IEEE-GRSS
Dept. of Electrical Eng. & Computer Science
Ann Arbor, MI 48109-2122, USA
E-Mail: saraband@eecs.umich.edu
(AdCom 2004-2006)

Dr. Paul Smits
VP for Technical Activities, IEEE-GRSS
Joint Research Centre Institute for Env. And Sustainability
TP262
I-21020 Ispra, ITALY
E-Mail: paul.smits@ieee.org
(AdCom 2006-2008)

Dr. Melba M. Crawford
VP for Meetings and Symposia, IEEE-GRSS
LARS/Lilly Hall
Purdue University
915 W. State Street
W. Lafayette, IN 47907-2054, USA
Email: mcrawford@purdue.edu
(AdCom 2006-2008)

Dr. Jon A. Benediktsson
Transactions Editor, IEEE-GRSS
Department of Electrical and Computer Engineering
University of Iceland
Hjardarhaga 2-6
107 Reykjavik, ICELAND
E-Mail: benedikt@hi.is

Dr. Andrew J. Blanchard
University of Texas Dallas
Johnson School
P. O. Box 830688
EC32
Richardson, TX 75083, USA
E-Mail: ablanch@utdallas.edu
(AdCom 2005-2007)

Dr. William J. Emery
Letters Editor, IEEE-GRSS
CCAR Box 431
University of Colorado
Boulder, CO 80309-0431, USA
E-Mail: Emery@colorado.edu

Dr. Diane Evans
NASA JPL
4800 Oak Grove Drive
M/S 180-404
Pasadena, CA 91109, USA
email: Diane.L.Evans@jpl.nasa.gov
(AdCom 2006-2008)

Dr. Albin J. Gasiewski
Past President, IEEE GRSS
NOAA Earth Systems Research Lab
325 Broadway R/PSD4
Boulder, CO 80305-3328, USA
E-Mail: al.gasiewski@noaa.gov

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

Dr. David G. Goodenough
Pacific Forestry Centre
Natural Resources Canada
506 West Burnside Road
Victoria, BC V8Z 1M5, CANADA
E-Mail: dgoodeno@nrcan.gc.ca
(AdCom 2006-2008)

Dr. Martti T. Hallikainen
Helsinki University of Technology
Laboratory of Space Technology
P. O. Box 3000
FIN-02015 HUT, FINLAND
E-Mail: Martti.Hallikainen@hut.fi
(AdCom 2004-2006)

Dr. Nahid Khazenie
8509 Capo Ct.
Vienna, VA 22182, USA
E-mail: n.khazenie@ieee.org
(AdCom 2005-2007)

Dr. Ellsworth LeDrew
University of Waterloo
Dept. of Geography
200 University Ave. West
Waterloo, Ontario N2L 3G1, CANADA
E-Mail: ells@watleo.uwaterloo.ca
(AdCom 2004-2006)

Dr. David M. Le Vine
NASA Goddard Space Flight Center
Code 614.6
Greenbelt, Maryland 20771, USA
E-mail: David.M.LeVine@nasa.gov
(AdCom 2004-2006)

Mr. Charles A. Luther
Past President, IEEE-GRSS
1113 Villamay Blvd.
Alexandria, VA 22307, USA
E-Mail: chuckluther@aol.com

Dr. Alberto Moreira
German Aerospace Center (DLR)
Microwaves and Radar Institute
P.O. Box 1116
82230 Wessling/Oberpfaffenhofen
GERMANY
Email: alberto.moreira@dlr.de
(AdCom 2004-2006)

Dr. Jay Pearlman
The Boeing Company
PO Box 3707 MS 8R-24
Seattle, WA 98124, USA
E-Mail: jay.pearlman@boeing.com
(AdCom 2005-2007)

Dr. Steven C. Reising
Electrical and Computer Engineering Department
1373 Campus Delivery
Colorado State University
Fort Collins, CO 80523-1373, USA
Email: reising@ieee.org;
steven.reising@colostate.edu
(AdCom 2006-2008)

Dr. Motoyuki Sato
Dept. of Geoscience and Technology
Graduate School of Tohoku University
980-8576 Sendai, JAPAN
E-mail: sato@cneas.tohoku.ac.jp
(AdCom 2005-2007)

Dr. Werner Wiesbeck
Honorary Life Member
University of Karlsruhe
Institute for High Frequency and Electronics
Kaiserstrasse 12
76128 Karlsruhe, GERMANY
E-Mail: werner.wiesbeck@ihe.uka.de

Dr. Kiyo Tomiyasu,
IEEE-GRSS Honorary Life Member
Lockheed Martin Corp.
366 Hilltop Road
Paoli, PA 19301-1211, USA
E-Mail: k.tomiyasu@ieee.org; kiyo.tomiyasu@lmco.com

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. 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

Ms. Lisa Ostendorf
Director of Conferences, IEEE-GRSS
IEEE Geoscience and Remote Sensing Society
63 Live Oak Lane
Stafford, VA 22554, USA
E-Mail: ieeegrss@adelphia.net

Ms. Kimberley Jacques
Director of Information Services, IEEE GRSS
8521 Trail View Drive
Ellicott City, MD 21043, USA
E-Mail: ieeegrss@comcast.net

Dr. Adriano Camps
GRS-S Newsletter Editor
Dept. of Signal Theory and Communication
Polytechnic University of Catalonia,
Campus Nord, D4-016
08034 Barcelona, SPAIN
E-mail: camps@tsc.upc.edu

Dr. R. Keith Raney
GRS-S 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

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

Dr. Wooil M. Moon
IGARSS05 General Chairman
Seoul National University
Dept. of Earth System Science
Kwanak-gu Shilim-dong San 56-1
Seoul, 151-742, KOREA
E-Mail: wmoon@eos1.snu.ac.kr
or
University of Manitoba
Geophysics Dept.
Winnipeg, MD R3T 2NT, CANADA
E-Mail: wmoon@cc.umanitoba.ca

Dr. V. Chandrasekhar
IGARSS06 General Co-Chairman
Colorado State University
Electrical Engineering Dept.
Fort Collins, CO 80523, USA
E-Mail: chandra@engr.colostate.edu

Dr. Ignasi Corbella
IGARSS07 General Chairman
UPC - TSC
Despatx: 208
Campus Nord - Edif. D3
C. Jordi Girona, 1-3
08034 Barcelona, SPAIN
E-Mail: corbella@tsc.upc.es

Dr. John Kerekes
IGARSS08 General Co-chair
Rochester Institute of Technology
54 Lamb Memorial Dr.
Rochester, NY 14623
USA
E-Mail: kerekes@cis.rit.edu

Dr. Eric Miller
IGARSS08 General Co-chair
Electrical and Computer Engineering
315 Sterns Center
Northeastern University
Boston, MA 02116, USA
E-Mail: elmiller@ece.neu.edu

Dr. Harold Annegarn
IGARSS09 General Chairman
Department of Geography and Environmental Management
Rand Afrikaans University
P O Box 524
Auckland Park 2006 Johannesburg
REPUBLIC OF SOUTH AFRICA
E-Mail: : han@rau.ac.za

Dr. Roger King
Instrumentation and Future Technologies Committee Chair
Mississippi State University
Box 9571
Mississippi State, MS 39762-9571, USA
E-Mail: rking@ece.msstate.edu

Dr. Liping Di
Data Archiving and Distribution Committee Chair
School of Computational Sciences
George Mason University
Fairfax, Virginia 22030-4444, USA
E-Mail: ldi@gmu.edu

Dr. Paolo Gamba
Data Fusion Technical Committee Chair
University of Pavia
Dept. Of Electronics
Via Ferrato 1
27100 Pavia, ITALY
E-Mail: paolo.gamba@unipv.it

Dr. Joel T. Johnson
Frequency Allocations in Remote Sensing Committee Chair
The ElectroScience Laboratory
The Ohio State University
1320 Kinnear Rd.
Columbus, OH 43212 ,USA
Email: Johnson@ee.eng.ohio-state.edu

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. David B. Kunkee
Communications and Info Policy Rep.
The Aerospace Corp.
Sensing and Exploitation Department
P.O. Box 92957, MS M4-041
Los Angeles, CA 90009-2957, USA
Email: David.Kunkee@aero.org

Dr. William B. Gail
Director of Corporate Relations, IEEE GRSS
Vexcel Corporation
1690 38th St.
Boulder, CO 80301, USA
E-Mail: bill.gail@vexcel.com

Mr. Granville E. Paules III
Director of Education, IEEE GRSS
Mission Infrastructure Management Division
Science Mission Directorate
NASA Headquarters Code DE
Washington, DC 20546, USA
E-mail: granville,paules@nasa.gov

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

GRS-S 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
Region 2: Eastern USA			
Washington / Northern VA	GRS	James Tilton	j.tilton@ieee.org
Region 3: Southeastern USA			
Atlanta Section, GA	AES, GRS	Greg Showman	greg.showman@gtri.gatech.edu
Eastern North Carolina Section, NC	GRS	Linda Hayden	haydenl@mindspring.com
Region 4: Central USA			
Southeastern Michigan Section	GRS	Mahta Moghaddam	mmoghadd@eecs.umich.edu
Region 5: Southwestern USA			
Denver Section, CO	AP, MTT, GRS	Karl Bois	karl.bois@hp.com
Houston Section, TX	AP, MTT, GRS, LEO	Christi Madsen	cmadsen@ee.tamu,edu
Region 7: Canada			
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	Jerry Lim	jl@mda.ca
Region 8: Europe and Middle East			
Central and South Italy Section 1	GRS	Nazzareno Pierdicca	nazzareno.pierdicca@uniromal.it
Central and South Italy Section 2	GRS	Maurizio Migliaccio	maurizio.migliaccio@uninav.it
Germany	GRS	Alberto Moreira	Alberto.Moreira@dlr.de
Russia Section	GRS	Anatolij Shutko	anatoli.shutko@email.aamu.edu ashutko@mail.ru
Spain Section	GRS	Adriano Camps	camps@tsc.upc.es
Ukraine Section	AP, NPS, AES, ED, MTT, GRS EMB	Anatoly Kirilenko	kirilenko@ire.kharkov.ua
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
Region 10: Asia and Pacific			
Beijing Section, China	GRS	Chao Wang	cwang@public.bta.net.cn
Seoul Section, Korea	GRS	Wooil Moon	wmoon@cc.umanitoba.ca
Taipei Section, Taiwan	GRS	Kun-Shan Chen	dkshen@csrsr.ncu.edu.tw
Japan Council	GRS	Masanobu Shimada	shimada.masanobu@jaxa.jp

PACE PIECE

AVOID THE TOP THREE COVER LETTER MISTAKES!

Deborah Walker, CCMC
Career Coach ~ Resume Writer
Find more job-search tips and resume samples at: www.AlphaAdvantage.com
Email: Deb@AlphaAdvantage.com

As a career coach and professional resume writer, I'm often asked "How important are cover letters to my job search?" My answer is, "It depends on how long you want to search for your next job." If you are in no hurry to get interviews, then don't worry about your cover letter.

The fact is I've never met a job searcher who wants to have a painfully slow job search. The whole point of sending out resumes is to get multiple interviews as quickly as possible. But many job seekers still unwittingly sabotage their efforts by using substandard cover letters. Instead of helping you, your cover letter may actually be hurting your job search.

For fast job search results, make sure to avoid these top three cover letter mistakes:

1. Not understanding the hiring motives of your audience
2. Repeating rather than introducing your resume
3. Overuse of the word "I"

1. Not understanding the hiring motives of your audience

There are three basic audiences that a job seeker sends his/her resume to: executive decision-makers, resume screeners, and third-party recruiters. Each of these groups has its own hiring motives.

Executive decision-makers are looking for candidates who will have a significant impact on bottom-line initiatives, such as time saved, income generated, revenue built, etc.

Resume screeners are searching for candidates who directly match the lists of qualifications in the job description.

Third-party recruiters are looking for selling points to help position you as a top candidate.

Knowing these hiring motives will help you craft your cover letter specifically to catch the attention of your particular hiring audience. By appealing directly to the reader, you are creating an immediate bond that will make you a stronger candidate.

2. Repeating rather than introducing your resume

Repeating the exact same things you wrote in your resume is one of the most common cover letter mistakes. No one wants to read the same thing twice. By the time most people have finished writing their resume, they feel that they have run out of ideas and just cut and paste to create a cover letter.

Instead, the cover letter should be what sells the reader on your skills. Like the jacket-cover introduction to a good book, the cover letter should give the reader a taste of the great things to come and encourage them to read more.

If you don't have any idea what your top skills are and how they will help the company, neither will your reader. Take the time to craft the right words and statements to make your skills shine.

3. Overuse of the word "I"

A cover letter that begins nearly every sentence with "I" is as boring as a conversation with someone who only talks about himself. That kind of person one avoids at all costs. Is that the way you want your reader to see you?

Focusing all the attention on yourself may seem like a good way to sell your skills. But it can also reflect lack of interest in the company, in the job, and in making a real contribution to that workplace. There's a good balance to be drawn between selling yourself and selling what you can do for the company.

Creating variety in the sentences of your cover letter is an easy way to show your interest without being self-centered. By shifting the emphasis to the recipient/company—and away from yourself—you can prove that your main interest is not just in winning the job but also in doing it effectively. Try to rewrite sentences that start with "I," "me," or "my," to start with "You," or "Your." Show how you can make a difference for them.

A cover letter that is poorly written may cause your resume to be ignored. But a well-crafted cover letter will invite and encourage the reader to take a closer look at your resume. You'll make a positive first impression before your resume is even opened.

Rather than making your cover letter an afterthought, take the time to really consider the type of presentation your cover letter will make. If your resume isn't winning you job interviews, consider hiring a professional resume writer to help. It's true what they say: You never get a second chance to make a good first impression.

