IEEE GEOSCIENCE and REMOTE SENSING Newsletter

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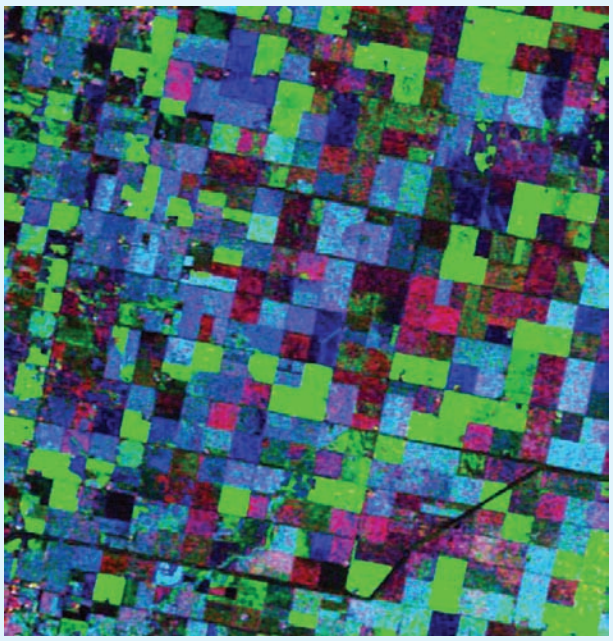
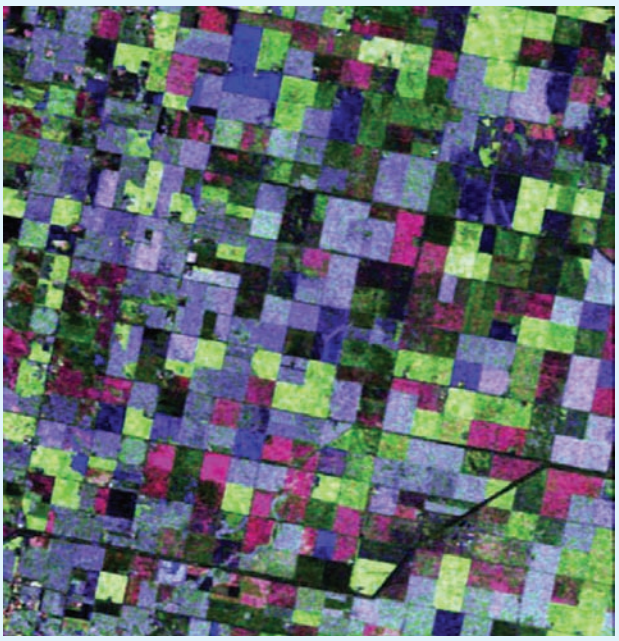


Freeman-Durden Decomposition (Quad-Pol)



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Input	April 15	July 15	Oct 15	Jan 15

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This issue of the IEEE Geoscience and Remote Sensing Newsletter is published after an excellent IGARSS 2011 in Vancouver and a summer filled with conferences and initiatives related to geosciences and remote sensing. Some of these events are described in this issue, which as usual also includes many articles on various technical areas of remote sensing, as well as contributions on the activities of the IEEE Geoscience and Remote Sensing Society (GRSS).

The issue opens with an article honoring the outstanding career of Granville Edward Paules, III, who died on January 4, 2011 at the age of 73 after a long battle with cancer. The passing of Gran Paules is a great loss for the GRSS society. As pointed out in the article, he was highly respected professionally, and his work had a very significant impact on the remote sensing community. Gran will be sorely missed.

The issue presents two main articles in the *Features* section. The first is a tutorial paper on compact polarimetry. This is the popular name of a class of synthetic aperture radars (SAR) in which only one polarization is transmitted and two orthogonal polarizations are received, together with their relative phase. As explained in the paper, the major motivation for compact polarimetry is to strive for quantitative backscatter classification of comparable finesse to those from a fully polarized system, while avoiding its associated disadvantages. The second main feature article addresses the contributions of GRSS members to the preparation of the Intergovernmental Climate Change (IPCC) Fifth Report on Climate Change (AR5). Through its three journals, workshops, and conferences, the IEEE GRSS has provided opportunities for scientists to publish and present remote sensing results related to monitoring global climate and the health of the planet. The GRSS is ideally positioned to contribute to the debate on climate change and variability in a substantial and unbiased manner and will continue to create opportunities for discussion and publication of related climate change results. Through the contributions of its members, GRSS has engaged many who incorporate earth observations in both operational and research analysis

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President's Message

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What a fantastic IGARSS 2011 we had in Vancouver, Canada on July 24–29! As discussed in my last message, IGARSS 2011 was to be held in Sendai, Japan but unfortunately had to be moved because of the terrible earthquake and tsunami disaster in Japan on March 11. Even though the conference was moved to Vancouver only four months prior to its opening, it proved to be very successful. Just over 1400 attendees were at IGARSS 2011, including junior and senior researchers from all over the world. In particular, it was great to see all the young faces at the symposium this year. The number of participants in Vancouver shows the importance of IGARSS in remote sensing. This reinforces that IGARSS is recognized as a premier event in the field and provides an ideal forum for obtaining up-to-date information about the latest developments, exchanging ideas, identifying future trends, and making contacts within the international remote sensing community. At IGARSS 2011, there were excellent plenary and technical sessions and very dynamic interactive poster sessions. Other highlights of IGARSS 2011 included a Technical Committees and Chapters luncheon, a Young Professionals' luncheon, and an outstanding Awards Banquet.

Although IGARSS moves from one country to another every year, IGARSS always has its home in the IEEE Geoscience and Remote Sensing Society (GRSS). Members of the GRSS can register for IGARSS at a reduced rate. The GRSS is doing very well as demonstrated by the following examples: The number of members increases year over year, the three excellent journals have demonstrated a great success and an

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Cover Information: Comparison of the thematic analysis of data from an agricultural test site (Carmen, Manitoba) using quadrature-polarimetric data (left panel) and hybrid-polarimetric data (right panel). Original data were Radarsat-2, fine quad, 11 August 2010. (Courtesy, Francois Charbonneau, Canada Centre for Remote Sensing.)

(Editor's Comments continued from page 3)

of climate change and variability. Of particular interest are potential new implications for renewable energy and water resources.

The *New Remote Sensing Missions* column presents an article related to the NigeriaSat-2 and NigeriaSat-X satellites that were successfully launched on August 17, 2011 onboard a Dnepr rocket from Yasny in southern Russia. This article describes these highly advanced Earth observation satellites that will significantly boost African capabilities for natural resource management, as well as aid disaster relief through the Disaster Monitoring Constellation (DMC).

The *Book Review* column presents an overview of *Image Registration for Remote Sensing*, edited by Jacqueline Le Moigne, Nathan S. Netanyahu, and Roger D. Eastman. The review of this interesting book was written by Gabriele Moser, Assistant Professor at the University of Genoa.

The *Reports* section contains three main contributions. The first is an article describing the GRSS Major Awards and Fellow Recognitions at the plenary session of IGARSS 2011, which was held in Vancouver, BC, Canada, on July 24–29, 2011. The article reports on the excellent organization of IGARSS 2012 and gives details on all of the Major Awards recipients. Congratulations to all of them! The second report addresses the *6th Workshop on the Analysis of Multitemporal Remote Sensing Images (MultiTemp 2011)*, which was held on the campus of the University of Trento, Trento, Italy, July 12–14, 2011. The *Reports* section also contains a report on the *3nd Workshop on Hyperspectral Image and Signal Processing – Evolution in Remote Sensing (WHISPERS 2011)*, which was held at the Instituto Superior Tecnico, Lisbon, Portugal, June 6–9, 2011.

The *Technical Committee Corner* column contains an article describing the activities of the Frequency Allocations in Remote Sensing (FARS) Technical Committee, which focuses on diverse aspects of facilitating the GRSS role in the frequency management process by fostering, archiving, and disseminating relevant technical information. I expect that many Newsletter readers will be interested in the activities of this committee and may want to participate in them by joining it.

The *Chapters Corner* section contains a contribution that describes the activities of the Boston Section of GRSS. Among others, this article describes a short radar course recently offered at MIT, which had the objective to build a small radar system capable of sensing range and Doppler using synthetic aperture radar (SAR) imaging.

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

I wish everyone an enjoyable and productive autumn season.

Lorenzo Bruzzone
Editor, IEEE GRSS Newsletter

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Region 7: Canada			
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Vancouver Section, BC	AES, GRS	David G. Michelson Steven McClain	dmichelson@ieee.org stevenmcclain@ieee.org
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Student Branch, South Brazil Section	GRS	Sam Murphy	sam@ige.unicamp.br
Student Branch, Colombia Section	GRS	Leyini Parra Espitia	leyiniparra@ieee.org
Region 10: Asia and Pacific			
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Japan Council	GRS	Yoshihisa Hara	Hara.Yoshihisa@cb.MitsubishiElectric.co.jp

GRSS MEMBER HIGHLIGHTS

GRSS MEMBERS ELEVATED TO THE GRADE OF SENIOR MEMBER DURING THE PERIOD JUNE–AUGUST 2011

June	James	Avery	Providence Section
	Robert	Blosser	Long Island Section
	Paul	Brown	Central Texas Section
	Il-Suek	Koh	Seoul Section
	Hoonyol	Lee	Seoul Section
	Xiaofeng	Li	Northern Virginia Section
	Feng	Li	New South Wales Section
	Joan	Serra-Sagrista	Spain Section
August	Frederick	Chen	Baltimore Section
	Xiaofeng	Li	Washington Section
	Francesca	Scire-Scappuzzo	Boston Section

Senior membership has the following distinct benefits:

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

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

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

IEEE GRSS AWARDS: CALL FOR NOMINATIONS

(http://www.grss-ieee.org/about/awards/)
Nominations for the IEEE GRS Society awards are due December 15. For the first time not only for the Major Awards, but also for the Publication Awards nominations from the members are possible. Below the awards are listed with links to a detailed description and to the nomination forms.

GRSS Distinguished Achievement Award (DAA)

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

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

GRSS Education Award (EA)

Eligibility: Member or Affiliate Member of the IEEE GRSS. The purpose of this award is to reward significant educational contributions in the field of remote sensing. The award

shall be considered annually, but will only be awarded when an outstanding recipient is identified.