GRS-S MEMBERS HIGHLIGHTS

TRIBUTE TO GUY ROCHARD

[from http://cimss.ssec.wisc.edu/itwg/news/guy_rochard.html]

The International (A)TOVS community will be sadly depleted by the untimely death of our good friend and colleague Guy Rochard in early December 2005. Guy was always passionate about his work, in true Breton style, and there were several issues that he pursued for the ITWG with great tenacity.

For example one such issue was ensuring the availability of direct read out data processing software for users of locally received (A)TOVS sounder data from the NOAA satellites. In 1977 Guy set up a team of scientists at the Centre Météorologie Spatiale in Lannion to help develop the use of NOAA data. Many of that original group are still active today. It was natural that Guy became involved with the ITWG group development of the first data processing package, the ITPP in the early 1980's. Then as other members created their own retrieval software, including the ICI and 3I his work in enabling scientists worldwide to use these software was influential in spreading the word about the usefulness of satellite direct readout around the world. In the mid 90's he helped to initiate the successful AAPP software development for the next generation ATOVS instruments. His lab at MétéoFrance in Lannion played a key role in its development and the package was subsequently adopted by EUMETSAT. Recently Guy has been very active in clarifying the plans for the direct readout software from NPP/NPOESS with much discussion between us.

Guy, more than anyone else, took the threat of radio frequency interference (RFI) on our microwave sounding and imaging channels very seriously and spent an incredible amount of effort over the last 15 years to ensure the frequencies needed for science would be protected. He traveled the world to make sure our cause was represented at the diversity of meetings on this topic and there is no doubt the protection of the ATOVS and other meteorological sensors was initiated and put in place by Guy's efforts. He made sure the ITWG were closely involved in this activity and at his invitation last year we hosted a meeting of the Space Frequency Co-ordination Group in Brittany to highlight the issue of protection for passive microwave sounding channels. Without his persistence we may have lost important regions of the microwave spectrum for remote sensing.

From its inception, Guy was a strong supporter of the ITWG, attending all the conferences except one. As a measure of his respect and popularity within the TOVS community he was elected Co-chair of the ITWG for the period from 1998 to 2003 and along with Co-chair John LeMarshall arranged the 10th to 12th International TOVS Study Conferences in Boulder, Colorado, USA, Budapest, Hungary and Lorne, Victoria, Australia. It was during this period and often through Guy's international activities that our community grew significantly. Guy also provided the initial impetus to hold a TOVS conference in China that recently came to pass with our successful ITSC-14 conference in Beijing, a city that he loved.

Guy truly believed in the international cooperation and opportunities for collaboration that the satellite remote sensing field provides for. He set up several successful collaborations with the Chinese Meteorological Agency and we were told by the locals that he knew Beijing better than they did! We know he was very happy to see his last TOVS conference in China. Guy also fostered student and scientist exchanges with eastern Europe, Africa and the Americas. His sudden death is all the more poignant as it is only a few days ago that he was helping us update the ITWG email list with suggestions for new members of the club from several continents. With a passion and a kindness, Guy helped to build the diversity of our international remote sensing community.

Life won't be the same without Guy ringing up from Britanny, comparing the current weather and then making sure one issue or other is fully clear, or taking the floor at a TOVS conference and warning us all of the dangers of radio frequency interference to our microwave sensors and urging us all to lobby our local governments. We owe it to Guy to continue his legacy of frequency protection for meteorological remote sensing channels and all the other issues which he pushed so fervently at the TOVS conferences. Guy may you rest in peace. We will miss you.

Roger Saunders and Tom Achtor ITWG Co-Chairs

YAHYA RAHMAT-SAMII RECEIVED THE 2005 URSI BOOKER GOLD MEDAL IN NEW DELHI, INDIA

The Booker Gold Medal honors the memory of Professor Henry G. Booker who served as URSI (International Union of Radio Science) Vice President, 1969-1975, and Honorary President until his death in 1988. The award is made normally at intervals of three years, on the occasion of the General Assembly of URSI. The Medal is awarded for outstanding contributions to telecommunications or a related discipline of direct interest to URSI. The award is for career achievements of the candidate with evidence of significant contributions within the most recent six-year period. The 2005 URSI General Assembly was held in New Delhi, India, October 23-29, 2005. President of India, Dr. Abdul Kalam attended the opening ceremony and presentation of awards with nearly 1300 participants from all corners of the world.

Yahya Rahmat-Samii (center) with the President of India (far left), Dr. Abdul Kalam. New Delhi, Oct. 23, 2005. Photo from the website of President of India.

Prof. Yahya Rahmat-Samii was the recipient of the 2005 URSI Gold Medal with citation, "For fundamental contributions to reflector antenna design and practice, near-field measurements and diagnostic techniques, handheld antennas and human interactions, genetic algorithms in electromagnetics, and the spectral theory of diffraction".

Yahya Rahmat-Samii obtained his B.S. Degree in Electrical Engineering from Tehran University and his M.S. and Ph.D. degrees from the University of Illinois, Urbana-Champaign. He is a distinguished professor and past chairman of the Electrical Engineering Department at the University of California, Los Angeles (UCLA). Before joining UCLA, he was a Senior Research Scientist at NASA Jet Propulsion Laboratory (JPL). He became a Fellow of IEEE in 1985, and was elected as the president of IEEE Antennas and Propagation Society (AP-S) in 1995. Rahmat-Samii has published over 650 journal and conference papers and over 20 books/book chapters in the areas of electromagnetics and antennas (www.ee.ucla.edu/antlab). In 1992 and 1995, he was the recipient of the Best Application Paper Prize Award (Wheeler Award) for papers published in IEEE AP-S Transactions. In 1999, he was the recipient of the University of Illinois ECE Distinguished Alumni Award. In 2000, Dr. Rahmat-Samii received the IEEE Third Millennium Medal and the AMTA Distinguished Achievement Award. In 2001, he received an Honorary Doctorate in physics from one of the oldest universities in Europe, the University of Santiago de Compostela, Spain. In 2001, he was elected as the Foreign Member of the Royal Academy of Belgium for Science and the Arts. In 2002, he received the Technical Excellence Award from JPL. He is the winner of the 2005 International Union of Radio Science (URSI) Booker Gold Medal presented at the URSI General Assembly, New Delhi, India. Professor Rahmat-Samii is the designer of the IEEE AP-S logo.

DR. MASSONET RECEIVES THE 2005 APPLETON PRIZE

Didier Massonnet was born in 1957 and received the B.S. degree from the Ecole Polytechnique, Paris, France, in 1982 and from the Ecole Nationale Supérieure des Techniques Avancées (Engineering School for Advanced Studies), Paris, in 1984. He received the Ph.D. degree for habilitation from the University of Toulouse, Toulouse, France, in 1997. He joined CNES (French Space Agency), Toulouse, in 1984 to work in the field of synthetic aperture radar (SAR). He was Deputy Delegate for Earth observation within the program directorate of CNES until 2004. Since 2005 he is a Senior Expert for the Atomic Clock Ensemble in Space project. He was the General Chairman of the IGARSS 03 (Toulouse).

His main research interests are in algorithms for SAR image formation, quality measurement on SAR images, development of geodetic applications based on active or passive electromagnetic systems, and system design for spaceborne radars. He has been closely involved with the early development of radar interferometry applied to ground deformation monitoring, producing in particular the first measurements of displacements due to an earthquake or a volcano and recognizing the effect of the atmosphere as the main limiting factor of the technique. Dr. Massonnet was awarded the First prize at the Geophysical Image Contest for the 50th anniversary of AGU in 1994, the Prize Kodak-Pathé Landucci: Grand Prix of the French Academy of Science in 1994, the "Vinci d'excellence" (with K. Feigl) in "Art and Science" international contest, the Silver Medal of the French Aerospace Academy in 1998, the French National Merit Order in 2002, and the Appleton Prize, Union Radioscientifique Internationale in 2005 with the citation : « For his outstanding work on radar imaging and satellitre radar interferometry, a technique combining high frequencies, propagation and digital signal processing.»

GRS-S MEMBERS ELECTED TO THE GRADE OF FELLOW OF THE IEEE, JANUARY 1, 2006:

Prof. Kultegin Aydin
Pennsylvania State University, PA, USA
For contributions to electromagnetic scattering and quantitative estimation in storms and clouds.

Dr. Eastwood Im
Jet Propulsion Laboratory, CA,USA
For contributions to spaceborne atmospheric radar remote sensing.

Dr. Ellsworth LeDrew
University of Waterloo, Ontario,Canada
For contributions to environmental remote sensing sciences.

Mr. Charles Luther
Office of Naval Research, VA, USA
For leadership in microwave remote sensing.

GRS-S MEMBERS ELEVATED TO THE GRADE OF SENIOR MEMBER FROM AUGUST 2005 TO JANUARY 2006

August 05: Ian G. Cumming, Juan M. Lopez-Sanchez

November 05: Rajat Bindlish, Jinsong Chong, Allan Corbeil, Anthony Milne, Maria Petrou, and Graeme Wilkinson

January 06: Aria Abubakar, Stephan Albert Bren, Srisakdi Charmonman, Kapil Chhabra, Francisco Eugenio, Paolo Ferrazzoli, Andre Garzelli, Hassan Ghassemian, Olaf H A Hellwich, Otmar Loffeld, Farid Melgani, Madras Nallaperumal Krishnan, Fernando Pellerano, Leif Persson, Patrick Rauss, Joshua Semeter, Domenico Solimini, Alla Timchenko, and Andreas Wiesmann.

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 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 form IEEE GRS-S website: http://ewh.ieee.org/soc/grss/ (click Join Us) or IEEE Senior membership program: http://www.ieee.org/organizations/rab/md/smprogram.html

CALL FOR NOMINATIONS

2007 IEEE DENNIS J. PICARD MEDAL FOR RADAR TECHNOLOGIES AND APPLICATIONS

IEEE Dennis J. Picard Medal for Radar Technologies and Applications is presented for outstanding accomplishments in advancing the fields of radar technologies to an individual or team of up to three. The medal is sponsored by Raytheon Co.

The recipient of the award receives a gold medal, bronze medal, certificate, and cash honorarium. The nomination deadline for the 2007 medal is July 1st, 2006.

For nomination forms, visit the IEEE Awards Web Site, http://www.ieee.org/portal/pages/about/awards/sums/picard.html or contact IEEE Awards Activities, 445 Hoes Lane, Piscataway, NJ, USA, 08855-1331; tel: +1 732 562 3844; email: awards@ieee.org.

FEATURE ARTICLE
SNOW COVER MONITORING IN THE SWISS ALPS WITH A GB-SAR

Alberto Martinez-Vazquez, Joaquim Fortuny-Guasch
DG Joint Research Centre, European Commission Ispra, Italy
e-mail: alberto.martinez@jrc.it, joaquim.fortuny@jrc.it

Introduction

Since 1997, the Sensors Radar Technologies and Cybersecurity Unit (SERAC) of the European Commission Directorate General Joint Research Centre (DG JRC) [1] has pioneered the use of Ground-Based Synthetic Aperture Radar (GB-SAR) systems in support of the risk assessment of landslides. The competencies of the Unit range from the design, construction, deployment and operation of the instrument, to the development of the routines for the acquisition and processing of the imagery, including the delivery of the final products in the form of the time evolution of the monitored points, two-dimensional maps of the surface displacement, geo-referencing of the maps over three-dimensional Digital Elevation Models (DEMs), snow height profiles, avalanche catalogues, etc.

The Unit started its activities in GB-SAR in 1997 with the design and construction of the LISA instrument (LInear SAr) [2]. Over the years, the Unit has constructed and operated a number of GB-SAR systems (among others, Ponte Dolo, Lecco, volcanic landslide of Stromboli in Italy, Schwaz in Austria, archaeological site of Machu Picchu in Peru, and Airolo in Switzerland), gaining increasing experience both in the hardware and software areas. The structures monitored range from dams, buildings and bridges to landslides and volcanoes [3, 4]. The success of this work led to the creation, in 2003, of a JRC's spin-off company, LISAlab srl, which is offering on a commercial basis the service of monitoring of landslides with the LISA technology.

This article presents the field campaign carried out by the SERAC Unit with the LISA instrument in the Sion valley of the Swiss Alps in collaboration with the Swiss Federal Institute for Snow and Avalanche Research Davos [5] during the winter seasons of 2003-2004 and 2004-2005.

The campaign

The goals of the campaign were the mapping of the snow accumulation, the identification of structural changes in the snow cover (e.g.: mass movements, snow wetness anomalies) and the search of precursors in natural avalanches in order to provide an early warning.

For this purpose, the LISA instrument was deployed in November 2003 by helicopter (see Fig. 1) in the mountain opposite to a natural avalanche corridor where every year some tenths of spontaneous avalanches occur. In addition, artificial avalanches are also triggered at least once per year.

Figure 1. Deployment of the instrument in the opposite slope

The deployment of the LISA instrument in the Sion valley has provided, up until now, more than 33000 radar images, distributed in 350 days along two winter seasons. During the winter 2003-2004 the system acquired 1 image every 30 minutes. This rate has been increased to 1 image every 11 minutes in the winter 2004-2005 thanks to the replacement of the network analyzer.

Although the system has been operated in a single polarization (vertical), single band (C band) and with a single reception antenna, it is scheduled for the next winter campaign (2005-2006) to perform some days of measurements with two reception antennae in order to generate a Digital Elevation Model of the mountain. Fully polarimetric measurements are also planned.

A DInSAR (Differential Interferometric SAR) analysis has been conducted on the data gathered by the instrument. This technique exploits the large penetration depth in dry snow, taking into account that the main contribution of backscattering from ground covered by dry winter snow stems from the ground surface. Thus, the snow acts as a layer which refracts and slightly attenuates the electromagnetic waves [6].

Synthetic aperture radar differential interferometry is based on the comparison of a pair of complex radar images of the same scene taken at different instants of time. The result of this comparison is called the complex coherence. The coherence (magnitude of the complex coherence) indicates the degree of correlation between the two images, while the interferometric phase (also called interferogram or phase of the complex coherence) reveals the differences in the wave travelling time associated with the two images.

Test site

The Swiss Federal Institute for Snow and Avalanche Research (SLF, Davos) manages a test site for avalanche experiments in the Sion valley, in the Canton Valais of Switzerland [7]. The site consists of a concave shaped channel of 1200 m vertical drop and an average slope of 27 degrees. The avalanche path length is 2.5 km, starting from the highest elevation level at 2650 m and finishing at the level of 1450 m.

Several instruments are available in the test site providing ground truth data. Two meteorological stations provide data concerning temperatures, wind speed and direction as well as snow height. Three pairs of FM-CW (Frequency Modulation Continuous Wave) radars are located in the avalanche corridor to determine the height of the avalanche, its speed, turbulences and density. A network of geophones automatically triggers the measuring equipment when spontaneous avalanches occur. For impact studies a narrow wedge steel construction 20 m high is in the middle of the avalanche track. It is equipped with force transducers and pressure and strain gauges to determine the avalanche flow height through contact with the moving snow mass.

In order to observe the avalanches under the best possible conditions, a bunker is located in the mountain opposite to the corridor 50 meters above the lower level of the valley. It holds a 5Mpixel digital photo camera that continuously takes a picture every 30 minutes. When a geophone detects an avalanche, the camera switches to burst mode with a rate of 1 picture every 4 seconds. The bunker is also used for recording the measurements made in the corridor and to provide the power energy to the LISA system.

The LISA system is located in the mountain opposite the avalanche corridor at an approximate level of 1780 m (330 meters above the lower level of the valley). In that way the instrument has direct visibility of the scenario, covering a cross range section of more than 2000 m. The distance of the instrument to the slope ranges approximately from 1000 m to 2900 m, hence, the area covered by the radar is nearly 2 km by 2 km as can be seen in Fig. 2.

Figure 2. Field of view of the instrument

Instrument

The instrument, LISA, is a ground-based linear SAR fully developed and built at the Joint Research Centre (Ispra, Italy). The radar is mounted in a temperature-controlled trailer for ease of transportation and deployment. A schematic and a picture of its components can be seen in Fig. 3.

The main component of the instrument is a vector network analyzer (VNA in the figure), which is used to generate the stepped-frequency continuous wave radar pulses and receive the coherent responses. A sled carrying the network analyzer, the power amplifier (AMP) and the antennas (Tx and Rx) slides along a rail 5 m long in order to synthesize a linear aperture such that the azimuth resolution is obtained. This movement is directed by a linear positioner (LP) by means of a serial interface and the appropriate control software. A mobile phone (CEL) is used to remotely control the automatic measurements through the public GSM network. This connection also allows the visualization of the instrument both inside and outside of the trailer thanks to two video cameras (WC1 and WC2) connected to an Ethernet switch (Eth SW). Two external hard disks (HD1 and HD2) implement the data archiving and backup. A meteorological station (METEO)

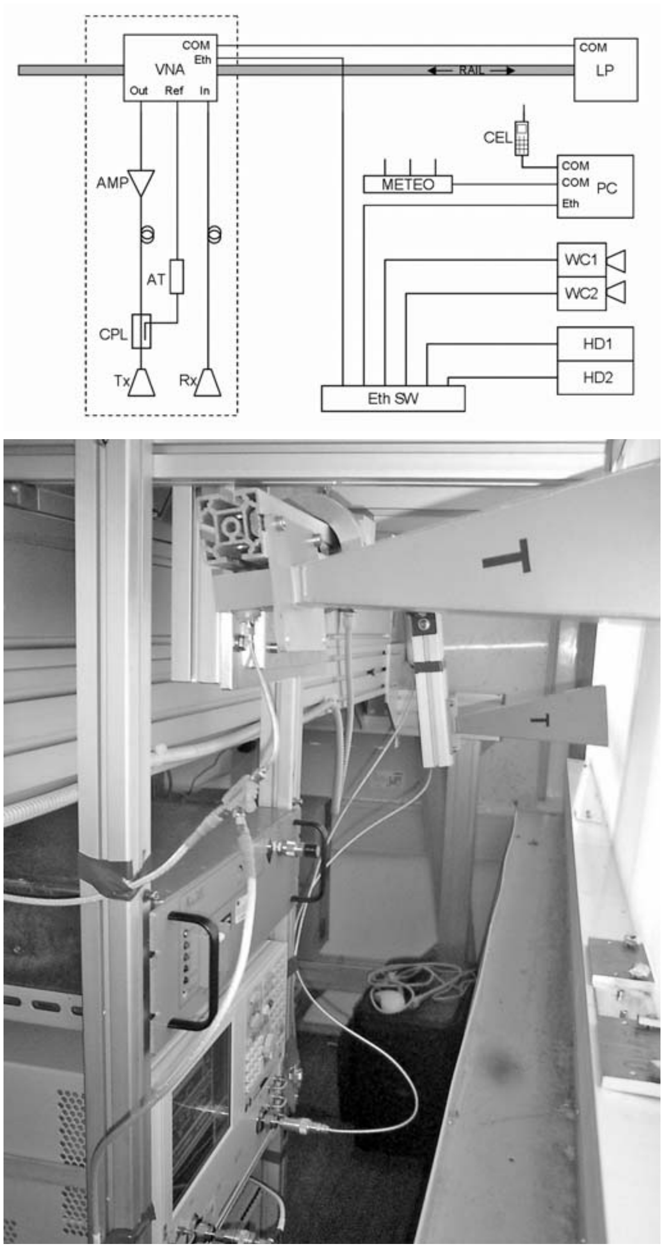


Figure 3. Schematic and RF components view of the LISA instrument

logs the air temperature, relative humidity, barometric pressure, wind speed and direction and rainfall at the outside of the trailer. And finally, a personal computer (PC) operates all the systems and is used for the image processing.

It is worth noting that the integration of all the radio-frequency components in the moving sled avoids folding the RF cables, a possible source of phase distortions in ground-based SARs because of the continuous bending of the cables caused by the movement of the linear positioner.

The radar has been operated in vertical polarization with a central frequency of 5.83 GHz (C-band) and a bandwidth of 60 MHz, sampled in 1601 points. The aperture synthesized along the x-axis was 3.5 m long in 251 steps. This gives a spatial resolution in azimuth of Dx ª 7.3 m, and a spatial resolution in range of Dr ª 2.5 m. The raw data has been focused in a 601¥601 pixels image over a 2200¥2200 m rectangle by means of an in-house near-field FFT-based algorithm, which has been specifically developed for this application.

Results

Currently two kinds of products have been preliminary derived from this campaign: the retrieval of the snow height and the creation of a catalogue with the spontaneous avalanches occurred.

The estimation of the snow height is given by a linear equation where the linear term is directly depending on the interferometric phase [8]. An additive constant (offset) has been assigned directly from the snow height value provided by the meteorological station at 00:00h of the day of interest, while the multiplicative factor has been computed in order to minimize the absolute value of the difference between the estimated snow height and the ground truth data.

The multiplicative parameter in the linear model is mainly dependent on the radar wavelength (l0), the incidence angle (qi) and the dielectric constant of the snow (e). Considering that the wavelength and the incidence angle are kept constant in all the measurements, the only main dependence of that factor is with the dielectric constant. The model used for the estimation of the snow height assumes dry snow, so the dielectric constant depends only on its density. Knowing the model, l0 and qi, it should be possible to invert the snow density from the obtained multiplicative constants. This work is scheduled to be done in the next campaign, since ground truth data for the density is not yet available.

Fig. 4 shows the snow height estimation over a four day period, from the 18th to the 21st of January, 2005. The snow height estimated is represented by a continuous line, while the ground truth data from the meteorological station is shown as a crossed line.

Regarding the accuracy of the results, it may be considered that the selected points for the estimation of the snow height are located at a slightly different altitude and 2 km away from the automatic meteo station. Additionally, while the meteo

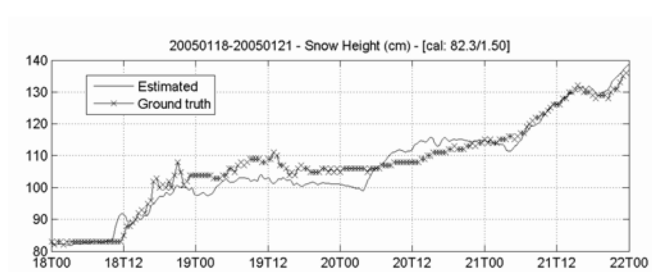


Figure 4. Snow height estimation vs. ground truth data

station is on a flat area, the radar estimations are performed over a steep slope. Nevertheless, a good matching has been found between the radar estimates and the ground truth data preliminary analyzed to the moment.

Thanks to the automatic and continuous measurements performed during the two winter campaigns, more than 80 natural avalanches have been monitored. A catalogue has been created containing the date and time of the avalanches, their size and the coordinates of the starting point [9].

Fig. 5 shows the coherence map of a big natural avalanche the 22nd of January, 2005, at 4.35h local time. The path length is 2 km, starting in two different points at different levels, joining in the middle of the slope (achieving a maximum width of 200 m) and then dividing again through two corridors up to the lowest level in the valley. The radar image has been co-registered over an ortho-photo and over a Digital Elevation Model of the mountain.

The avalanche produces a clear reduction of the coherence on the affected paths, decreasing the average value from 0.95 to 0.55. The interferometric phase, although not shown here, becomes completely random on the avalanche paths. These patterns allow an easy automatic classification based on contour and brightness detection.

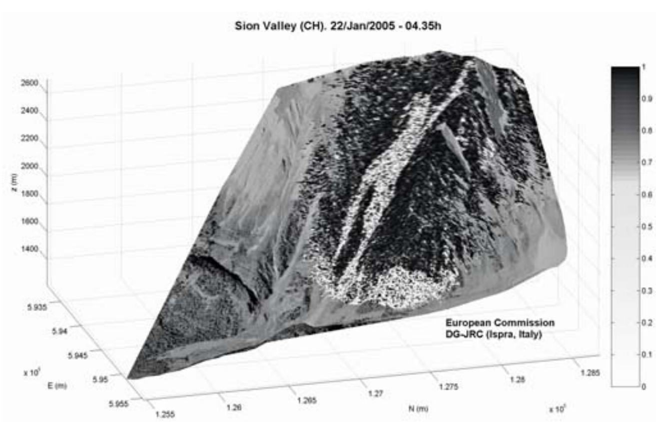


Figure 5. Avalanche path (low coherence) over an elevation model of the area

Another interesting phenomenon observed is a uniform decrease in the coherence on the base of the mountain (very bottom of the radar image). This is because this zone corresponds to a forested area. Interferometry is sensitive to submillimetric changes, and that day a maximum wind speed of 15 m/s, together with snow fall that increased the level of snow by 30 cm, made the forest a very agitated zone.

Although snowfall is also seen in the interferometric maps as a reduction of the coherence, this phenomenon has a slower temporal behaviour and can be distinguished from avalanches by observing the previous interferometric maps. In the case of snowfall, interferometric maps show a progressive degradation of the coherence over the time, uniformly distributed all along the area covered by the radar. With avalanches, on the contrary, the coherence deteriorates abruptly and in a very well localized zone.

Conclusions

The field campaign described in this article has provided the first archive of ground based synthetic aperture radar imagery for the study of the snow cover. Different radar signatures are present in the archive, such as those corresponding to natural avalanches, artificially triggered avalanches, snow fall, snow drift, etc. corresponding to two winter seasons, and accompanied by ground truth (meteorological) data. This variety of data will allow the study of different aspects of the snow cover.

The snow height retrieval, as well as the detection and classification of spontaneous avalanches, have already been introduced in this article, confirming the potential use of GB-SAR for the monitoring of dry snow. But there is still work to be done in order to exploit the huge archive of radar images available. A deeper study of these images, together with the ground truth data, may lead to the univocal discrimination of avalanches with respect to heavy snowfall or snow drift because of the weather conditions, and to the identification of some new precursors of avalanches based on ground-based SAR imagery in order to forecast them.

Acknowledgements

The authors would like to thank Urs Gruber from SLF (Davos, Switzerland) and Giuseppe Antonello, David Shaw and Dario Tarchi from DG JRC (Ispra, Italy) for their collaboration in this campaign.

References

[1] Sensors, Radar Technologies and Cybersecurity, DG JRC, European Commission. http://serac.jrc.it

[2] H. Rudolf, D. Tarchi, "LISA: The Linear SAR Instrument." DG JRC, European Commission, Technical Note No. I.99.126. July 1999.

[3] M. Pieraccini, D. Tarchi, H. Rudolf, D. Leva, G. Luzi, C. Atzeni, "Interferometric radar for remote monitoring of buildings deformations." Electronic Letters, vol.36, no.6, pp.569-570, 2000.

[4] D. Leva, G. Nico, D. Tarchi, J. Fortuny-Guasch, A.J. Sieber. "Temporal analysis of a landslide by means of a ground-based SAR interferometer." IEEE Transactions on Geoscience and Remote Sensing, vol.41, April, pp.745-752, 2003

[5] Swiss Federal Institute for Snow and Avalanche Research Davos. http://www.wsl.ch/slf/welcome-en.html

[6] C. Matzler. "Microwave Permitivity of Dry Snow." IEEE Transactions on Geoscience and Remote Sensing, vol.34, no.2, March, 1996.

[7] F. Dufour, U. Gruber, B. Sovilla, P. Bartelt. "A new Swiss test-site for avalanche Experiments in the Vallée de la Sionne / Valais". http://www.wsl.ch/slf/schnee-lawinen/Lawinendynamik/VdlS/vdls-haupt-en.html

[8] H. Rott, T. Nagler, R. Scheiber. "Snow Mass Retrieval by means of SAR Interferometry." 3rd FRINGE Workshop, European Space Agency, Earth Observation, 2003.