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

GRSS Outstanding Service Award (OSA)

Eligibility: Must be an IEEE GRSS member.

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

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

GRSS GOLD Early Career Award (GA)

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

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

Deadline: Dec. 15. 2011
Please mail Major Award nominations directly to:
Prof. Werner Wiesbeck
Chair, GRSS Major Awards Committee
Karlsruhe Institute of Technology (KIT)
Kaiserstrasse 12
76131 Karlsruhe, GERMANY
E Mail: werner.wiesbeck@kit.edu

GRSS Transactions Prize Paper Award

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

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

GRSS Letters Prize Paper Award

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

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

GRSS J-STARS Prize Paper Award

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

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

Deadline: Dec. 15. 2011
Please mail Publications Award nominations directly to:

Prof. Martti Hallikainen
Chair, GRSS Publications Awards Committee
Aalto University
Department of Radio Science and Engineering
P.O. Box 13000
Aalto 00076, Finland
martti.hallikainen@aalto.fi

GRSS MEMBER THOMAS COOLEY SELECTED AS AFRL FELLOW

John Kerekes and Melba Crawford

IEEE GRSS Senior Member Dr. Thomas Cooley has been selected as a Fellow of the United States Air Force Research Laboratory (AFRL). Dr. Cooley is a scientist in the Space Vehicles and Sensors Directorates of AFRL, and has received this prestigious recognition for his long-term contributions to hyperspectral imaging and space technologies.

Dr. Cooley's contributions span several areas. His most recent and perhaps most significant contribution has been his leadership in the development of the Tactical Satellite-3 (TacSat-3) with its operationally responsive hyperspectral imaging payload. Launched in 2009, this satellite achieved 100% of its planned goals during its year-long experimental phase and has now transitioned to use as an operational asset.

In addition, throughout his career Dr. Cooley has led in the development of atmospheric radiance modeling and compensation models and tools and is currently the leader of AFRL's Imaging Spectroscopy Program, which conducts research into advanced hyperspectral imaging methods and sensor characterization. He has also represented the United States as a leader of international project arrangements with coalition partner countries.

Congratulations Tom!

Nomination Package Text

Dr. Cooley is a world-recognized leader of revolutionary space programs, as well as an articulate communicator and superb problem solver. His significant contributions to space science and technology include: (1) Dr. Cooley developed Tactical Satellite-3 (TacSat-3) as an operationally responsive hyperspectral imaging surveillance satellite with tactical support capability, and guided it from the initial concept through launch and experimental phases, and into dramatically successful operations for the combatant commands. His vision for TacSat-3 was truly revolutionary, and the amazing results of this space demonstration have validated his vision, as TacSat-3 is employed today with great effect by operational users. (2) Prior to TacSat-3, Dr. Cooley led the development of another groundbreaking payload, Warfighter-1, employing a highly innovative acquisition strategy based on a unique government-industry partnership. (3) Dr. Cooley has developed world-leading atmospheric radiance and compensation models and tools for imaging spectroscopy, and demonstrated for the military, intelligence, commercial, and academic communities the importance of this technology for the full exploitation of hyperspectral data. (4) As the leader of the Imaging Spectroscopy Program, and in his inter-directorate role as Technical Advisor for Electro Optical Space Sensing, Dr. Cooley has been at the forefront of the most advanced hyperspectral imaging methods. For example, he led the development of the Hyperspectral Calibration Laboratory, which has been used to provide important sensor characterization information for DoD customers. (5) Dr. Cooley has furthered the cause of our national defense by leveraging the technology investments of our international coalition partners in his role as a strong leader of international project arrangements that have borne valuable fruit in both technological progress and warfighting capability.

Dr. Cooley's most significant achievement is the spectacular success of TacSat-3. He guided this satellite from its inception as a rapid-build, highly capable, but low-cost, space demonstration under the Operationally Responsive Space (ORS) model - the first satellite developed end-to-end using this method. TacSat-3 has been an extremely important accomplishment in multiple ways. First, its successful completion of 100% of its planned goals in its one year on-orbit experimental phase proves the soundness of the ORS model when implemented by a strong team under Dr. Cooley's outstanding leadership. Second, even though TacSat-3 was an experiment, it has delivered over 3000 unique images to the data users. Third, TacSat-3 demonstrated the military and scientific utility of hyperspectral imaging from a space-based platform. Fourth, TacSat-3 proved the concept of tactical imaging from space. In this approach, the satellite can be tasked by ground forces, process hyperspectral imagery on board, and downlink target information back to the user—all in a single pass over a ground site in under ten minutes. This represents a major breakthrough compared to the normal multi-hour or days it would take otherwise. Finally, the success of TacSat-3 has been capped off by its transition to AFSPC for operational use, where it has demonstrated extremely high military utility.

IN MEMORIAM

IN MEMORY OF GRANVILLE EDWARD PAULES, III

David G. Goodenough, F. IEEE Natural Resources Canada, Victoria, BC, Canada

Granville Edward Paules, III, was the Education Director of the IEEE Geoscience and Remote Sensing Society when he died on January 4, 2011 at the age of 73. His death occurred at Shady Grove Adventist Hospital in Rockville, Maryland after a difficult and painful two-year fight with bladder cancer.

Gran Paules had a long and diverse career. He graduated from the University of Texas with a B.S. in Electrical Engineering in 1960 in Austin, Texas. He served in the US navy from 1960 to 1964 and was on the USS Coontz, DLG9. He left the active Navy in 1964 to join NASA Flight Control in Houston. He continued his Naval Service through the Reserves and retired as a Captain.

Granville Paules served as a NASA Flight Controller and was a Primary Guidance Officer (Flight Dynamics) during the Apollo missions. He was on the console in "The Trench" during the moon-landing of Apollo XI. Mr. Paules received in 1970 the **Presidential Medal of Freedom** for his efforts as a member of the Mission Operations Team during the Apollo XIII crisis.

In 1971 Gran Paules began work for the Department of Transportation (DOT) as Chief of the Research and Development Division. He received the DOT **Distinguished Service Medal** for significantly advancing the state of transportation systems planning using the emerging desk top computer capabilities.

Granville Paules joined NASA Headquarters in Washington DC in 1985 to work on the Space Station. In 1994, Gran Paules became Director, Technology Innovation and Systems Integration Office, Office of Mission to Planet Earth. In 1998 he joined the Office of Space Science and became Deputy Director for Program Planning and Development with the Earth Science Enterprise Division and, concurrently, as its **Chief Technologist**. As Chief Technologist he advocated and obtained budget support for the Advanced Information Systems Technology Program and led the Earth Science 2025 Vision formulation effort, based on a highly interoperable constellation of environmental sensors. As a senior program executive for the Earth Science Enterprise and, more recently, the Science Mission Directorate at NASA Headquarters, Mr. Paules was engaged in formulation of many advanced concept satellite missions including the New Millennium Earth Observer-1, now a major test bed for evaluating multi-sensor interoperability. Throughout this assignment he was the Senior DOD Liaison, serving as NASA's representative to the multi-agency Space Technology Alliance and the Civil Applications Committee. While at NASA, he received the **NASA Exceptional Service Medal**. Granville Paules served the Federal Government as a senior level manager for over 40 years.

Gran Paules retired from NASA in 2006 but did not retire! He joined Kelly, Anderson and Associates, Inc. as a Principal for Aerospace Services. There he managed a business line which provided comprehensive services spanning the full range of government and commercial business support. During this time he was also a Board Member of OGC (Open Geospatial Consortium) and Director of Education for IEEE GRSS.

Gran and I first met to discuss the EO-1 satellite mission for which he was a champion, and I was the PI for the Evaluation and Validation of EO-1 for Sustainable Development of Forests project. He was active in the organization of NASA's

Granville E. Paules at the Guidance Console for Apollo 11.

participation in special sessions and panels, educational sessions, and technical program committees for the International Geoscience and Remote Sensing Symposium (IGARSS), beginning with IGARSS 2000. Granville Paules served as an elected member of the IEEE GRSS Administrative Committee (AdCom) in 2003 and 2004. He became **Education Director** for IEEE GRSS. He pioneered web broadcasting of plenary sessions of our major international conferences, on-line tutorials developed with national and international academics, and was responsible for a successful and equitable student travel program. In all of Gran's business dealings he showed honesty, integrity, respect, and excellence.

Granville Paules always provided thoughtful and respectful advice to the AdCom. He was well connected to the international remote sensing community and was supportive of international engagement by GRSS. He was deeply respected by his AdCom colleagues for his patience, generous spirit, and warm smile.

The President of the United States of America

Awards this

Presidential Medal of Freedom

To

The Apollo XIII Mission Operations Team

We often speak of scientific "miracles"--forgetting that these are not miraculous happenings at all, but rather the product of hard work, long hours and disciplined intelligence.

The men and women of the Apollo XIII mission operations team performed such a miracle, transforming potential tragedy into one of the most dramatic rescues of all time. Years of intense preparation made this rescue possible. The skill, coordination and performance under pressure of the mission operations team made it happen. Three brave astronauts are alive and on Earth because of their dedication, and because at the critical moments the people of that team were wise enough and self-possessed enough to make the right decisions. Their extraordinary feat is a tribute to man's ingenuity, to his resourcefulness and to his courage.

The White House
Washington, D.C.
April 18, 1970

Presidential Medal of Freedom Certificate Signed by President Richard Nixon (1970).

He was blessed with a wonderful soul mate, Diane, with whom he shared more than 50 exciting years. Gran and Diane are adventurous, something my wife Genevieve and I learned about travelling with them to more than 20 destinations around the world. Gran had a wide range of interests from sports to opera, from technology to protecting the health of our planet. Gran Paules was our courageous friend.

Gran and Diane Paules were both active with their Christ Episcopal Church community in Rockville, Maryland. Granville Paules held many offices in Vestry of the church, including that of Senior Warden.

Granville E. Paules died on January 4th, in the loving arms of his wife Diane and son Skip. Gran Paules had suffered greatly with bladder cancer and had endured radiation, five chemotherapies, surgery, and a plethora of side-effects. Granville Paules is survived by his wife, Diane; his son, Granville E. Paules IV (Skip), of Bainbridge Island, Washington state (Julie); his daughter, Allison R. Nelson, of El Cerrito, California (Geoffrey); a brother and a sister of Fort Worth, Texas; and five grandchildren: James, Matiya, Elaine, Oliver, and Harris.