[9] A. Martinez-Vazquez, J. Fortuny-Guasch. "Monitoring Structural Changes and Stability of the Snow Cover with a Ground-Based Synthetic Aperture Radar." URSI Commission F Symposium. Ispra (Italy), 2005.

EDUCATIONAL TUTORIAL

A BRIEF INTRODUCTION TO REMOTE SENSING USING GNSS REFLECTIONS

Giulio Ruffini
giulio.ruffini@starlab.es
Research Department, Starlab Barcelona SL
Edifici de l'Observatori Fabra, Camí de l'Observatori, s/n
08035 Barcelona, Spain

Introduction

GNSS-R, the use of Global Navigation Satellite Systems (GNSS) reflected signals is a powerful and potentially disruptive technology for remote sensing: wide coverage, passive, precise, long-term, all-weather and multi-purpose. GNSS emit very precise signals which will be available for decades as part of an emerging infrastructure resulting from the enormous effort invested in GPS, GLONASS, Galileo and augmentation systems. Moreover, GNSS-R technologies will be mature for space applications by the time Galileo and GLONASS are fully deployed, thanks to ongoing ground, air and space research.

In this short tutorial we review the basic concepts of GNSS-R, focusing on marine applications using GPS signal (the pioneering US Global Positioning System).

Global Navigation Satellite Systems

GNSS are designed to provide users with precise position/navigation information. The term "global" navigation refers to the fact that GNSS are to support users everywhere on the surface of the planet, as well as in air and near space. In practice this is achieved with the use of satellite technology. Typically, GNSS satellites are deployed in relatively high orbits and large inclinations to cover most of the globe. For example, GPS satellites have a period of about 12 h and they are located at some 20,000 km altitude in near circular orbits at 55 degrees of inclination (see Table 1). As of today, we have a fully deployed GPS system, a growing GLONASS constellation, and the first successful launch of a Galileo satellite, plus infrastructure on the ground and also on geostationary orbits (so-called augmentation systems).

The principle of operation in GNSS is conceptually straightforward: triangulation based on time of flight of radio signals. The details are rather complex, in fact, as a series of considerations have to be made in order to achieve precise (few m) or ultra precise (few cm) positioning precisions. These include accounting for clock errors, orbit perturbations, atmospheric effects (troposphere, ionosphere) as well as Special and General Relativity effects.

In addition to the space segment, GNSS include a ground segment as well as so-called augmentation systems, including geostationary satellites providing additional information for a more precise and robust service to dedicated areas.

To see how GNSS work an example will suffice. Let us assume that at a given moment four satellites are in view by a user on the ground, and that the clocks on board the satellites are synchronized. The signals transmitted by each of the satellites contain messages of the sort "I am satellite S in orbit O, and I am transmitting this signal at GPS time T". It is not hard to see that, upon reception of four such messages, four equations relating the space-time coordinates of the emission and reception events can be written to figure out the user's time and location. This assumes that the user's clock, although biased, is precise in the time scales needed to cover the four reception times. It also assumes that the user is capable of inferring the emitter positions using the time and orbit information she gets from the message.

In the next few years, the European Satellite Navigation System (Galileo, with 30 satellites) will be deployed and GPS will be modernized, providing more frequencies and wider bandwidth civilian codes. GLONASS is presently undergoing a revitalization phase, with more and more modern satellites. More than 80 GNSS satellites will soon be emitting precise L-band spread spectrum signals for at least a few decades (see Table 1).

	Operational by	Inclination (degrees)	Number of Planes	Altitude (km)	Signal structure	Number of satellites
GPS	Now	55	6	20,180	CDMA in L1, L2 and L5	29
GLONASS	2010	64.8	3	19,140	FDMA in L1, L2	24
GALILEO	2010	56	3	23,222	CDMA in E5a,b, E6 and E2-L1-E1	30

Table 1. A comparison of GPS, GLONASS and Galileo. Both GPS and Galileo use Code Division Multiple Access (CDMA) to allow all satellite emissions share the same spectral band, while GLONASS uses a frequency division scheme (FDMA). All systems are spread spectrum in L band.

While we address here GNSS-R, other established remote sensing applications using GNSS already exist, including atmospheric sounding for tropospheric water vapor and ionospheric electron content through refractometric measurements.

GPS emits spread spectrum signals. In simplified form (we focus on the GPS L1 C/A code), the emitted signal s(t) by a given satellite contains three important ingredients: the carrier frequency, the spreading code CA(t) and the actual navigation message N(t) (i.e., "*I am satellite S, … and it is now time T.*"). After down-conversion we can describe the received signal in complex form by

$$s(t)=N(t)\bullet CA(t)\bullet e^{i2\pi ft}, \quad (1)$$

where f is the down-converted carrier frequency (which will in general now be Doppler shifted). The spreading code is known and unique for each satellite. The code is a simple series of plus minus ones (a phase modulation of the carrier) at a rate of 1023 "chips" per ms—or about 1 MHz. The Navigation code is again also of the same type, but at a much lower rate of 50 Hz. The details are somewhat tricky, but it is basically possible to "despread" the signal by multiplication (and accumulation during a few ms) of the signal with a signal replica like $s(t+\pi)=CA(t=\pi)\bullet e^{-i2\pi ft}$ with the correct delay and frequency. This makes use of the fact that the navigation code is only shifting at the relatively low rate of once every 20 ms. The "multiply and sum" operation just mentioned—that is, cross-correlation—is typically carried out with data streams of a few ms—while there are no navigation bit transitions. The output of the cross-correlation as a function of the shifting time is a (basically) a triangular pulse with a base of 2 chips (~600 light meters): the cross-correlation waveform shown in Figure 1.

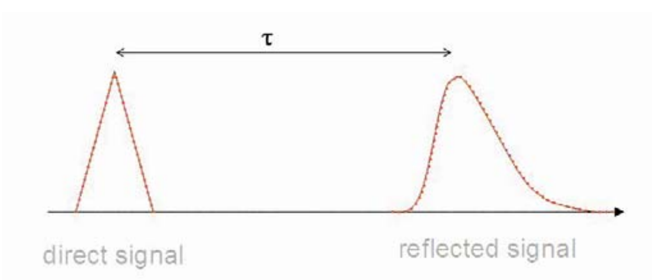


Figure 1. In this figure both the direct and reflected waveforms are illustrated as a function of delay. The direct signal is triangular in shape, while the reflected one is distorted by the reflection process. This transformation, if correctly modeled, can be "undone" in order to compare on the same footing the direct and reflected times of arrival.

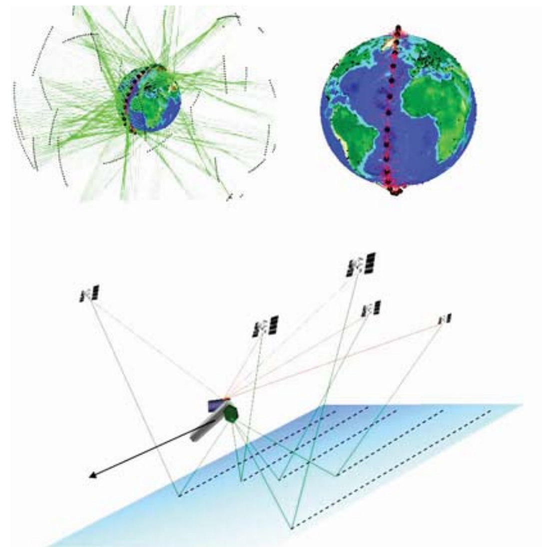


Figure 2. Top, GNSS-R low earth orbiter (LEO) simulation is depicted—one LEO orbit. GNSS satellites are shown as black small dots, with a single LEO receiver. The GNSS satellites emit signals (green) which reflect on the Earth's surface (the ocean in the figure) and are picked up by the receiver—red lines. The scattering points span an area of scale ~2h (where h is the altitude). From space the reflection "ground tracks" provide a comb-like mapping (red arrows) driven by the LEO satellite motion (bottom).

GNSS-R

GNSS-R is a form of "passive" radar. "Passive" radar is akin to human sight: our eyes pick up reflected radiation originating from a source like the Sun and decode it to extract information. What we usually call radar will be called here "active radar" to differentiate it from passive radar. Active radar is similar to sonar or echo-location, as used by dolphins and bats.

While "passive" bistatic radar has a long history (the first radars were bistatic, i.e., the emitter and receiver were located in separate places with their own antennas), the use of GNSS signals reflected by the sea surface as a remote sensing tool has only generated considerable attention during the last decade, after the pioneering efforts of ESA [Martín-Neira 1993]. Among several, two classes of applications have rapidly emerged in the community: sea-surface altimetry, which aims at retrieving the mean sea level like classical radar altimeters do, and sea-surface reflectometry for the determination of sea roughness and near surface winds.

A key advantage of GNSS-R is its "multistatic" character: unlike monostatic systems, a single receiver will collect information from a simultaneous set of reflection points associated to GNSS emitters (see Figure 2)—typically many more than two. A system in low Earth orbit capable of collecting GPS, Galileo and GLONASS data would potentially be combing the surface with more than twenty reflection tracks at the same time.

Another important aspect is that GNSS signals are very weak as they were not designed for radar applications. For this reason, signal processing plays an important role: although weak, the signals can be detected and contain a wealth of information. The first detection of GNSS signals from space was documented in [Lowe et al., 2002]. More

Figure 3. Sunglint over the ocean. The coordinates provide a "tilt-azimuth map", i.e., for each surface point the facet inclination angles required for the facet to forward the energy towards the camera (receiver). The image intensity as a function of these coordinates can be used to infer the surface roughness. For example, for a rough ocean with large surface slopes, the "glistening zone" will become very large. The use of sun reflections to estimate sea state has a long history (see [Spooner, 1822]).

recently, GPS-R L1 CA signals have been successfully detected from a dedicated experiment in space using a moderate gain antenna [Gleason et al., 2005], complementing a large number of experiments from aircraft and stratospheric balloons, and the resulting data will be used to further validate models.

The reflection process affects the signal in several ways, at the same time degrading (from the point of view of detection) and loading it with information from the reflecting surface. The amplitude is normally reduced, the waveform shape distorted and the coherence mostly lost.

A picture of the sunglint over the ocean will be useful to illustrate these effects—see Figure 3. When the ocean is flat one can see a clear single image reflected on the water from a single point—the specular point (or rather a disk in case of the Sun). For (relatively) short wavelengths the rough ocean can be modeled by facets. Geometric optics can be used to show that the reflected power is proportional to the number of correctly oriented facets and their curvature. The rougher the ocean, the larger the number of facets with large inclination angles will be, providing a wider area of reflection. In GNSS-R, instead of and optical source like the Sun we have GNSS emitters, and instead of a camera we need to build a dedicated GNSS receiver, but the picture is mostly the same. Although the GNSS wavelength (~20 cm) is long compared to the optical, experimental results indicate that Geometric Optics is a reasonably good model in GNSS-R.

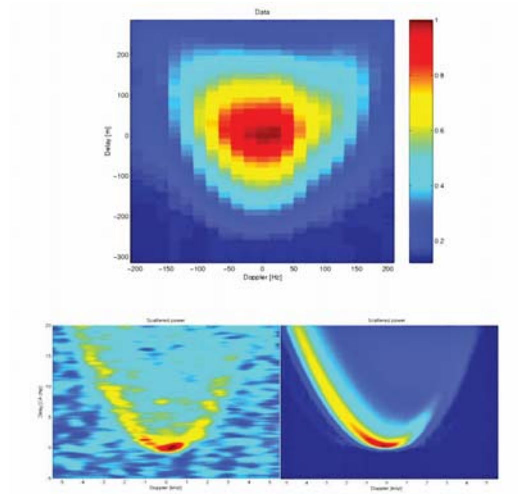


Figure 4. Top: an example DDM as detected from an airborne platform. The scale is arbitrary. The x-axis marks the frequency offset from the specular, while the y-axis displays the delay from the specular. Bottom: GNSS-R DDM data from SSTL's UK DMC space experiment (left) and output from current DDM model in the StarGym simulator (right) [Germain et al., 2005].

Signals scattering from off-specular locations arrive later than the specular—recall that the specular point provides the shortest path. As a function of delay, power will continue to arrive with rather long delays (depending on sea roughness). The waveform will no longer be a triangle. Also, since the ocean surface and scattering geometry evolve in time, the scattered signal will no longer be coherent and will be affected by "speckle": the resulting electric field sum at the receiver from all the scatterers displays fading phenomena, with the resulting amplitude obeying Rayleigh statistics.

The Delay Doppler Map

At the core of GNSS-R lies the concept of bistatic Delay Doppler mapping. All the information available in the signal is contained in the Complex Delay Doppler map (DDM), correctly referenced in space, time and frequency. The DDM is obtained by cross-correlation of the received signal with a generated "replica" just as we described in Equation (2) but with an important modification. The cross-correlation is computed not only for a range of delays, but also for a range of frequencies, $s(t+\tau) = CA(t+\tau) \bullet e^{-i2\pi(f+\delta f)t}$. For each selected delay and frequency offset value a cross-correlation value is computed.