On January 15, 2011 a funeral service was held for Granville E. Paules at the Christ Episcopal Church in Rockville, Maryland. As a Past President of GRSS, I was asked to speak for GRSS to the attendees about Gran's contributions. One third of the AdCom was there to honor Gran's many contributions to our society, the world's largest remote sensing science and engineering organization. We will miss our good conversation, our camaraderie, and our adventures together.

Gran and Diane Paules in Milan in 2008 after an AdCom meeting.

FEATURES

A PERSPECTIVE ON COMPACT POLARIMETRY

R. K. Raney, Johns Hopkins University, Applied Physics Laboratory

I. Overview

Compact polarimetry is the currently popular name for the class of synthetic aperture radars (SAR), in which only one polarization is transmitted, and two orthogonal polarizations are received, together with their relative phase. The phase is essential for compact polarimetric radars [1], in distinct contrast to conventional "dual-polarized" SARs in which the relative phase is not available. The major motivation for compact polarimetry is to strive for quantitative backscatter classifications of comparable finesse as those from a fully polarized system, while avoiding their associated disadvantages.

The fundamental data product from a compact polarimetric radar is the covariance matrix of the backscattered field, which in turn may be transformed into the Stokes vector. Either form captures all of the information contained in the observed EM field. The four elements of the Stokes vector may be evaluated from the intensities of the two received polarizations, and the real and imaginary parts of their relative phase.

Characteristics of the backscattered field depend on the transmitted polarization. In contrast, the values of the Stokes parameters of the backscattered field are independent of the receiver's polarization basis. Thus, there are only two high-level considerations for selecting the architecture of a compact polarimetric radar: choice of the transmitted polarization (driven by the radar's intended application), and optimization of the radar itself (driven by technical system trade-offs).

A compact polarimetric (CP) SAR in general cannot be "as good as" a fully-polarimetric system (FP), because a FP SAR measures the 4×4 scattering matrix of the scene, whereas a CP SAR has access only to the 2×2 covariance matrix of the backscattered field. However, in many applications, the results enjoyed from CP architecture are equivalent to those from a FP radar, to first order. Likewise, the results from a CP radar always will be "very much better" than those from a singly-polarized SAR, and almost always "much better" than those from a conventional dual-polarized radar. World-wide, more and more investigations are aimed at validating these comparative performance assertions as they relate to specific applications.

At least four Earth-observing SARs to be launched in the next five years will include compact polarimetric modes. Those systems are: RISAT-1 (India), ALOS-2 (Japan), SAOCOM-1 (Argentina), and the Radarsat Constellation Mission (Canada).

II. Polarimetric SAR

Figure 1 portrays all combinations of SAR polarization diversity. The simplest form of imaging radar transmits on one polarization, and receives on the same (like) polarization. There are many examples, including Seasat (1978) and Radarsat-1 (1995). Dual-polarized radars are those that transmit on one polarization, and then receive simultaneously on two polarizations, one being the same as that which was transmitted, and the other its orthogonal counterpart, known respectively as the like- and cross-polarized channels. In traditional (Earth-observing) radar remote sensing, all systems have used linear polarizations, H and/or V. Typical dual-polarized examples include the airborne real aperture Ka-band APQ-97 flown by Westinghouse (early 1960s), and the alternating-polarization mode of Envisat ASAR (2002). These two examples, although separated by 40 years, produce the same class of outputs, namely, like- and cross-polarized two-dimensional mappings of radar brightness. The figure includes variations on the theme of dual polarization, including transmissions that alternate between orthogonal polarizations. In all such cases, the data products can be described generically as "images", since (by definition) they do not include the relative phase between the two received channels. Consequently, analysis options are restricted primarily to ratios or differences of their respective images.

If relative phase is retained between the two received (nominally orthogonal) polarizations, then the resulting data are sufficient to calculate the covariance matrix that corresponds to the polarimetric degrees of freedom of each type of SAR. In contrast to elemental imagery, such matrices are an entirely different class of data product. They embrace a quantitative measurement of the (relative) phase and amplitudes of the backscattered data, in marked contrast to simple radar brightness. One way to help keep this significant distinction in mind is to restrict the term "polarimetric" to those systems whose data products are matrices, and the term "dual-polarized" to radars having only imagery as data products.

The gold standard among polarimetric radars is the fully-polarized case, at the top of the hierarchy shown in Figure 1. The intrinsic data product from this class of SAR is the 4×4 scattering matrix of each resolved element in the scene. After applying certain symmetry relations, this may be reduced to a 3×3 array, such as a compressed Stokes matrix [2] or the compressed (Sinclair) scattering matrix [3]. These reduced forms are known as quadrature-polarimetric SAR (quad-pol in common parlance), although (*Alert!*) this terminology

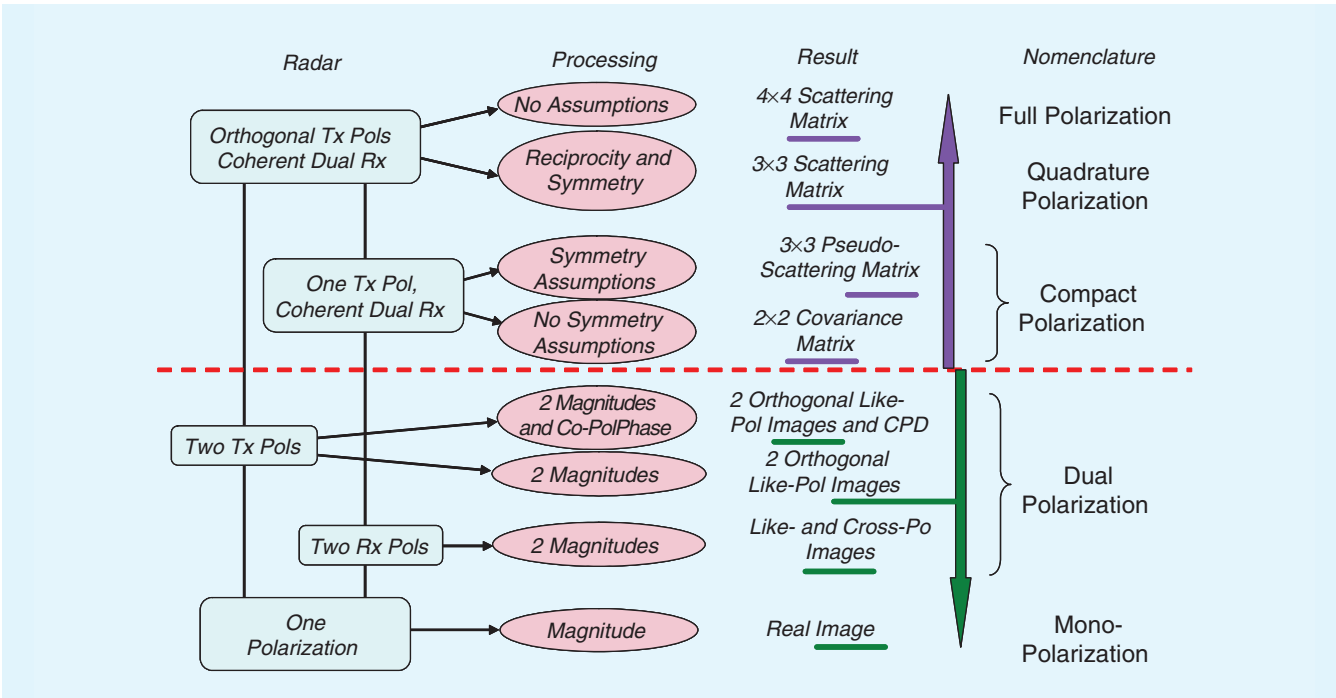

Figure 1. The family of polarization diversity and polarimetric imaging radars.

sometimes is meant to imply the 4 × 4 fully-polarized version. Note in both the 4 × 4 and 3 × 3 data format cases that the radar is the same; the distinction resides in the way their respective data products are prepared. Quad-pol SARs have attracted considerable attention since their introduction in the mid-1980s [4].

Compact polarimetry encompasses those options that fall between dual-polarized and quad-pol SARs. Compact polarimetric radars transmit on only one polarization, and receive on two orthogonal polarizations, retaining their relative phase. Although adopted many years ago in the fields of meteorology and radar astronomy, coherent dual-polarimetric imaging radar was over-looked for decades in the radar remote sensing world. It now is recognized as an important SAR option worth serious consideration.

III. Quadrature Polarimetry

Overview

Quadrature polarimetry implies that the transmitted polarizations as well as the received polarizations must be orthogonal pairs. That is straight-forward on reception, but it is possible to transmit only one polarization at a time. Orthogonal transmit polarizations must be interleaved (time-multiplexed). This requires that the pulse-repetition frequency (PRF) be twice that of a dual-polarized (or singly-polarized) radar, so that the Nyquist lower bound on sampling rate [5] can be satisfied for both polarizations. The doubly-polarized transmitted field as well as the orthogonally-polarized received data each may be described by a four-element Stokes vector, thus capturing all of the information available from the observed scene, either by the 4 × 4 (symmetric Sinclair or Kennaugh) scattering matrix [6], or in a reduced 3 × 3 form. The architectural precedent for all such quad-pol imaging radars is "linear-linear", in which the transmitted polarizations are multiplexed H and V, and the receive polarizations (and their differential phase) are simultaneous H and V.

Disadvantages

Quad-pol systems come at a cost, in terms of coverage as well as complexity. The doubled PRF implies immediately that the imaged swath can be no more than half the width of a singly- or dual-polarized SAR. It might be thought that the data rate must be doubled as well, but taking the halved swath into account, the average data rate should be comparable to that of a dual-polarimetric radar (although the data volume per pixel is doubled). More subtle factors emerge, including in particular that the nearest range ambiguities (in conventional linearly-polarized systems) are always cross-polarized with respect to those from the correct imaged swath. In order to suppress these ambiguities, the span of useful incident angles must be substantially smaller than for non-quad-pol systems [7]. From a radar systems point of view, quad-pol radars require twice the (average) power as their counterparts that transmit on only one polarization. Of these limitations, reduced coverage (swath width) and limited choice in incidence are the most significant for users.

IV. Compact Polarimetry

Overview

In the field of radar meteorology, experiments on inventive dual polarimetry began more than 40 years ago [8–12], including demonstrations of transmitting "slant" linear polarization (at a 45° angle relative to horizontal) or circular polarization, and receiving orthogonal linear polarizations. Radar astronomy offers the oldest precedent for compact polarimetry [13–16], for which a standard method is to transmit circular polarization, and receive coherent dual-circular polarizations (CC) [17]. Very nice results have been obtained, including backscatter analyses based on Stokes parameters. A pioneering example of this technique was estimation of the degree of polarization of the lunar surface [18].

Similar investigations for remote sensing imaging radars are much more recent. One of the first compact polarization concepts to appear in the SAR literature is the $\pi/4$ mode [19], which posits radiating a linearly-polarized field at 45° (with respect to either H or V orientations), then receiving coherently the resulting H and V backscatter components. Performance is claimed [20] to be comparable to that of a fully-polarimetric SAR, but only for scatterers within the scene whose orientation distributions are predominantly horizontal or vertical. In many applications, however, the objective is to ascertain the scattering properties of the scene [21–25], rather than to presume them at the outset, and to realize image classification over an unconstrained variety of scene characteristics. For such applications, an *a priori* assumption on the orientation of the mean terrain profile or the backscatterers may be inappropriate.

There have been several attempts in SAR applications to achieve compact polarimetry by transmitting a conventional H- or V- polarized field, and receiving H and V polarizations together with their relative phase. Such experiments invariably have led to disappointing results [22].

Circular polarization is not entirely foreign to Earth-observing SARs. Noteworthy examples include analysis of quadrature-polarized data from sloping terrain, for which it has been shown that synthesis of circularly-polarized data leads to results that are superior to those from the original linearly-polarized data [26]. It turns out that a CC radar usually is more awkward to implement than alternatives, and so this architecture has not played a role in Earth-oriented remote sensing.

Alternatively, compact polarimetry may be implemented by receiving orthogonal linear polarizations when transmitting circular polarization. The resulting hybrid-polarity (CL) architecture [1, 27] retains all of the measurement characteristics of the CC polarization plan, while leading to a radar implementation that usually is simpler and more robust than either an end-to-end linearly- or circularly-polarized system. The resulting data are equivalent (indeed, nominally identical) to data produced by a CC radar. This equivalence between CC and CL measurements follows from first principles, namely, that the values of the Stokes parameters of an arbitrary EM field do not depend on the polarization basis in which the data are observed [14, 28, 29].

Two lunar imaging radars—the Mini-SAR on Chandraayan-1 [30] and the Mini-RF on the Lunar Reconnaissance Orbiter [31]—were the first compact polarimetric synthetic aperture systems. Hybrid-polarimetric architecture was adopted for their design, because that combination offered the optimum "science to hardware" ratio. Their science requirements included maximized potential to distinguish between backscatter types, especially measurement of the circular-polarization ratio and robustness to randomly-oriented dihedral backscatterer distributions. Their implementation requirements included minimal mass and power. The results have been excellent [32, 33].

In sum, all forms of compact polarimetry share three themes: (1) the information content of the backscattered field depends on the choice of transmitted polarization; (2) relative phase is required in addition to the intensities of the orthogonal dual-polarized returns if the backscattered field is to be fully characterized; and (3) characterization of the backscattered field is independent of the particular basis vectors in which the coherent dual-polarized measurements are made.

V. Hybrid-Polarity

It is reasonable to conclude that the radar should transmit circular polarization if the backscattered field is to be rotationally robust with respect to the geometric characteristics of the scene, and if the image analysis objectives include discrimination between even- and odd-bounce backscatterers that may have random orientations. Given that the transmitted polarization is circular, it would be natural to assume that the radar must be dual-circularly polarized on receive. However, such a conventional approach falls short of a potentially optimum alternative. Fundamental principles assure that the backscattered power from a given scene element will be conserved when split into any pair of orthogonal polarizations. The obvious implication is that the energy will be divided evenly if and only if the receive polarizations have no "like-" or "cross-polarized" relationship to the transmitted polarization. Thus, if circular-polarization is transmitted, the receive polarization bases should be orthogonal linears.

A generic diagram of the resulting hybrid-polarity (CL-pol) architecture is shown in Fig 2. A dual-linearly-polarized antenna will radiate circular polarization if the H and V feeds are driven simultaneously and 90° out of phase. Upon reception by a dual-linearly-polarized antenna, the data are kept in their linear bases all the way through to the processor inputs. The processor is comprised of two logical sections: focus, and multi-looking. The native output from the focusing stage is single-look complex (SLC) image data, which is the starting point for either polarimetry or interferometry. The native output from the multi-look stage is the (averaged) 2×2 covariance matrix, which may be transformed into the 4-element Stokes vector.

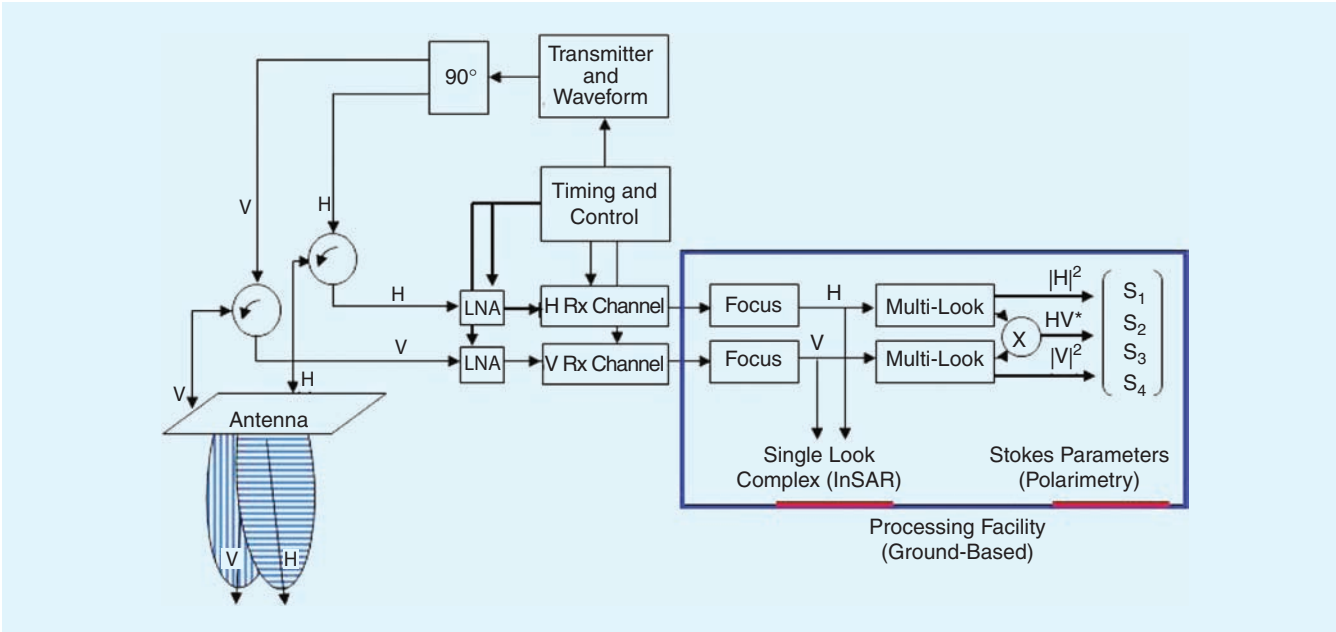

Figure 2. Generic architecture of a hybrid-polarity radar.

Signal-to-Noise Ratio

Note for this architecture that only half of the radiated power is allocated to a given linear polarization. From this fact, it is tempting to conclude that there should be a 3-dB loss in sensitivity (minimum detectable radar brightness, or noise-equivalent sigma-0). One may show [34] however, if the image products are displayed in circular polarization, that the 3-dB is recovered. (Recent experiments on the hybrid-polarity data from the Moon verify this theoretical result.)

Backscatter Behavior

The basic constituents of backscatter for a compact polarimetric imaging radar are even bounce, odd bounce, and random. (Note that the term "depolarized" which is often used has two meanings, either randomly polarized, or cross-polarized [14]. The term "randomly polarized" is preferred so as to avoid ambiguity.)

The expected sense of received circular polarization is opposite to the transmitted sense, using the jargon of radar astronomy. For example, transmitting R usually results in L-polarized backscatter being stronger, so that R becomes the cross-polarized receive state. This is because odd-bounce reflection usually dominates, as from specular surfaces, Bragg scattering from random hard surfaces, or trihedrals (3-sided corners, either natural or fabricated). In contrast, double-bounce (or more generally, even-bounce) backscatter, such as from dihedral reflectors, imposes offsetting phase reversals in the linear EM component that is aligned with the dihedral's axis, in which case stronger backscatter is observed in the same-sense circular polarity. Double-bounce reflections of circularly-polarized waves are indicated rather sensitively by their relative phase. In the case of a lossless dihedral, the phase would differ by 180 degrees relative to that from a single-bounce scattering surface or from alternative odd-bounce shapes. Multiple in-scene scattering, such as from within a volumetric deposit, randomizes the polarimetric properties of the backscatter, a component that is measured by the degree of polarization, a parameter that follows directly from the Stokes vector.

Hybrid (CL) Quad-pol

These same principles may be extended to a quad-pol radar whose architecture is hybrid-polarimetric. Such a configuration would transmit multiplexed right-circular (R) and left-circular (L) polarizations, and receive simultaneously H and V polarizations in each case. This architecture has several significant advantages when compared to the conventional "linear-linear" case [34]. Calibration is simplified, because neither receive channel is "cross-polarized" with respect to the transmitted polarization. Thus the mean signal levels on both sides of the receiver are always comparable. Finally, the troublesome nearest range ambiguities would never be of opposite—and potentially stronger—polarization, thus easing the incident angle restraint that plagues conventional quad-pol SARs [35].