The received power at different frequency (δf) and delay (τ) offsets can be modeled using the bistatic radar equation [Zavorotny et al., 2000],

$$P_0(\tau, \delta f) = \frac{\lambda^2}{(4\pi)^3} P_t G_t . A . \int \frac{G_r}{R_t^2 R_r^2} \sigma^0 \chi^2(\tau, \delta f) dS \qquad (2)$$

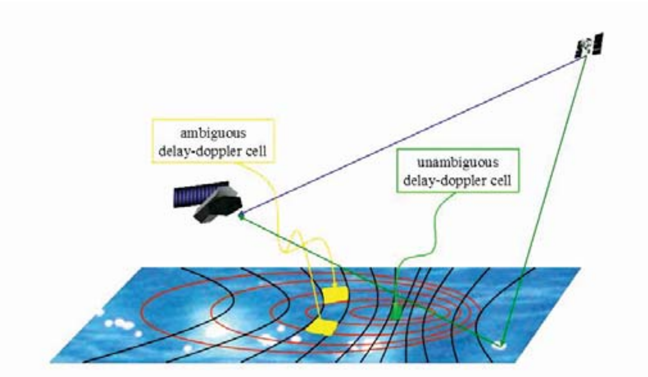


Figure 5. The Delay Doppler map of the surface. The (iso)-Delay ellipses are shown in red, the (iso)-Doppler hyperbolas in black. The direct path from the GNSS satellite to the receiver is shown in blue, while a given reflection path over a scatterer is shown in green. As mentioned in the text, the Delay-Doppler map to the surface is 1 to 2: for a given delay and Doppler, there will in general be two points mapped on the surface (yellow). The exception is the specular (green).

where

- $P_t G_t$ is the Transmitter EIRP (Effective Isotropic Radiated Power),
- A is the Double-way atmosphere attenuation,
- G_r the Receiver antenna gain,
- R_r and R_t are distance between specular point and receiver/transmitter respectively,
- σ^0 is the bistatic scattering coefficient, which in geometric optics at the specular amounts to $R^2/\ 2mss$, where R=0.61 (Fresnel coefficient) and mss is the sea-surface mean square slope, depending on the wind speed,
- $\chi^2(\tau, \delta f)$is the Woodward Ambiguity Function. Tuning delay and frequency has the effect of filtering the power from different reflecting surface regions, as we will describe in some more detail below.

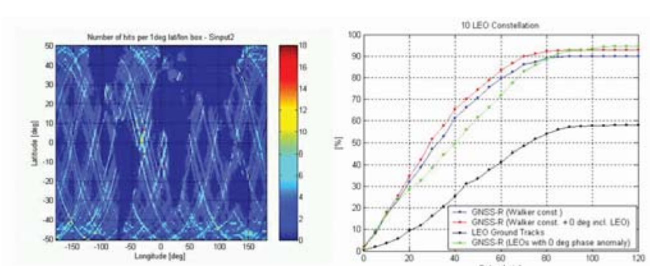


Figure 6. Simulation of a dedicated tsunami monitoring constellation. Left: number of hits per 1 deg lat/lon box after one orbit with 10 GNSS-R satellites after one orbital period. Right, percent of tsunamis detected with a 10 LEO GNSS-R or traditional Radar Altimeters as a function of time after event, showing the clear superiority of the multistatic approach.

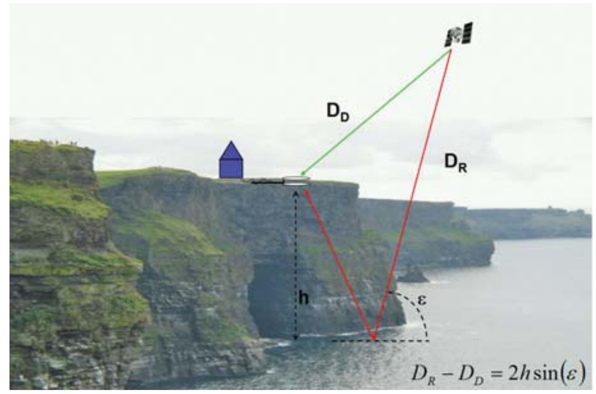


Figure 7. An illustration of coastal altimetry with GNSS-R. The Direct signal travels a shorter path to the antennas than the reflected one. At low altitudes the path difference (in light meters) is proportional to the altitude h over the reflecting surface and the sine of the elevation e.

Figure 4 shows a DDM produced from an air experiment [Germain et al., 2004] and from SSTL's satellite mission [Gleason et al., 2005], [Germain et al., 2005]. How can this type of plot be interpreted? The first return of the signal originates from the geometric specular point (the one associated to the shortest reflection path). Later returns arise from scattering in (approximate) ellipses around the specular (the intersection of an ellipsoid with the satellites at its focal points with the ocean surface). This provides the "delay" part of the mapping (Figure 1). The Doppler mapping arises from the motion of, e.g., the receiver. Iso-Doppler lines can be approximated by hyperbolas [Caparrini, 1998]—see Figure 5. Thus, selecting a particular frequency offset (Doppler) and delay, filters the power return from selected ocean patches, a process controlled by the Woodward Ambiguity Function described above. Unfortunately the mapping of the surface to Delay Doppler space is not one to one. This means that imaging is not straightforward. Nevertheless, there is quite a bit of information on the DDM, and different techniques can be used to extract information.

Applications in ocean science

The artificial separation between geophysical "layers" (ocean, troposphere, stratosphere, etc.) will disappear in future Earth global models, which will therefore address the fundamental role of atmosphere-ocean coupling in a wide range of spatial and temporal scales. The sea surface provides the ocean-atmosphere link, regulating momentum, energy and gas exchange and several fundamental ocean circulation features which are directly related to wind-wave induced turbulent transports in the oceanic mixed layer. In particular, ocean eddies and gyres are fundamental agents for mixing, heat transport and feedback to general circulation, as well as trans-

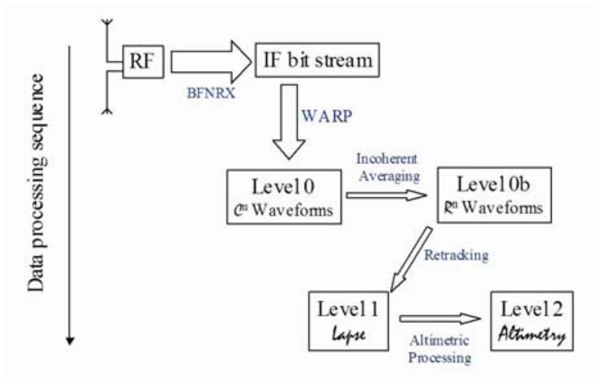


Figure 8. GNSS-R Data processing sequence: from RF data to Altimetry products. Each box represents data processing levels and the arrows processes carried out on the data.

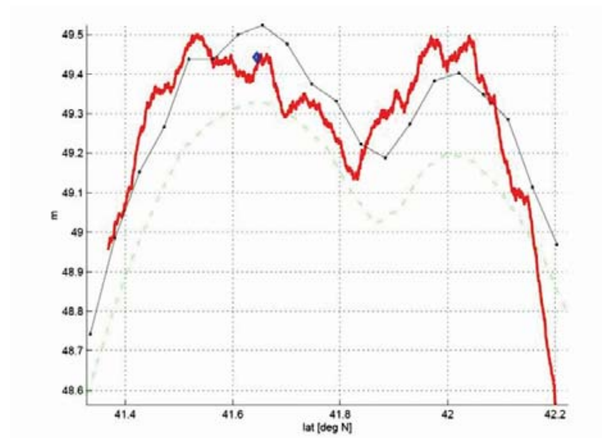


Figure 9. Altimetry results from the Eddy Experiment. The figure shows in red the Sea Surface Height profile obtained processing GPS-R L1 data and comparison with Jason-1 altimetry (solid black line) [Ruffini et al., 2004a]. The green dashed line shows the mean sea surface height (also measured by Jason-1).

port of nutrients, chemicals and biota for biochemical processes. For this reason, observing this interface appropriately is an important objective for global observation systems, which will require high resolution, wide swaths, frequent revisits and long-term stability. All of these are addressed by the GNSS-R concept.

To statistical first order, the ocean-atmosphere interface is characterized by the local mean sea level (h), significant wave height (SWH) and directional mean square slope (DMSS). Presently, mesoscale measurements of sea surface height constitute an important missing element from the global climate and ocean observation systems. In addition, since ocean forcing is a non-linear and strongly intermittent phenomenon (both in space and time), frequent space-time co-located mesoscale measurements of h and DMSS are highly desirable.

Although GNSS-R cannot provide the precision of dedicated radar altimetry missions, it offers a significant advantage thanks to its multistatic character. The impact of GNSS-R altimetry data to global circulations models has been studied through simulations, with very promising results [Le Traon et al., 2002]. Another recent impact study has focused on the potential of GNSS-R to detect Tsunami's [Martín-Neira et al., 2005]. Major tsunami events occur about once a month, with significant damage reported roughly once a year. Although such events are rare, the higher spatial and temporal resolution available with a GNSS altimeter would provide unprecedented measurements of tsunamis. A dedicated GNSS altimetry system could provide timely warnings, potentially saving many lives. As described in [Soulat et al., 2005], simulations have indicated that a global 100% tsunami detection rate in less than 2 hours is possible with a 10 satellite GNSS-R constellation—see Figure 6.

Altimetry

Altimetry in GNSS-R can be carried out in two general ways, depending on the ranging principle used. In code altimetry the code is used for ranging with the direct and reflected signals. In phase altimetry, the phase is used. All of this is rather similar to normal GNSS processing. The main difference is that the reflected signal is affected by the reflection process, which generally distorts the triangular waveform shape of the return and renders the reflected signal very incoherent. This makes the ranging task rather challenging.

The basic principle in GNSS-R altimetry is that the reflected signal will arrive later than the direct one, since it will travel a longer path to the receiver. The arrival time difference is called the *lapse*. In Figure 7 we illustrate the low altitude reflection process. Uncertainty in the lapse translates rather directly into altimetric uncertainty, $\delta h = \delta l / 2 sin\varepsilon$, where e is the local elevation of the satellite at the specular point.

GNSS code ranging with can be conceptualized as radar pulse ranging. Indeed, after correlation with a clean replica, the continuous signal in the CA code can be represented by a triangular pulse. The triangle's base is twice the chip length (300 light meters in GPS CA).

One of the most surprising things about GNSS-R is the fact that the precision attainable is orders of magnitude below the chip length. It is often assumed that the precision obtainable (resolution) in a radar system is of the order of magnitude as the pulse length. For this reason, it is argued, it is impossible that a system like GPS C/A, with a bandwidth of about 1 MHz and associated pulse length of 300 m, can provide centimeter precision ranging. In fact, it can be shown (using the Rao-Cramer bound formalism) that the ranging uncertainty is proportional to the pulse width and inversely proportional to the signal to noise ratio. In practice this

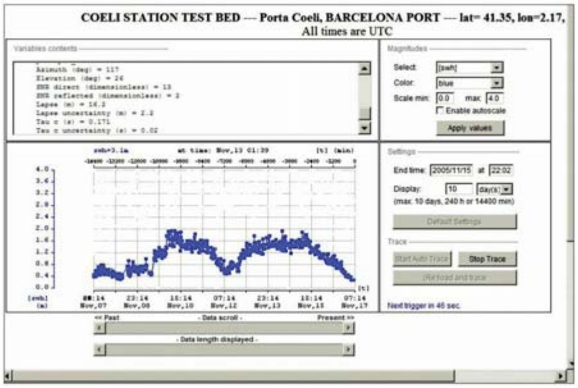


Figure 10. Typical output of a GNSS-R web service (http://ocean-pal.net), providing sea state information from a coastal location (in this case the Barcelona port).

improvement involves a technique well known to the traditional radar altimetry community: retracking. The term "retracking" itself is a bit of a misnomer. What is involved is simply function-fitting via, e.g., least squares. That is, on reception from a direct or a reflected signal, if a model for the waveform shape is available then precision can be greatly improved by a fitting procedure.

Clearly, retracking is easily carried out with the direct signal, since the shape after correlation is a well-known. With the reflected signal, the scattering process has to be taken into account, and the resulting waveform modeled. The waveform shape, as it happens in monostatic altimetry, is affected in several ways by the reflection process. The peak height is affected, the waveform leading edge modified by the ocean roughness, as is the trailing edge. All these effects can be modeled. Some aspects of the waveform are less sensitive than others to the precise roughness model. The leading edge of the waveform is typically used in GNSS-R altimetry (as is in monostatic altimetry). The entire waveform can be used in the other applications of GNSS-R (as described below).

Code altimetry is robust and applicable for ground, air and space applications. Code altimetry precision from the air has been demonstrated in several experiments [Lowe, 2002]. The term "precision" is used to quantify the noise in a measurement. A measurement can be precise but be biased (inaccurate), or un-precise yet accurate. Accuracy in code altimetry was demonstrated during the airborne Eddy Experiment [Ruffini, et al., 2004a]. In this experiment as in others, two synchronous GPS receivers and antennas were flown. After signal processing to obtain waveforms (Level 0 data, see Figure 8), a geophysical parametric waveform model was used for retracking and estimation of the lapse between the direct and reflected signals with a 1-second precision ranging between 2 and 3 m (Level 1 data), an information then used to estimate the Sea Surface Height along the track (Level 2 data). In that particular experiment, the RMS error of the 20 km averaged GNSS-R absolute altimetric solution with respect to Jason-1 and GPS buoy measurements was of 10 cm, with a 2 cm mean difference (see Figure 9). This first accurate altimetric result provided an important milestone on the road to a GNSS-R mesoscale altimetry space mission.

A few experiments for GNSS-R altimetry based on phase tracking from the ground on coastal locations [Ruffini et al., 2002] or lakes [Treuhaft et al., 2001] have also been performed—obtaining centimeter precisions. Phase processing is severely affected by the ocean roughness and dynamics, however, which render the reflected signal largely incoherent under rough conditions. The coherent power component of the reflected signal is described by $P_c \propto n^2 \bullet exp[-4\pi(\sigma sin\varepsilon/\lambda)^2]$, where n is the number of scatterers, ε the elevation angle, λ the electromagnetic wavelength and σ the sea elevation standard deviation [Beckmann and Spizzichino, 1987]. Cleary, low elevation angles and long electromagnetic wavelengths are needed to work with the coherent component in the open ocean. Several proposed solutions to this problem are under study, e.g., using several frequencies to synthesize longer wavelengths as well as using a filtering approach to recover the coherent part of the signal [Ruffini et al., 2002], or working at low elevation angles [Beyerle et al., 2001][Treuhaft et al., 2005].