VI. Results

Experimental Method

Data from a quad-pol radar may be transformed into data that correspond to any combination of transmit and receive polarizations, including compact polarization in particular. The methodology follows directly from fundamental vector-matrix polarimetric synthesis operations [36]. In brief, the quad-pol data are

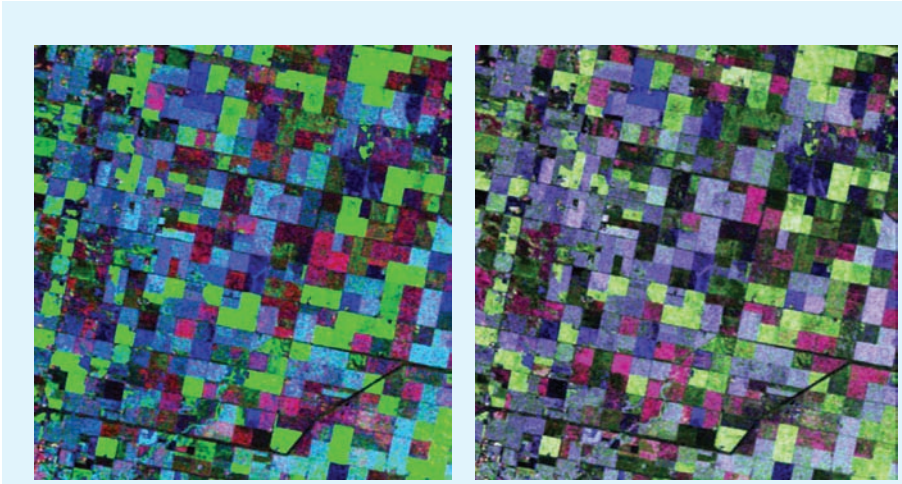

Figure 3. Comparison of the thematic analysis of data from an agricultural test site (Carmen, Manitoba) using quadrature-polarimetric data (left panel) and hybrid-polarimetric data (right panel). Original data were Radarsat-2, fine quad, 11 August 2010. (Courtesy, Francois Charbonneau, Canada Centre for Remote Sensing.)

pre-multiplied and post-multiplied by (Jones) vectors that represent the desired combination of transmitted and received polarizations. This approach is ideal, in the sense that the same data—large quantities of which already exist—may be processed to provide a quantitative means of comparison between a compact-polarimetric architecture of interest, and alternatives such as quadrature-polarization, (non-coherent) dual-polarization, or single polarization.

Decomposition

Decomposition is a broad class of strategies that have proven to be helpful in objectively classifying radar backscatter through the properties of its associated covariance matrix [37]. The most widely used tools [38] have been developed for quad-pol data that are characterized by a 3×3 covariance matrix. The natural data product from a coherent dual-polarized radar, however, is a 2×2 covariance matrix. The resulting 3×3 *vs* 2×2 conflict has spawned two decomposition methodologies for compact polarimetry.

The original compact polarimetric analyses used 3×3 matrix tools [20, 24], which required that the 2×2 data be expanded to a 3×3 pseudo-covariance matrix. Such an operation depends on certain symmetry assumptions. The advantage is that familiar decomposition techniques may be applied. The disadvantage is that there would seem to be no theoretical justification for a 2×2 to 3×3 matrix expansion. (*Alert:* When authors from this persuasion refer to "compact polarimetry", invariably they include this expansion as part of their paradigm.)

An alternative decomposition methodology for compact polarimetric radar data is based on the 2×2 covariance matrix, often rendered in the form of the four-element Stokes vector. This approach has substantial heritage in radar astronomy. One example is the *m*-chi decomposition, in which the observed field is characterized by the degree of polarization (*m*), and chi (the Poincaré variable that denotes its ellipticity, including its L or R sense of rotation [6]). These two quantities (among several other "child parameters") may be calculated easily from the Stokes parameters.

Example. There is an increasing number of studies that compare polarimetric methods for a variety of applications [39–42]. Their respective conclusions agree: hybrid polarimetric data always approach—and occasionally are comparable to—analyses of quad-pol data. Figure 3 shows a typical result for an agricultural scene, where an *m*-chi decomposition of the Stokes parameters derived from hybrid-polarimetric data appears to be equivalent to an analysis of the original quad-pol data using the Freeman-Durden decomposition.

VII. Conclusions

The objective of compact polarimetry is characterization and exploitation of the backscattered field excited by a monostatic radar that transmits only one polarization and receives two orthogonal polarizations and their relative phase. Full characterization of the field requires measurement of the 2×2 covariance matrix, often recast as the 4-element Stokes vector. There are four generic candidates for compact polarimetric architecture. Citing transmitted and received polarizations in sequence, those four are: (1) H::H&V; (2) 45°::H&V; (3) C::R&L); and (4) C::X&Y (where X&Y represents any orthogonal pair of linear polarizations, such as H and V). Of these, (1) offers only poor results, and (3) usually implies hardware and performance disadvantages for an orbital system when compared to alternatives. The $\pi/4$ mode (2) may be advantageous in certain situations, but not in general.

Hybrid-polarity (4) emerges as the leading option, based on measurement potential, ease of calibration, and on favorable implementation. The arguments to this end progress through four ordered conclusions: (1) the receiver must be coherently dual-polarized; (2) the transmit polarization must be circular; (3) the receiver polarization basis does not have to be circular; and (4) from a radar design standpoint, the optimum receiver polarization basis is linear. The pivotal objective reasons for these conclusions are: (1) the Stokes parameters require measuring the relative phase as well as the amplitudes of the received backscatter; (2) any non-circular illuminating polarization would impose preferential selectivity onto the backscattered

polarizations in response to the relative alignment between the principal axis of the incoming elliptically polarized field and the angular orientation of scene constituents; (3) Stokes parameter values are independent of the observation polarization basis; and (4) calibration is optimized only if the signal levels in the two receivers are comparable and bear no like- or cross-polarized relationship to the transmitted polarization.

In contrast to an otherwise similar quad-pol radar, a compact polarimetric system is not compromised by doubled average transmit power, halved swath width, nor limited incidence.

Data from compact polarimetric SARs are fully characterized by a 2×2 covariance matrix, which is well-suited to a streamlined decomposition strategy. Existing quad-pol data files can be converted easily to replicate 4-element Stokes vector data products from a compact polarimetric SAR, thus facilitating quantitative comparisons between alternative radar architectures, without additional data collection campaigns, or development of new proof-of-concept hardware.

References

[1] R. K. Raney, "Dual-Polarized SAR and Stokes Parameters," *IEEE Geoscience and Remote Sensing Letters,* vol. 3, pp. 317–319, 2006.

[2] P. C. Dubois and L. Norikane, "Data volume reduction for imaging radar polarimetry," in *Proceedings International Geoscience and Remote Sensing Symposium IGARSS'87*, Ann Arbor, Michigan: IEEE, 1987, pp. 691–696.

[3] J. J. van Zyl and C. V. Burnette, "Data volume reduction for single-look polarimetric imaging radar data," *IEEE Transactions on Geoscience and Remote Sensing,* vol. 29, pp. 784–786, 1991.

[4] H. A. Zebker*, et al.*, "Imaging radar polarimetry from wave synthesis," *Journal of Geophysical Research,* vol. 92, pp. 1295–1304, 1987.

[5] J. C. Curlander and R. N. McDonough, *Synthetic Aperture Radar: Systems and Signal Processing.* New York: John Wiley & Sons, Inc., 1991.

[6] W.-M. Boerner*, et al.*, "Polarimetry in Radar Remote Sensing: Basic and Applied Concepts," in *Principles and Applications of Imaging Radar.* vol. Manual of Remote Sensing, Third Edition, Volume 2, F. M. Henderson and A. J. Lewis, Eds., John Wiley & Sons, Inc, 1998.

[7] P. Dubois-Fernandez*, et al.*, "The specificity of P-band POLinSAR data over vegetation," in *Proceedings POLinSAR 2007*, Frascati, Italy: European Space Agency, 2007.

[8] G. C. McCormick, "An antenna for obtaining polarization-related data with the Alberta Hail radar," in *13th Conference on Radar Meteorology*, Boston, 1968, pp. 340–347.

[9] A. Hendry and A. Antar, "Radar observations of polarization characteristics and lightning-induced realignment of atmospheric ice crystals," *Radio Science,* vol. 17, pp. 1243–1250, 1982.

[10] V. N. Bringi and A. Hendry, "Technology of polarization diversity radars for meteorology," in *Radar in Meteorology*, D. Atlas, Ed., American Meteorological Society, 1990, pp. 153–190.

[11] E. Torlaschi and A. R. Holt, "A comparison of different polarization schemes for the radar sensing of precipitation," *Radio Science,* vol. 33, pp. 1335–1352, 1998.

[12] R. F. Reinking*, et al.*, "Evaluation of a 45° slant quasi-linear radar polarization state for distinguishing drizzle droplets, pristine ice crystals, and less regular ice particles," *J. Atmospheric and Oceanic Technology,* vol. 19, pp. 296–321, 2002.

[13] M. H. Cohen, "Radio astronomy polarization measurements," *Proceedings IRE,* vol. 46, pp. 172–183, 1958.

[14] P. E. Green Jr, "Radar Measurements of Target Scattering Properties," in *Radar Astronomy*, J. V. Evans and T. Hagfors, Eds., New York: McGraw-Hill, 1968, pp. 1–78.

[15] N. J. S. Stacy and D. B. Campbell, "Stokes vector analysis of lunar radar backscatter," in *Proceedings Geoscience and Remote Sensing Symposium IGARSS93*, Tokyo, Japan: IEEE, 1993, pp. 30–33.

[16] L. M. Carter*, et al.*, "Impact crater related surficial deposits on Venus: Multipolarization radar observations with Arecibo," *J of Geophysical Research,* vol. 109, p. E06009, 2004.

[17] N. Stacy and M. Preiss, "Compact polarimetric analysis of X-band SAR data," in *Proceedings, 6th European Conference on Synthetic Aperture Radar*, Dresden, Germany: VDE Verlag GMBH, 2006.

[18] G. H. Pettengill and J. C. Henry, "Radar measurements of the lunar surface," in *The Moon*, Z. Kopal and Mikhailov, Eds., New York: Academic Press, 1962.

[19] J.-C. Souyris and S. Mingot, "Polarimetry based on one transmitting and two receiving polarizations: the $\pi/4$ mode," in *Proceedings IEEE International Geoscience and Remote Sensing Symposium*, Toronto, Canada, 2002.

[20] J.-C. Souyris*, et al.*, "Compact polarimetry based on symmetry properties of geophysical media: The $\pi/4$ mode," *IEEE Trans. Geoscience and Remote Sensing,* vol. 43, pp. 634–646, 2005.

[21] C. Lopez-Martinez*, et al.*, "Statistical assessment of Eigenvector-based target decomposition theorems in radar polarimetry," *IEEE Trans. Geoscience and Remote Sensing,* vol. 43, pp. 2058–2074, 2005.

[22] J.-S. Lee*, et al.*, "Unsupervised terrain classification preserving polarimetric scattering characteristics," *IEEE Transactions on Geoscience and Remote Sensing,* vol. 42, pp. 722–731, 2004.

[23] R. Touzi*, et al.*, "On the use of permanent symmetric scatterers for ship characterization," *IEEE Transactions on Geoscience and Remote Sensing,* vol. 42, pp. 2039–2045, 2004.

[24] T. L. Ainsworth*, et al.*, "Orientation angle preserving *a posteriori* polarimetric SAR calibration," *IEEE Transactions on Geoscience and Remote Sensing,* vol. 44, pp. 994–1003, 2006.

[25] R. Z. Schneider*, et al.*, "Polarimetric and interferometric characterization of coherent scatterers in urban areas," *IEEE Transactions on Geoscience and Remote Sensing,* vol. 44, pp. 971–984, 2006.

[26] D. L. Schuler*, et al.*, "Correction for terrain azimuth slope effects in polarimetric SAR images," in *Proceedings,*

International Geoscience and Remote Sensing Symposium, Honolulu, Hawai'i: IEEE, 2000.
[27] R. K. Raney, "Hybrid-Polarity SAR Architecture," in *CD-ROM Proceedings, IEEE International and Geoscience Remote Sensing Symposium IGARSS*, Denver, CO, 2006.
[28] G. G. Stokes, "On the composition and resolution of streams of polarized light from different sources," *Transactions of the Cambridge Philosophical Society,* vol. 9, pp. 399–416, 1852.
[29] E. Wolf, "Optics in terms of observable quantities," *Nuovo Cimento,* vol. 12, pp. 884–888, 1954.
[30] P. D. Spudis, *et al.*, "Mini-SAR: An imaging radar for the Chandrayaan-1 mission to the Moon, Paper 1153," *Proceedings, Lunar and Planetary Science XXXVI, Houston, TX,* 2005.
[31] G. Chin, *et al.*, "Lunar Reconnaissance Orbiter overview: The instrument suite and mission," *Space Science Review,* vol. 129, pp. 391–419, 2007.
[32] Mini-RF. (2009). *http://www.nasa.gov/mission_pages/Mini-RF/multimedia/index.html*.
[33] R. K. Raney, *et al.*, "The Lunar Mini-RF Radars: Hybrid Polarimetric Architecture and Initial Results," *Proceedings of the IEEE,* vol. 99, pp. 808–823, 2011.
[34] R. K. Raney, "Hybrid-quad-pol SAR," in *Proceedings, International Geoscience and Remote Sensing Symposium IGARSS*, Boston: IEEE, 2008.
[35] R. K. Raney, *et al.*, "Improving range ambiguity performance in quad-pol SAR," *IEEE Transactions Geoscience and Remote Sensing,* vol. (to appear), 2011.
[36] J. J. van Zyl, *et al.*, "Imaging radar polarization signatures: theory and observation," *Radio Science,* vol. 22, pp. 529–543, 1987.
[37] S. R. Cloude and E. Pottier, "A review of target decomposition theorems in radar polarimetry," *IEEE Trans. Geoscience and Remote Sensing,* vol. 34, pp. 498–518, 1996.
[38] PolSARPro. (2009). *http://earth.esa.int/polsarpro/*.
[39] T. L. Ainsworth, *et al.*, "Classification comparisons between dual-pol, compact polarimetry, and quad-pol imagery," *ISPRS Journal of Photogrammetry and Remote Sensing,* vol. (on line) March, 2009.
[40] M. E. Nord, *et al.*, "Comparison of compact polarimetric synthetic aperture radar modes," *IEEE Transactions on Geoscience and Remote Sensing,* vol. 47, pp. 174–188, 2009.
[41] F. J. Charbonneau, *et al.*, "Compact polarimetry overview and applications assessment," *Canadian Journal of Remote Sensing,* vol. 36, pp. S298-S315, 2010.
[42] M.-L. Truong-Loï "Potentials d'un système RSO basse fréquence opérant en polarimétrie compacte," Docteur de l'Université, Université de Rennes 1, Rennes, France, 2010.

IEEE GRSS WELCOMES CONTRIBUTIONS OF THE SOCIETY MEMBERS TO THE PREPARATION OF THE IPCC FIFTH ASSESSMENT REPORT

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I. Scope of the IPCC Fifth Assessment Report on Climate Change

The Intergovernmental Panel on Climate Change (IPCC [1]) is currently preparing its Fifth Assessment Report on Climate Change (AR5). More than 800 authors, selected from around 3000 nominations, are involved in writing the reports, including members of the IEEE GRSS [2]. The AR5 will consist of three Working Group (WG) Reports and a Synthesis Report that will be approved in 2013/2014 [3]:

- WG I: The Physical Science Basis – mid September 2013
- WG II: Impacts, Adaptation and Vulnerability – mid March 2014
- WG III: Mitigation of Climate Change – early April 2014
- AR5 Synthesis Report (SYR) – end October 2014

Earth observations are a central component of the WG I contribution to the AR5 that will assess observed changes, process understanding, and climate change projections in 14 chapters. Three of the chapters focus specifically on Earth observations of the atmosphere and surface, of the ocean, and of the cryosphere, respectively. Observations, in particular long-term and global remote sensing data, will also play an essential role in subsequent chapters on process understanding, for example to verify physical and biogeochemical processes in Earth system models, which are necessary to understand and project climate change. New elements of the AR5 WG I Report will include an end-to-end assessment of sea level change and the carbon cycle, and for the first time in a separate chapter an assessment of the understanding on clouds and aerosols. Greater emphasis will be put on regional

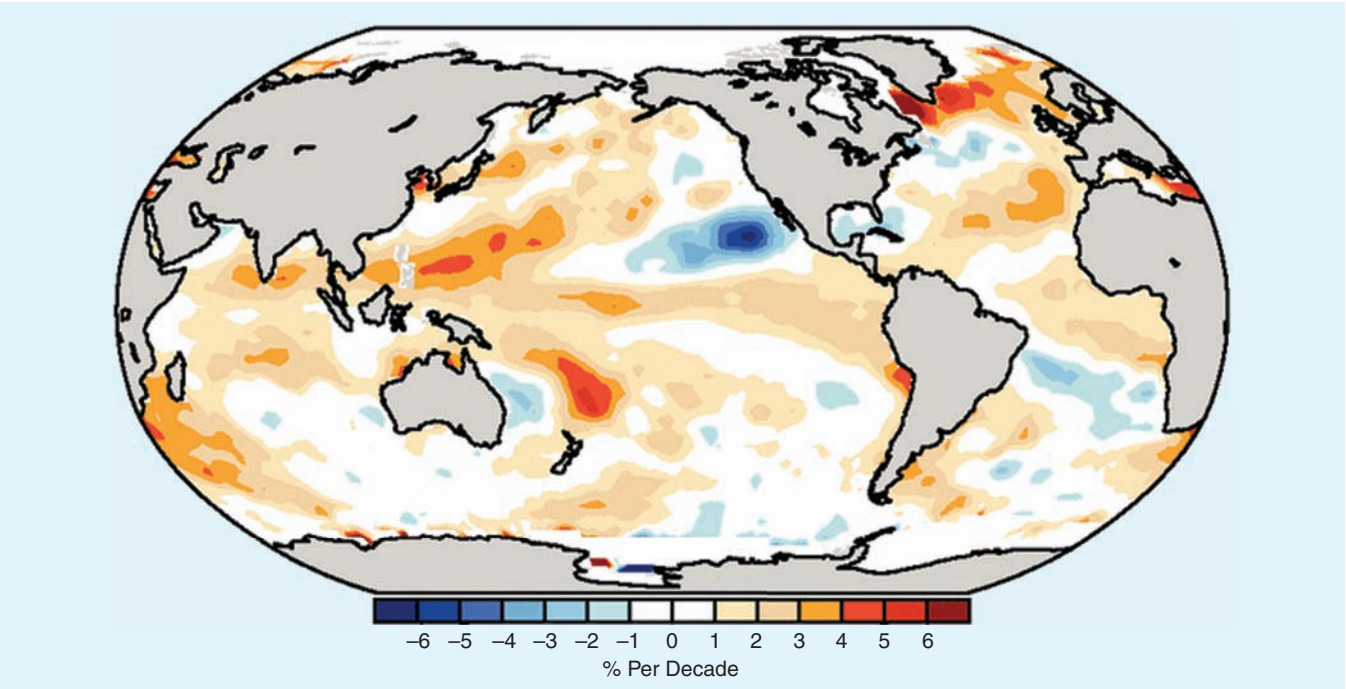


Figure 1. Water vapour in the atmosphere is increasing as a result of warming, and at the same time constitutes one of the major feedbacks that amplify the initial warming caused by the emission of anthropogenic greenhouse gases. The figure shows linear trends in precipitable water (total column water vapour) over the period 1988 to 2004 (% per decade) Figure TS.8. of [4].

information by specifically assessing key climate phenomena (monsoon, El Niño, etc.) and their relevance for future regional climate change. In addition, the coverage of climate change projections will be extended in WGI AR5 by assessing near- and long-term projections including stabilisation of greenhouse gas concentrations for the first time in two separate chapters.

The WG II report will contain two parts, one on global and sectoral aspects, and one on regional aspects. A broad range of impacts, including impacts on ocean systems will be assessed. Information on the impacts and costs of climate change will be considered for different sectors and regions. Special sections will be devoted to natural and managed resources and systems, and their uses, human settlements, industry, and infrastructure, as well as human health, well-being, and security. AR5 will provide a detailed analysis of risk management, the impact of multiple stresses, an expanded treatment of adaptation, and will consider the interaction between adaptation, mitigation and sustainable development.

WG III will assess the risks, economics and ethics and will treat socio-economic aspects of climate change and its implications for sustainable development. Global climate protection goals will be assessed with respect to concepts, costs and implications. Pathways for mitigating climate change will be evaluated for different sectors including energy, transport, buildings, industry and human settlement infrastructure. WG III will also address climate change response policies on the global, regional, national and sub-national level, as well as investment and finance issues.