Reflectometry and other applications

The scattering of GNSS signals from the ocean can be approximated by an effective Geometric Optics model, where the fundamental physical process is the scattering from facet-like surface elements. The detected GNSS-R return is dominated by the statistics of facet slopes and their curvatures at scales larger than λ. Under a Gaussian assumption, three parameters fully define the detected L-band sea surface slope probability distribution (PDF). These parameters are encapsulated by the directional mean square slope, DMSS, a symmetric tensor which derives from the ocean spectrum at wavelengths larger than λ, and which characterizes the ellipsoidal shape of the slope PDF. DMSS can be extracted from GNSS-R Delay Doppler Maps and optical-sunglint measurements ([Germain et al., 2004], [Cox and Munk, 1954] and [Soulat, 2004]).

Surface slope statistics are related to surface area, and they could help quantify atmosphere-ocean coupling, including momentum, energy and gas fluxes. In addition, L-band sea surface roughness data can be used to support L-band radiometric missions, such as SMOS (Soil Moisture and Ocean Salinity), to both quantify and efficiently separate roughness and salinity contributions to L-band radiometric brightness measurements.

GNSS-R DMSS measurements can complement ocean winds and wave models, and can provide valuable information under extreme conditions such as hurricanes, since L-band is rain immune. It is possible to relate the DMSS to other quantities, such as surface winds and SWH. However, such relations are indirect and approximate. For example, just as it happens with other instruments (such as radar altimeters), it is possible to have the same mean square slope with very different wind conditions, since the ocean spectrum is not necessarily in equilibrium with the wind at all times. Nevertheless, it may be useful for some applications to produce such approximate products (indicators) related to Sea State and Winds.

An interesting operational application of GNSS-R is coastal monitoring of sea state and tides. From the coast, sea state can be estimated by studying the coherence properties of the reflected signal (see [Soulat et al., 2004a] and Figure 10), while tides can be estimated in coastal areas using code altimetry, or inside harbors using phase methods. Such an instrument can provide a passive, dry alternative to buoys or standard tide gauges.

GNSS-R can also be used to recover estimates of the fraction of new ice and open water in the Arctic. Global observations of sea ice, ice sheets, ice caps, glaciers and their surrounding seas are crucial to determining their mass balance, contributions to sea level change, global circulation and climate change. GNSS-R could be used to develop statistics on the occurrence of such areas in the polar sea ice pack. Other potential measurements include ice altimetry and reflectometry (ice age).

Soil moisture measurements are another potential application currently under study. L-band reflectivity over soil is sensitive to water content, an effect which can be used to quantify soil moisture.

Finally, ionospheric electron density measurements are important for Space Weather research and operations. Data on ionospheric electron content is presently sparse over the oceans, although this situation will be mitigated by occultation measurements. The vertical character of GNSS-R soundings together with their availability over the oceans could fill these gaps.

In conclusion, GNSS-R is a rapidly maturing technology with a niche in applications which require a dense, stable, fast mapping all-weather capability—such as mesoscale altimetry for climate monitoring and operations, hurricane mapping, tsunami detection or sea state monitoring. Relying on present and future GNSS infrastructures, GNSS-R should provide valuable geophysical measurements for years to come at relatively low cost.

References

1. Beyerle, G. and K. Hoche, “Observation and simulation of direct and reflected GPS signals in radio occultation experiments”, GRL, 28 (9), 1895-8, May 2001.
2. Beckmann, P., Spizzichino, A., The scattering of electromagnetic waves from rough surfaces, Attch house, In., Nordwood, MA, 1987
3. Caparrini, M., Using reflected GNSS signals to estimate surface features over wide ocean areas. ESTEC Working Paper No. 2003, Dec 1998.
4. Cox, C., W. Munk, “Measurement of the roughness of the sea surface from photographs of the sun’s glitter ”, Journal of the Optical Society of America, 44:838-850,1954.
5. Garrison, J. L., S. G. Katzberg, M. I. Hill, “Effect of sea roughness on bistatically scattered range coded signals from the Global Positioning System”, GRL, 25 (13), pp. 2257-60, July 1, 1998.
6. Garrison, J. L., A. Komjathy, V. U. Zavorotny, and S. J. Katzberg, “Wind-Speed Measurement using Forward-Scattered GPS Signals”, IEEE Tran. on Geoscience and Remote Sensing, 40 (1), 50-65, Jan., 2002.
7. Germain, O., G. Ruffini, F. Soulat, M. Caparrini, B. Chapron, P. Silvestrin, “The Eddy Experiment: GNSS-R speculometry for directional sea-roughness retrieval from low altitude aircraft,” GRL, 31 (21), Nov. 16, 2004.
8. Germain, O., Caparrini, M., Ruffini, G., First Analysis of SSTL GPS-R experiment, Starlab Technical Brief TB0012, May 2005. Available at http://starlab.es Library.
9. Le Traon, P.Y., G. Dibarboure, G. Ruffini, E. Cardellach, “Mesoscale Ocean Altimetry Requirements and Impact of GPS-R measurements for Ocean Mesoscale Circulation Mapping,” eprint arXiv:physics/0212068, Dec., 2002.
10. Lowe, Stephen T.; LaBrecque, John L.; Zuffada, Cinzia; Romans, Larry J.; Young, Larry E.; Hajj, George A., First spaceborne observation of an Earth-reflected GPS signal, Radio Science, Vol. 37, No. 1, 07 February 2002.
11. Martín-Neira, M., A passive reflectometry and interferometry system (PARIS): application to ocean altimetry, ESA Journal, vol 17, pp 331-355, 1993.
12. Martín-Neira, M., C. Buck, S. Gleason, M. Unwin, M. Caparrini, E. Farrès, O. Germain, G. Ruffini and F. Soulat, “Tsunami detection using the PARIS concept”, Progress in Electromagnetics Research Symposium 2005, Hangzou, China, August 22-26.
13. Ruffini G., M. Caparrini, L. Ruffini, PARIS Altimetry with L1 Frequency Data from the Bridge 2 Experiment, Abridged Starlab ESA/ESTEC Technical Report-no: ESA/ESTEC Contract No. 14285/85/nl/pb, Starlab CCN3-WP3, Dec 2002. Available at http://starlab.es Library.
14. Ruffini, G., F. Soulat, M. Caparrini, O. Germain, Martín-Neira, “The eddy experiment - accurate GNSS-R ocean altimetry from low altitude aircraft,” GRL, 31 (12), June 18, 2004.
15. Soulat, F., M. Caparrini, O. Germain, P. Lopez-Dekker, M. Taani, G. Ruffini, “Sea state monitoring using coastal GNSS-R,” GRL, 31 (21), Nov. 5, 2004a.
16. Soulat, F., “Sea Surface Remote Sensing with GNSS and Sunlight Reflections”, Ph.D. Dissertation, Universitat Politècnica de Catalunya, 2004b.
17. Soulat, F., M. Caparrini, O. Germain, G. Ruffini, “PARIS Mission Impact Analysis,” GNSS Reflections Workshop 2005, Surrey, UK, June, 2005. Available at http://starlab.es Library.
18. Spooner, J., Sur la lumiere des ondes de la mer, Corresp. Astronomique du Baron de Zach, 6:331, 1822.
19. Treuhaft, R. N., S. T. Lowe, C. Zuffada, Y. Chao, “Two-cm GPS altimetry over Crater Lake”, GRL, 28 (23), pp. 4343-6, Dec. 1, 2001.
20. Treuhaft, R., S. Lowe, E. Cardellach, G. Franklin, T. Meehan, L. Young, “Coastal Altimetry and Atmospheric Inhomogeneities from Reflected GPS Signals,”, GNSS Reflections Workshop 2005, Surrey, UK, June, 2005.
21. Zavorotny, V.U., Voronovich, A.G., (2000), Scattering of GPS Signals from the Ocean with Wind Remote Sensing Application, IEEE Transactions on Geoscience and Remote Sensing, Vol. 38, No. 2, pp. 951-964.

GRS-S RENEWS ITS SUCCESSFUL STRATEGIC PLANNING EFFORT

Professor Andy Blanchard
GRS-S Strategic Planning Committee

The AdCom of the GRS-S recently conducted a two day strategic planning session in Boulder, Colorado on November 17th and 18th. The planning session preceded the regular Fall AdCom meeting of 2005. The GRS-S has been functioning under a carefully conceived strategic plan for several years conceived 8 years ago at the Helsinki November 1997 AdCom meeting. During the past five years, however, we have recognized that significant changes have occurred in the technical and applications environment involving the use of remote sensing. Accordingly, we have undertaken to renew our strategic planning initiative to update the goals and objectives of the Society.

The following proposed revisions to various key statements about our Society summarize the initial results of our renewed strategic planning effort. The planning process is ongoing and as we refine objectives and strategic implementation processes, we will post the plan on the website and solicit input from the membership. An immediate goal is to develop strategic implementation requirements for discussion at the February 2006 AdCom meeting in San Juan. Following this meeting we will publish a formal document containing specific objectives and recommendations for their implementation. Our intent is to manage the Society according to these objectives and to measure our on-going success as a professional body by how well we achieve our strategic goals.

Vision. To be the leading professional remote sensing society in science, engineering, applications, and education for the geospatial information community.

The vision of the society has not changed significantly since its inception. This revised vision includes specific reference to the geospatial community. This new statement reflects our Society's intention to be more responsive to the user community, especially those groups that utilize remotely sensed information in geospatial applications.

Field of Interest. The Field of Interest of the Society is the theory, concepts, and techniques of science and engineering as applied to sensing the earth, oceans, atmosphere and space, and the processing, interpretation and dissemination of this information.

This statement continues to define our field of interest as officially referenced within IEEE. The statement is broad and allows the Society to participate in all areas that interest our members and the allied technical community.

Mission. The GRS Society strives to continually improve its services in its primary areas of responsibility. These include:

1. Information dissemination at the leading edge of science, technology, and applications.
2. Pursuing a broad based education agenda
3. Implementing effective Society operations
4. Developing expanded member and community services
5. Contributing to and impacting on societal issues

The Society has matured over the past 20 years. Its ability to impact major issues of global social relevance has significantly increased, supported by its broad outreach to focused sectors of the technical and applications communities. We view our primary objective as being to serve our members and the community by providing access to quality information in the field of remote sensing and applications. We now anticipate (reflected in our revised objective statement) that we can also support an expanded education and training activity for the community. The Society has been supporting the remote sensing community for over 40 years. Because of broad based international representation we feel that we can better represent the global aspects of this remote sensing community, particularly by providing guidance to decision making bodies regarding the likely societal impacts of policy and management decisions and processes. Finally, effective Society management is critical to the success of our corporate objectives. By improving our AdCom management processes we will be better able to implement and run programs that positively impact our constituents.

The Objectives and Goals of the Society include:

1. Be recognized as the professional society that leads at the edge of science, technology, and applications.
2. Engage professional skills and technologies to provide effective educational/training/communication.
3. Develop new operational business models that allow the Society to respond to appropriate value propositions for the future.
4. Expand our ability to deliver member and community services especially in selected communities that strategically impact the future
5. Recognize and implement systemic behavior that insures our

relevance to societal issues.

We have strategically limited our objectives and goals to those we feel are most significant to the Society's future capability. We continue to recognize that our main goal is information dissemination, however, we recognize that a renewed focus on applications is critical to the future of our discipline. This expansion of our scope will be reflected in our interaction with the community and the products we provide to members and community participants.

Over the past several years we have implemented, usually at IGARSS and small specialty workshops, educational programs of interest to the community. In collaboration with IEEE and our support organizations the Society will begin to implement programs using a variety of appropriate delivery mechanisms. The intent is to provide expanded accessibility to material that can benefit all members of the community (this includes the lay person as well as the technical professional).

The Society has been operating under its current business model for almost 25 years. The Strategic Planning committee has suggested that more modern business practices would improve efficiency and effectiveness. The Society will evaluate improved business structure over the next several months in an effort to implement more effective business and management practices for the GRS-S of the future. This is in large part driven by our need to serve an international community of scientists, engineers, and practitioners in the field.

All of these strategic objectives focus on one purpose: Implement programs that better serve the community. The revised strategic plan moves the Society toward a position of being able to expand services for the membership, improve our ability to impact the future of the field, and structure our processes in a cost effective manner. Ultimately we want the Society and its membership to make a more significant contribution to, and impact on, pressing societal problems and issues through their technology development.

What remains of the strategic planning process? The activity is continuous. As a Society, we address strategic planning issues at every AdCom meeting in an effort to keep the implementation on track. Over the next several months the Strategic Planning committee will propose implementation strategies for consideration by AdCom. The intent is to have tactical strategies proposed at successive AdCom meetings. When those are completed we will begin the process of acting on our plans. Our planning process will require the conscious effort of our members and volunteers, but past experience suggests that it can work for the betterment of the GRS-S. Look to the Newsletter for ongoing updates, and please feel free to comment and make suggestions for the improvement of your Society.

ESA-EUSC REPORT

NOTE ON ESA-EUSC IMAGE INFORMATION MINING CONFERENCES

The European Image Information Mining Coordination Group has organised the ESA-EUSC 2005 Conference on "Image Information Mining - Theory and Application to EO", which was held at ESRIN, Frascati (Italy), on October 5-7, 2005 (see http://earth.esa.int/rtd/Events/ESA-EUSC_2005).

Fig. 1. ESA ESRIN, Frascati, Italy.