Compared to the IPCC Fourth Assessment Report [4], more emphasis is put on an integrated assessment of interactions between climate change impacts, adaptation and mitigation across the three WGs, also at the regional level. The goal is to improve consistency throughout the WGs by addressing a number of cross-cutting issues. These include water and the Earth system, carbon cycle including ocean acidification, ice sheets and sea-level rise, as well as mitigation, adaptation and sustainable development. In addition, consistent methodologies will be applied including evaluation of uncertainties and risks, costing and economic analysis, regional aspects as well as treatment of scenarios and greenhouse gas metrics. Where possible integrative analyses will be performed, addressing inter- and intra-regional impacts as well as multi-sector synthesis.

Policy relevant scientific knowledge will be provided by all three WGs, for example information regarding Article 2 of the UNFCCC (referring to the "…stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system").

The IPCC assessment report is based as far as possible on peer-reviewed literature. To be included in AR5, papers have to be published or accepted for publication before the following indicative cut-off dates:

- WG I: submitted by 31.07.2012, accepted by 15.03.2013
- WG II: submitted by 31.01.2013; accepted by 31.08.2013
- WG III: submitted by 11.03.2013; accepted by 28.10.2013

The preparation of IPCC reports [5] is based on the voluntary contributions of many authors, contributors, review editors and reviewers. The composition of the lead author teams for each chapter reflects a range of views, expertise and geographical representation. IPCC reports undergo a comprehensive review of three stages. The first draft is reviewed by experts, the second draft simultaneously by both governments and experts. The summaries for policymakers, overview chapters and synthesis reports are subject to a government review, and are adopted or approved by consensus of governments in Panel sessions. The purpose of this review process is to ensure that the IPCC reports present a comprehensive, objective, and balanced view of the areas they cover.

II. Activities in Preparation of IPCC AR5

In support of AR5, the integrated assessment and climate modelling communities have been preparing a set of new coherent scenarios of future climates with information on radiative forcings, emissions and socio-economic development [6]. Consistent definitions of baseline and mitigation scenarios are critical to ensure comparability across WG contributions. Trajectories have been developed for future climate forcing through greenhouse gases. These so called Representative Concentration Pathways (RCPs) and the related emission trajectories are the new standard used in climate modelling for AR5. Each RCP could result from alternative sets of assumptions (socioeconomic scenarios) about future socioeconomic development, technology, and policy. This flexibility is an intentional and innovative feature of the RCP process. A framework is currently being established that will contain a new set of socioeconomic scenarios allowing for consistent assessments of climate change impacts and options for adaptation and mitigation.

In addition, the Working Group on Coupled Modelling (WGCM) of the World Climate Research Programme (WCRP) has agreed on a new set of coordinated climate model experiments in support of AR5 [7, 8]. This set of climate model simulations forms phase five of the Coupled Model Intercomparison Project (CMIP5). Its purpose is to address outstanding scientific questions that arose as part of the IPCC Fourth Assessment Report (AR4), to improve understanding of climate, and to provide estimates of future climate change. CMIP5 is a very ambitious coordinated model intercomparison exercise involving most of the climate modelling groups worldwide. This set of coordinated climate model experiments is expected to form a unique opportunity to undertake high-impact multi-model research on the fundamental physics of climate and its expected changes that can be assessed in IPCC AR5 [8]. Output from the CMIP5 model simulations is made publicly available for the community at the Earth System Grid web page [9].

Similarly, coordinated efforts are underway that actively support the model evaluation and analysis of CMIP5 data with satellite observations. Examples include the NASA initiative on Satellite Observations for CMIP5 Simulations and the ESA Climate Change Initiative (CCI). The goals of the NASA initiative are to provide the community with access to satellite observational data that are analogous to CMIP5 data in terms of variables, temporal and spatial frequency, and periods, and to provide a strategy for accessing them that closely parallels the model data archive [10]. The goal of the ESA CCI initiative is to produce consistent, error-characterized long-term data sets for selected essential climate variables (ECVs) from multiple instruments and satellite platforms to monitor and understand climate [11].

Within the scope of the IPCC work programme, a number of specific workshops and Expert meetings have been held in support of the IPCC assessment process, with reports and Good Practice Guidance Papers (GPGP) available online [1]. For example, the GPGP on Assessing and Combining Multi-Model Climate Projections provides recommendations for good practice in using multi-model ensembles for detection and attribution, model evaluation and global climate projections as well as regional projections relevant for impact and adaptation studies [12], and the GPGP on Detection and Attribution Related to Anthropogenic Climate Change provides recommendations for good practice in detection and attribution studies, including outlines on data requirements [13].

III. IPCC Special Reports

In addition to climate assessment reports, the IPCC is publishing Special Reports on specific topics. Recently, the Special Report on Renewable Energy Sources and Climate Change Mitigation was published [14]. This report assesses six Renewable Energy sources (bioenergy, direct solar energy, geothermal energy, hydropower, ocean energy, and wind energy). Renewable Energy technologies offer large potentials to contribute to climate change mitigation. The technical potentials of Renewable Energy sources exceed the current and projected global energy requirements substantially. The cost of Renewable Energy is falling and is in some cases already today comparable to current energy costs. Policy measures, investments and further research are needed at regional, national and local levels to further enable the technical potential of Renewable Energy. Another IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation will be published early 2012 [15].

IV. IPCC Reform Process

The procedures and processes of the IPCC have been enhanced [16]. This concerns the establishment of reports, e.g. clearer guidance for the consideration of sources of knowledge and protocols on how to handle scientific uncertainties across all three WGs, as well as for addressing possible errors in previous assessment reports. IPCC has also adopted a framework for its communications strategy. The operational management has been strengthened through the establishment of an Executive Committee. The terms of office of IPCC-leadership have been limited to one term with possible extension for one further term. A conflict of interest (CoI) policy has been adopted by the IPCC Panel that will protect the integrity, trust, and credibility of the IPCC and its reports through enhanced transparency. This policy applies to senior IPCC leadership, lead authors with responsibilities for report content, Review Editors, and the members of the Technical Support Units.

References

[1] Website of the Intergovernmental Panel on Climate Change http://www.ipcc.ch/

[2] Website of the IEEE Geoscience and Remote Sensing Society http://www.grss-ieee.org/

[3] Agreed reference material for IPCC AR5 http://www.ipcc.ch/pdf/ar5/ar5-outline-compilation.pdf

[4] IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S. D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996pp.

[5] Appendix A to the Principles Governing IPCC Work: Procedures for the preparation, review, acceptance, adoption, approval and publication of IPCC Reports: http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles-appendix-a.pdf

[6] Moss, R., J. Edmonds, K. Hibbard, M. Manning, S. Rose, D. P. van Vuuren, T. Carter, S. Emori, M. Kainuma, T. Kram, G. A. Meehl, J.F.B. Mitchell, N. Nakicenovic, K. Riahi, S. Smith, R.J. Stouffer, A.M. Thomson, J.P. Weyant, and T.J. Wilbanks, 2010: A new approach to scenario development for the IPCC Fifth Assessment Report. Nature, 463, doi:10.1038/nature08823.

[7] Taylor, K.E., R.J. Stouffer, and G.A. Meehl, 2009: A summary of the CMIP5 Experimental Design. http://cmip-pcmdi.llnl.gov/cmip5/docs/Taylor_CMIP5_design.pdf

[8] WCRP Coupled Model Intercomparison Project - Phase 5 - CMIP5 [J. Hurrell, M. Visbeck, A. Pirani (eds.)], CLIVAR Special Issue No. 56, Vol. 16, No.2, May 2011.

[9] Earth System Grid web page, project CMIP5: http://www.earthsystemgrid.org/

[10] Teixeira, J., D. Waliser, R. Ferraro, P. Gleckler, G. Potter et al., Satellite Observations for CMIP5 Simulations, In: WCRP Coupled Model Intercomparison Project - Phase 5 - CMIP5 [J. Hurrell, M. Visbeck, A. Pirani (eds.)], CLIVAR Special Issue No. 56, Vol. 16, No.2, May 2011.

[11] van der Linden, P., and R. Saunders, ESA Climate Change Initiative: Challenging climate models with observations, In: WCRP Coupled Model Intercomparison Project - Phase 5 - CMIP5 [J. Hurrell, M. Visbeck, A. Pirani (eds.)], CLIVAR Special Issue No. 56, Vol. 16, No.2, May 2011.

[12] Knutti, R., G. Abramowitz, M. Collins, V. Eyring, P.J. Gleckler, B. Hewitson, and L. Mearns: Good Practice Guidance Paper on Assessing and Combining Multi Model Climate Projections. In: Meeting Report of the Intergovernmental Panel on Climate Change Expert Meeting on Assessing and Combining Multi Model Climate Projections [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, and P.M. Midgley (eds.)]. IPCC Working Group I Technical Support Unit, University of Bern, Bern, Switzerland, 2010.

[13] Hegerl, G.C., O. Hoegh-Guldberg, G. Casassa, M.P. Hoerling, R.S. Kovats, C. Parmesan, D.W. Pierce, P.A. Stott: Good Practice Guidance Paper on Detection and Attribution Related to Anthropogenic Climate Change. In: Meeting Report of the Intergovernmental Panel on Climate Change Expert Meeting on Detection and Attribution of Anthropogenic Climate Change [Stocker, T.F., C.B. Field, D. Qin, V. Barros, G.-K. Plattner, M. Tignor, P.M. Midgley, and K.L. Ebi (eds.)]. IPCC Working Group I Technical Support Unit, University of Bern, Bern, Switzerland, 2010.