After the Workshop on "Image Information Mining" held on September 19-20, 2002 in Zurich, Switzerland, this is the third Conference, preceded by:

- ESA-EUSC 2004 held on March 17-18, 2004, at EUSC Madrid (Torrejon air base), Spain
- ESA-EUSC 2002 held on December 5-6 at ESA/ESRIN Frascati, Italy

Motivation of the Conference is linked to the dramatic increase in volume, details, diversity and complexity, and the user demand for simultaneous access to multi-domain EO data. These urgently require new approaches for image information mining, multi-domain information management, and knowledge management and sharing (in support to information mining and training).

The Conference was sponsored by ESA, EUSC and IEEE GRS. The presentations and articles are published by ESA proceedings and Conference Web site. Selected articles will be reviewed and published within the Special Issue "Image Information Mining" of the IEEE Transactions on Geoscience and Remote Sensing, planned for early 2007 (guest editors: Mihai Datcu, Roger King, Lorenzo Bruzzone, Sergio D'Elia).

Similar activities are coordinated by the IEEE GRS DAD Committee and also addressed at IGARSS special sessions.

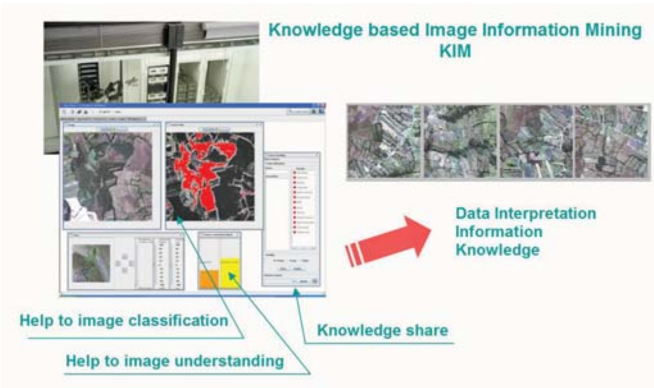


Fig. 2. Knowledge based Image Information Mining system.

Fig. 3. EU Satellite Center, Madrid -Torrejon air base, Spain.

More than 70 participants from over 18 countries attended this edition of the Conference, which had sessions on: International perspectives, Theory and Applications. The relevant topics were:

- Feature extraction
- Registration
- Classification/clustering/segmentation
- Machine learning
- Relevance feedback
- Knowledge and ontologies
- Evaluation and user satisfaction
- Statistics
- Information theory
- Signal processing
- Formal languages
- Architectures

During the Conference have also been presented applications of new technologies for exploitation of EO data. The KIM knowledge based Image Information Mining system was one of the prototypes demonstrated in applications.

The KIM (http://kes.acsys.it/kes/) is a first prototype system changing from data to information and knowledge access. Thus supporting users to search, discover, and also interpret EO data. The KIM system was validated on data ranging from Ikonos to MERIS and from airborne SAR to ERS products.

Summary conclusions from the Conference have been:

- In Europe IIM has experienced about a duplication in the number of teams involved
- Some applications using the IIM technology for Earth Observation are reaching operational maturity
- For Knowledge Discovery applied to high resolution EO images there is a trend in collaborative use of IIM, GIS and textual information

The IIM Coordination Group is organising the next conference, ESA-EUSC 2006, which will be held in November 2006 at EUSC (Madrid - Torrejon air base, Spain) with the title "Image Information Mining for Security and Intelligence". The Conference will be followed by a Panel on Information Mining from images, geo information and text, for interested participants, with specific registration.

IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING CALL FOR PAPERS

Special Issue on Image Information Mining in Earth Observation - Concepts, Methods, Systems and Applications

IEEE Transactions on Geoscience and Remote Sensing seeks original and unpublished manuscripts for a special issue reporting innovative concepts, new methods, implemented systems and prototype applications of Image Information Mining in areas of Earth Observation. This special issue is intended to gather high-quality papers that will provide a major reference source in this emerging and challenging field. Suggested topics include (but are not limited to) the following:

- Image content extraction and data cleaning
- Image information representation and indexing
- Mining the content of image archives
- Advanced communication concepts and information mining
- Human Machine Interaction and relevance feedback
- Semantic gap and non-visual data exploration
- Complexity analysis
- EO ontologies and knowledge shearing methods
- Modelling the user conjecture and KDD
- Designing image information mining systems
- Applications, and examples in EO sciences
- EO and multimedia intercation

Procedure

Prospective authors should follow the regular guidelines of the IEEE Transactions on Geoscience and Remote Sensing as listed inside the back cover of the Transactions. Authors should submit their manuscripts electronically to http://mc.manuscriptcentral.com/tgrs/. Instructions for creating new user accounts, if necessary, are available on the login screen. Please indicate in your submission that the paper is intended for the Special Issue on Image Information Mining in Earth Observation by selection "Image Information Mining in Earth Observation" from the pull down menu for manuscript type. Questions concerning the submission process should be addressed to tgrs-editor@ieee.org.

Inquiries concerning the Special Issue should be directed to the Guest Editors:

Prof. Dr. Mihai Datcu
German Aerospace Center DLR
Remote Sensing Technology Institute IMF
Oberpfaffenhofen D-82234 Wessling
Tel: + 49 8153 28 1388
Fax: + 49 8153 28 1444
Email: mihai.datcu@dlr.de
datcu@vision.ee.ethz.ch

Dr. Roger King
Mississippi State University
Mississippi State, MS 39762-9544 USA
Tel: 662-325-2189
Fax: 662-325-8573
Email: rking@engr.msstate.edu

Prof. Lorenzo Bruzzone, PhD
Head of the Remote Sensing Laboratory
Associate Editor of IEEE Transactions on Geoscience and Remote Sensing
DIT - Dept. of Information and Communication Technologies
University of Trento
Via Sommarive, 14
I-38050, Trento, ITALY
Phone: +39-0461-882056
Fax: +39-0461-882093
E-mail: lorenzo.bruzzone@ing.unitn.it; bruzzone@ieee.org

Sergio D'Elia
ESA / ESRIN - EOP-GDR
Head / Services Infrastructure and Technology
Via Galileo Galilei
00044 Frascati (Italy)
tel +39 06 94180650
fax +39 06 94180296

Manuscript Submission Deadline: February 28, 2006

IEEE Transactions on Geoscience and Remote Sensing

CALL FOR PAPERS

UPCOMING SPECIAL ISSUE – REMOTE SENSING FOR MAJOR DISASTER PREVENTION, MONITORING AND ASSESSMENT

Submission deadline: May 1, 2006

The tsunami generated by the great Sumatra-Andaman Earthquake of 26 December, 2004 in Indian Ocean claimed extensive damage and big death toll. Hurricane Katrina hit the Southern United States, with far larger consequences than local and federal administrations may have forecasted. Recent and less recent earthquakes in Pakistan and Iran highlighted the problems due to lack in infrastructures and long distances.

All of these major natural disasters stress problems that may be addressed by a more substantial use of remotely sensed data.

- Disaster prevention is based on a precise modelling of the natural phenomena underlying the disasters. The scale of these phenomena are often too large for in situ measurements, and satellite or airborne observations are the only way to gather enough information to develop and validate consistent models.
- Extreme event observation and short-term forecasting of their effects, especially for atmospheric phenomena, is already in place, but the huge amount of information to manage and interpret in very short time needs adequate algorithms and computing power.
- Post-event crisis management and damage assessment in temporarily unreachable or just very far areas justify the growth of on-line resources for map providing to rescue team based on satellite observations and quick human interpretation.

So, papers are solicited on science and applications studies for disaster prevention, monitoring and assessment using remote sensing. Submissions in a broad range of applications areas are encouraged. Sample study areas include but are not limited to: remote sensing contribution to hazard and risk modelling of tsunamis, hurricanes and earthquakes or disease pandemics; models of extreme oceanic, land and atmospheric phenomena or pandemic outbreaks using remote sensing; remote sensing based early warning systems for tsunamis, hurricanes and earthquakes or pandemic outbreaks; satellite and/or airborne observations of extreme oceanic, land and atmospheric phenomena; applications of remote sensing in support of disaster response; damage assessment using satellite and airborne sensors; integration of GIS and remotely sensed data for damage and loss estimation.

Procedure:

Prospective authors should follow the regular guidelines of the IEEE Transactions on Geoscience and Remote Sensing as listed inside the back cover of the Transactions. Authors should submit their manuscripts electronically to http://mc.manuscriptcentral.com/tgrs Instructions for creating new user accounts, if necessary, are available on the login screen. Please indicate in your submission that the paper is intended for the Disaster Special Issue by selection "Disaster Special Issue" from the pull down menu for manuscript type.

Inquiries concerning the Special Issue should be directed to the Guest Editors:

Kun-Shan Chen
Center for Space and Remote Sensing Research
National Central University
Chung-Li, Taiwan 32054
Tel: +886-3-926-225-897
Fax:+886-3-427-3586
Email: dkschen@csrsr.ncu.edu.tw

Melba M. Crawford
LARS/Lilly Hall
Purdue University
915 W. State Street
W. Lafayette, IN 47907-2054, USA
Phone: (765)496-9355
Fax: (765)496-2926
Email: mcrawford@purdue.edu

Paolo Gamba
Department of Electronics
University of Pavia
Via Ferrata, 1
27100 Pavia (Italy)
Telephone: +39-0382-985781
Fax: +39-0382-422583
Email: paolo.gamba@unipv.it

James A. Smith
Hydrospheric and Biospheric Sciences Laboratory
Code 614
NASA Goddard Space Flight Center;
Greenbelt, MD 20771
Tel.: 301-614-6020
Fax: 301-614-5666
Email: James.A.Smith@nasa.gov

CALL FOR PAPERS

TGARS SPECIAL ISSUE ON MICROWAVE RADIOMETRY AND REMOTE SENSING APPLICATIONS

A **Special Issue** of the IEEE Transactions on Geoscience and Remote Sensing (TGARS) on Microwave Radiometry has been recently approved by the TGARS Editorial Board. The Guest Editors of the TGARS Special Issue will be *Dr. Steven C. Reising, Dr. Frank S. Marzano, Dr. Eni G. Njoku and Dr. Ed R. Westwater.*

This Special Issue is associated with the **9th Specialist Meeting on Microwave Radiometry and Remote Sensing Applications**, to be held in San Juan, Puerto Rico, from February 28 to March 3, 2006. The MicroRad '06 Meeting is the next in a series devoted to microwave remote sensing of the environment. Held approximately every 2.5 years alternating between Italy and the United States since their inception in Rome in 1983, the MicroRad meetings provide an opportunity to communicate and compare experience gained with passive microwave remote sensing data and sensors on ground-based, airborne and space-based platforms, which play mutually beneficial roles in monitoring hazardous weather and climate-interaction processes of our planet. MicroRad '06 is co-sponsored by the IEEE, the IEEE Geoscience and Remote Sensing Society, NASA, NOAA, NCAR, URSI, the University of Puerto Rico at Mayagüez and Colorado State University.

The **objective of the Special Issue, open to all researchers,** is to select outstanding contributions on recent advances in the field of microwave radiometry, bringing together participants from the research, industrial and academic communities who are engaged in projects on microwave radiometry of the land, oceans and atmosphere.

Contributions on **topics** of primary interest are expected. These include remote sensing of the sea, including salinity, winds and sea ice; of the atmosphere, including temperature and humidity sounding as well as clouds and precipitation; of the land, including soil, vegetation and snow cover; electromagnetic modeling of the land, ice and oceans; sensor calibration; RFI mitigation; instruments and advanced techniques; future satellite missions; retrieval methodologies; and radiance assimilation.

Prospective authors should follow the regular guidelines of the IEEE Transactions on Geoscience and Remote Sensing, as listed in the back cover of the Transactions. Authors should submit their manuscripts electronically to **http://mc.manuscriptcentral.com/tgrs**. Instructions for creating new accounts, if necessary, are available on the login screen. Please indicate in your submission that the paper is intended for the Special Issue by selecting "MicroRad06 Special Issue" from the pull-down menu for manuscript type. Questions concerning the submission process should be addressed to tgrs-editor@ieee.org. For this Special Issue, all page charges, including voluntary and mandatory charges, will need to be paid by the authors.

Inquires concerning the Special Issue should be directed to the Guest Editors:

Dr. Steven C. Reising
Electrical and Computer Engineering Dept.
Colorado State University
Fort Collins, CO 80523-1373 USA
Phone: 970-491-2228
Fax: 970-491-2249
E-mail: Steven.Reising@ColoState.edu

Dr. Frank S. Marzano
Dept. of Electronic Engineering
Univ. "La Sapienza" of Rome, Italy
Via Eudossiana 18, 00184 Rome ITALY
Phone: +39.06.44585406, 0862.434412
Fax : +39.06.4742647, 0862.433089
E-mail: marzano@die.uniroma1.it

Dr. Eni G. Njoku
M/S 300-233, Jet Propulsion Laboratory
4800 Oak Grove Drive,
Pasadena, CA 91109
Phone: 818-354-3693
Fax: 818-354-9476
E-mail: Eni.G.Njoku@jpl.nasa.gov

Dr. Ed R. Westwater
CIRES – University of Colorado
NOAA ESRL Physical Science Division
325 Broadway, MS R/PSD4
Boulder, CO 80305-3328
Phone: 303-497-6527
Fax: 303-497-3577
E-mail: Ed.R.Westwater@noaa.gov

Updated information on the Special Issue of TGARS is available at **http://www.microrad06.org**.
Submission Deadline: **May 1, 2006**

11th International Conference on Ground Penetration Radars

June 19 - 22, 2006
The Ohio State University
Columbus, Ohio, USA

General Chair:
Jeffrey J. Daniels (The Ohio State University)
Technical Chairs:
Chi-Chih Chen (The Ohio State University)
Barry J. Allred (USDA -Agricultural Research Service)

Web Address:
www.gpr.osu.edu

3rd International Symposium on Future Intelligent Earth Observing Satellites

24-26 May 2006, Beijing CHINA

General Chair:
Guanhua Xu, Minister of Science and Technology, China
Organizing Chairs:
Chao Wang, China Remote Sensing Ground Station, CAS
Xiaohan Liao, Ministry of Science of Technology of China
Technical Program Chairs:
Guoqing Zhou, Old Domain University, USA
Bin Xiangli, Chinese Academy of Sciences
Steering Chairs:
Shupeng Chen, Institute of Remote Sensing Applications, CAS
Oktay Baysal, Old Dominion University, USA
Abstract submission:
Before February 20,2006
Email: FIEOS@ne.rsgs.ac.cn

Web Address:
http://www.rsgs.ac.cn/fieos3
http://fieos3.rsgs.ac.cn

Progress in Electromagnetics Research Symposium 2006

26-29 March 2006

J. A. Kong
MIT, Cambridge, USA

PIERS General Chair:
R. S. Shin, Lincoln Laboratory, M.I.T., USA

Abstract submission:
Before September 7, 2005
1-page abstract
Email: piers@ewt.mit.edu and/or tpc@piers.org

Pre-register:
Before November 7, 2005

Web Address:
http://piers.org
http://emacademy.org/piers2k6Cambridge/

EUSAR, European Conference on Synthetic Aperture Radar, is an international conference dedicated to SAR techniques, technology and applications. The first EUSAR was held in the year 1996 in Königswinter, continued 1998 in Friedrichshafen, 2000 in Munich, 2002 in Cologne, and 2004 in Ulm. EUSAR will have its 10th anniversary in Dresden in 2006. EUSAR has accompanied the worldwide evolution of high-resolution imaging radar, both airborne and space-borne, and has helped to establish an international community of SAR engineers and scientists. As in previous years, EUSAR 2006 will provide a forum for exchanging information and discussion on a wide variety of SAR topics, representing the latest SAR developments. You are cordially invited to participate in EUSAR 2006, and visit the beautiful city of Dresden, which will be celebrating its 800th jubilee year.

GENERAL CONFERENCE CHAIRMAN
Alberto Moreira, DLR (German Aerospace Center)

Please follow: www.eusar.de

COMMERCIAL EXHIBITION
Please contact: vde-conferences@vde.com or eusar2006@dlr.de

Technically sponsored by: EUREL URSI DGON IEEE GRSS IEEE AESS

The 6th Bi-annual Conference of The African Association of Remote Sensing of the Environment (AARSE)

30 Oct. - 2 Nov. 2006

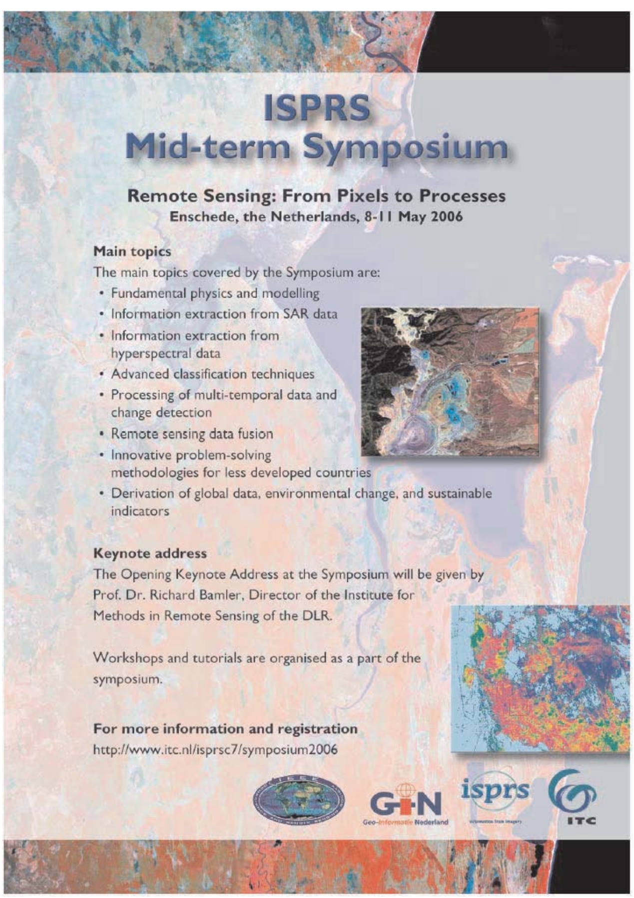
Cairo, Egypt

Conference Chair: Dr. Atef Sherif (NARSS)
AARSE President: Dr. Tsehaie Woldai

Abstract submission: January 31 2006
Check website for possible extension
Full paper due: July 31, 2006
Registration fees: $250 (full), and $75 (students)

Online registration and submissions:
http://www.narss.sci.eg/aarse2006/

For abstract submission after deadline please contact mohammed.shokr@ec.gc.ca



Workshop on Pattern Recognition in Remote Sensing (PRRS '06)

20 August 2006

Chairs:

D. A. Clausi, University of Waterloo (Canada)
S. Aksoy, Bilkent University (Turkey)

Submission: April 1, 2006 (4-page paper; peer-review)
Email To: tc7@engmail.uwaterloo.ca

Host: IAPR Technical Committee 7 – Remote Sensing
In conjunction with: ICPR 2006
Location: Hong Kong Convention and Exhibition Center
Co-sponsors: IAPR and IEEE GRSS

Guest Speaker: Peng Gong, U. of California (Berkeley)

For workshop and submission details:
http://retina.cs.bilkent.edu.tr/prrs06

2006 IEEE International Geoscience & Remote Sensing Symposium
& 27th Canadian Symposium on Remote Sensing

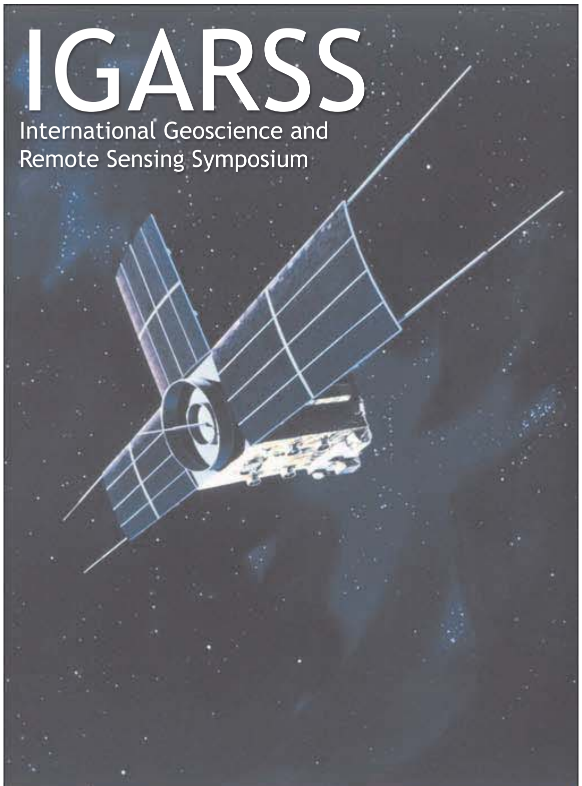
Reach the Mile High City and Discover Denver!

Important Dates
Abstract Submission System Online .... 1 December 2005
Invited Abstract Deadline .... 6 January 2006
General Abstract Deadline .... 13 January 2006
Abstract Status Available Online .... 13 March 2006
Full Paper Submission & Registration Fee................................ 21 April 2006
Early Registration Deadline .... 22 May 2006

Colorado Convention Center ✦ Denver, Colorado ✦ 31 July - 04 August 2006

IGARSS 2006

Remote Sensing: A Natural Global Partnership
www.igarss06.org



Graphic of ITOS Satellite in Orbit/NOAA In Space Collection

Future Locations

IGARSS 2006 • Denver Colorado
31 July - 04 August • Colorado Convention Center
A.J. Gasiewski, NOAA (al.gasiewski@noaa.gov) and
V. Chandrasekar, Colorado State University
(chandra@engr.colostate.edu) General Co-Chairmen

IGARSS 2007 • Barcelona Spain
23-27 July • Centre De Convencions Internacional
Ignasi Corbella, Universitat Politecnica de Catalunya
Barcelona (corbella@tsc.upc.es), General Chairman

IGARSS 2008 • Boston Massachusetts
7-11 July • Hynes Veteran Memorial Convention Center
John Kerekes, Rochester Institute of Technology
(kerekes@cis.rit.edu), and Eric Miller, Northeastern
University (elmiller@ece.neu.edu), General Co-Chairmen

IGARSS 2009 • Capetown South Africa
Harold Annegarn, Rand Afrikaans University
(annegarnh@geosciences.wits.ac.za) General Chairman

If you are interested in forming a team to host IGARSS 2011, please contact:IEEE GRS-S at: ieeegrss@adelphia.net for information.

President's Message continued from page 4

the Satellite Remote Sensing Receiving Station in Hong Kong. The IEEE GEOSS Workshop in Seoul addressed the societal need of disaster mitigation. The AdCom has also recently approved a Special issue on "Remote Sensing for Major Disaster Prevention, Monitoring and Assessment" with an international team of guest editors. These and other international activities firmly establish GRS-S as one of the most transnational of IEEE Societies.

I would like to welcome two new AdCom members, Drs. Diane Evans and Motoyuki Sato. Dr. Evans will serve as the GRS-S Chair of Local Chapters. Dr. Sato will serve as Co-Chair of Specialty Symposia. Dr. Evans' experience in Earth Science and Technology at the Jet Propulsion Laboratory is an important asset for our Society. Dr. Sato's remote sensing research is carried out in the Asia Pacific Region and he will help GRS-S develop our activities in that region. I also want to thank Dr. William Gail who has completed three years of service to our Society as an elected AdCom member. He will continue to serve as the Director of Corporate Relations for GRS-S as an ex-officio AdCom member.

I would also like to congratulate four GRS-S members who were elected IEEE Fellows in 2006. They are: Kultegin Aydin for "contributions to electromagnetic scattering and quantitative estimation in storms and clouds", Eastwood Im for "contributions to spaceborne atmospheric radar remote sensing", Ellsworth LeDrew for "contributions to environmental remote sensing sciences", and Charles Luther – the 2002-2003 President of the GRS-S – for "leadership in microwave remote sensing".

UPCOMING CONFERENCES

See also **http://www.techexpo.com/events** or **http://www.papersinvited.com** for more conference listings

Name: Progress in Electromagnetics Research Symposium 2006
Dates: March 26-29, 2006
Contact: R. S. Shin, General Chair
Fax:
E-mail: piers@ewt.mit.edu
URL: http://piers.org

Name: 2006 Southwest Symposium on Image Analysis and Interpretation (SSIAI)
Location: Denver, Colorado, USA
Dates: March 26-28, 2006
Contact: Phil Mlsna, General Chair
Fax: (928) 523-2300
E-mail: Phillip.Mlsna@nau.edu
URL: http://www.cet.nau.edu/Research/SSIAI/

Name: 6th European Conference on Synthetic Aperture Radar
Location: Dresden, Germany
Dates: May 16-18, 2006,
Contact: Rudolf Schmid, DLR
Fax: -
E-mail: rudolf.schmid@dlr.de
URL: http://www.dlr.de/hr/eusar2006

Name: 3rd International Symposium on Future Intelligent Earth Observing Satellites
Location: Beijing, CHINA
Dates: May 24 - 26, 2006
Contact: Chao Wang
Fax:
E-mail: FIEOS@ne.rsgs.ac.cn
URL: http://www.rsgs.ac.cn/fieos3

Name: 11th International Conference on Ground Penetration Radars
Location: Columbus, Ohio, USA
Dates: June 19 - 22, 2006
Contact: Mark Cramer, ExpoMasters, Inc.
Fax: +1-303-843-6232
E-mail: mcramer@expomasters.com
URL: http://www.gpr.osu.edu/

Name: 2006 International Geoscience and Remote Sensing Symposium & 27th Canadian Symposium on Remote Sensing
Location: Denver, Colorado, USA
Dates: July 31 – August 4, 2006
Contact: V. Chandrasekar, A. J. Gasiewski, general co-chairs.
E-mail: ieeegrss@adelphia.net
URL: http://www.igarss06.org/

Name: The 2nd International Symposium On Recent Advances In Quantitative Remote Sensing (Raqrs'ii)
Location: Torrent, València, Spain
Dates: September 25-29, 2006
Contact: José A. Sobrino
E-mail: sobrino@uv.es
URL: http://www.uv.es/raqrs/index.htm

Name: XII Simposio Internacional SELPER SIG y Percepción Remota aplicados a "Riesgos Naturales y Gestión del Territorio"
Location: Cartagena, Colombia
Dates: September 24 – 29, 2006
Contact: info@selper.org.co
Fax: 571- 3694096
URL: www.selper.org.co

Name: The 6th Bi-annual Conference of The African Association of Remote Sensing of the Environment (AARSE)
Location: Cairo, Egypt
Dates: October 30 – November 2, 2006
Contact: Atef Sherif
E-mail: mohammed.shokr@ec.gc.ca
URL: http://www.narss.sci.eg/aarse2006/

Name: 28th Review of Atmospheric Transmission Models
Location: Lexington, Massachusetts
Dates: June 14-15, 2006
Contact: tistein@ev1.net
URL: www.grss-ieee.org

Name: ISPRS Mid-Term Symposium. Remote Sensing: From Pixels to Processes
Location: Enschede, The Netherlands
Dates: May 8 - 11, 2006
URL: www.itc.nl/isprsc7/symposium2006

Name: 3rd International Conference on Microwaves, Antenna, Propagation and Remote Sensing
Location: Jodhpur, India
Dates: December 18 - 22, 2006
Contact: O.P.N. Calla
Fax: 91-0291-2626166
E-mail: opncalla@yahoo.co.in

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