[14] Websites of the IPCC Special Report on Renewable Energy Source and Climate Change Mitigation: http://srren.ipcc-wg3.de/

[15] Websites of the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: http://www.ipcc-wg2.gov/AR5/extremes-sr/index.html

[16] Decisions with respect to the "Review of IPCC processes and procedures", taken at the Thirty-third Session of the IPCC, Abu Dhabi, United Arab Emirates, 10–13 May 2011: http://www.ipcc.ch/scripts/_session_template.php?page=_33ipcc.htm

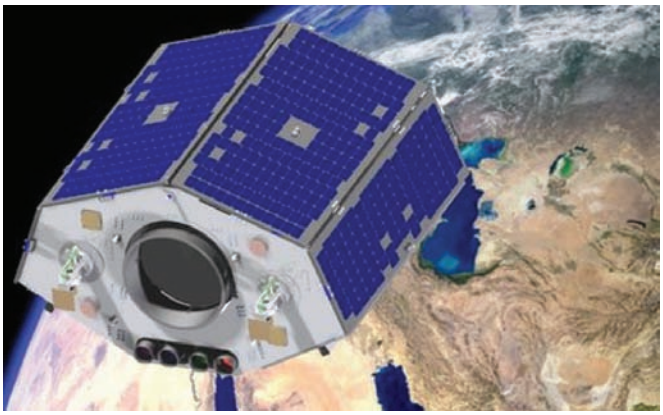
NEW SATELLITE MISSIONS

NIGERIA SUCCESSFULLY LAUNCHED NIGERIASAT-2 AND NIGERIASAT-X

Source: NigeriansAbroad.com and SSLT news release

NigeriaSat-2 and NigeriaSat-X satellites were successfully launched on the 17th of August onboard a Dnepr rocket from Yasny in southern Russia. The highly advanced Earth observation satellites will significantly boost African capabilities for natural resource management, as well as aid disaster relief through the Disaster Monitoring Constellation (DMC). Following confirmation of separation from the launch vehicle, ground stations in Guildford and Abuja established contact with NigeriaSat-2 and NigeriaSat-X respectively and commissioning of the satellites in their 686 km sun-synchronous orbit was progressing well.

The two satellites, built under contract with the Nigerian National Space Research and Development Agency (NASRDA), will provide Nigeria with the ability to enhance food security through monthly crop monitoring, assist with burgeoning urban planning demands and, through the development of engineering skills, will advance the growth of new technologies in Nigeria.



NigeriaSat-2, one of the most advanced Earth observation small satellites launched, will provide high-resolution images (2.5-metres panchromatic and 5–meters multispectral). 26 Nigerian engineers have worked alongside Surrey Satellite Technology Ltd (SSTL) engineers in Guildford, assembling the accompanying 100kg NigeriaSat-X. After completion of the commissioning phase, the new generation of Nigerian scientists at NASRDA will control both satellites from their ground station in Abuja, thus ensuring its continued success and sustainability..

SSTL Executive Chairman, Sir Martin Sweeting, commented: "*NigeriaSat-X is the product of Nigeria's training and development programme here at Surrey. It is a great credit to NASRDA and their engineers that this satellite is performing well and its operations are progressing so quickly. These highly skilled engineers will not only help Nigeria to manage its resources, but also bootstrap its fledgling high tech economy alongside a growing nucleus of highly trained people.*"

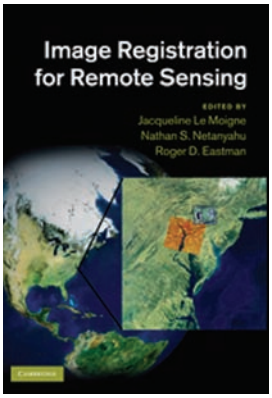
President Goodluck Jonathan, the President of Nigeria on his part while reacting to the successfully launching praised the country's team of engineers and their partners. "*I congratulate our nation for this new chapter in our transformational efforts as we strive for self reliance. Let me also congratulate the resourceful Nigerians who made this history possible.*" The president further urges professionals in both the public and private sector to take advantage of the new space technology for improve planning and policy undertaking. In a similar statement, and quoted by SSTL, NASRDA head, Dr S.O Mohammed, said: "*This is a great day for the Nigerian space industry and builds on the success of NigeriaSat-1, launched in 2003*".

To know more about NigeriaSat-2 and its future operations, visit www.sstl.co.uk/

BOOK REVIEW

IMAGE REGISTRATION FOR REMOTE SENSING

Gabriele Moser, Department of Biophysical and Electronic Engineering (DIBE), University of Genoa, Italy



Edited by Jacqueline Le Moigne, Nathan S. Netanyahu, and Roger D. Eastman
Cambridge University Press, March 2011
(ISBN: 978-0-521-51611-2)

The book *Image Registration for Remote Sensing* addresses the main issues involved in the registration of multiple remotely sensed images, a very important and topical subject because of the current availability of data from many heterogeneous satellite sensors. The book is a collection of 23 chapters, edited by three leading scientists and written by 36 experts in the field. It is structured into five parts. Part I is primarily devoted to introductory and survey aspects; Parts II and III are essentially methodological; Part IV primarily focuses on currently operational remote-sensing systems; and Part V reports conclusions. A remarkable feature is that not only techniques and algorithms but also operational aspects are presented, thus giving the reader a picture of the registration subject in both its methodological and real-world facets.

Part I comprises the first three chapters. Chapter 1 clearly introduces the registration problem, its role in remote sensing, its challenges, and how its subproblems (feature extraction, matching, geometrical transformations, etc.) are mapped through the structure of the book. This introduction is well complemented by Chapter 2, which offers an interesting example of the importance of registration in the framework of MODIS biophysical products. Chapter 3 presents an excellent analysis of the state of the art for image registration, providing a broad overview of the key approaches, many of which are detailed in later chapters. One characteristic that further helps the reader to grasp the real-world aspects of the problem is the focus on the roles of the involved communities (image-processing specialists, ground-support satellite teams, users).

Part II (Chapters 4–6) deals with similarity metrics for registration. Correlation-based approaches in the space and frequency domains, from classical correlation operators to more advanced phase-correlation techniques, are introduced in Chapter 4 in a didactically clear manner. Related topics are treated in Chapter 5, which describes matched-filtering approaches and also covers techniques based on Fourier-Mellin transforms. Altogether, Chapters 4 and 5 provide a comprehensive description of correlation and Fourier-based registration methods. The discussion of similarity metrics is completed by Chapter 6, in which the use of the mutual-information functional is clearly presented, from basic information-theory concepts to more advanced numerical-maximization issues.

Part III (Chapters 7–13) focuses on feature extraction and matching for registration, and it includes quite diverse contributions, ranging from introductory to rather specific content and thus providing a comprehensive picture of classical and more advanced methods. Chapters 11 and 12 offer excellent introductions to wavelet feature extraction and gradient-descent matching, respectively. In Chapter 11, wavelets are recalled, and the issues associated with their use in registration (e.g., shift or rotational invariance) are investigated. Chapter 12 complements Part I by examining a number of gradient-like techniques to be applied to similarity metrics. As expected, several chapters in Part III deal with the important framework of feature-point approaches to registration. Chapter 10 provides a clear explanation of feature-point detection and matching, presenting both the state of the art and advanced contributions. Chapter 8 proposes an interesting feature-point algorithm by integrating wavelets, branch-and-bound search, and metrics robust to outliers. Chapter 9 presents a stimulating discussion of geometric transformations used for point matching from the perspective of condition theory, also outlining the relationships with corner detection. In Chapter 7, the problem of geometric modeling for aligning control points in multiview images is tackled from an interesting approximation-theory viewpoint. The problem of assessing registration performances is addressed in Chapter 13 by developing valuable theoretical benchmarks (essentially Cramér-Rao bounds) for several geometrical transformations.

Part IV (Chapters 14–22) focuses on applicative and operational aspects. It opens with Chapter 14, which outlines a framework for multitemporal and multisensor image registration, thoroughly testing several combinations of feature extraction and matching techniques and nicely bridging

the methodological and the applicative parts of the book. The other chapters in Part IV describe automated or semiautomated operational systems currently in use with several passive spaceborne sensors, including GOES, METEOSAT, and other meteorological sensors (Chapter 15), MISR (Chapter 16), AVHRR (Chapter 17), Landsat TM and ETM+ (Chapter 18), SPOT-HRS and VEGETATION (Chapters 19 and 20), MODIS (Chapter 21), and SeaWiFS (Chapter 22). These contributions offer excellent examples of real systems, spanning from high to low resolution and encompassing a number of diverse applications. It is especially stimulating to see how techniques explained in methodological terms earlier in the book (e.g., correlation, mutual information) may fit within the peculiarities of each mission, including, for instance, spacecraft stabilization, multiangle acquisition, satellite-attitude estimation, modeling of the sensor imaging geometry, use and generation of reference databases, the role of ancillary data, and multitemporal application requirements.

Finally, Part V consists of Chapter 23, which draws general conclusions and outlines the main future directions.

The book explains the main image-registration issues involved in remote sensing in a comprehensive, convincing, and well-written manner. The coverage of the topic is excellent, and experimental examples with simulated and real data are also shown in most chapters. The reading is accessible to both specialists and nonspecialists, including students. Stimulating discussions on scientific and applicative challenges, possible solution strategies, and the accuracy, optimality, and efficiency of such strategies can be found throughout the book and make it an outstanding treatise that can be extremely interesting to a wide audience.

Gabriele Moser

Gabriele received the *laurea* (M.Sc.) degree in telecommunications engineering and the Ph.D. degree in space sciences and engineering from the University of Genoa, Genoa, Italy, in 2001 and 2005, respectively. Since 2001, he has cooperated with the Signal Processing and Telecommunications Research Group (SP&T) of the Department of Biophysical and Electronic Engineering (DIBE), University of Genoa, in the field of remote-sensing image analysis. From January to March 2004, he was a visiting student at the *Institut National de Recherche en Informatique et en Automatique* (INRIA), Sophia Antipolis, France, working with the "Ariana" research group on the problem of SAR data modeling. He is currently an Assistant Professor of Telecommunications at the University of Genoa.

His research focuses on image-processing and pattern-recognition methodologies for remote-sensing data interpretation. In particular, his current research interests include SAR data analysis, multitemporal image classification, hyperspectral image analysis, contextual classification, kernel-based methods, and geo/biophysical parameter estimation. He has been a reviewer for several international journals. Since 2008 and March 2011, he has been an Associate Editor of *IEEE Geoscience and Remote Sensing Letters and Pattern Recognition Letters*, respectively.

(President's Message continued from page 3)

increase in all of their impact factors as compared to last year, the number of active chapters spread all over the world has been increasing steadily, and the five technical committees of the GRSS have been very successful. Furthermore, the GRSS Newsletter under the outstanding leadership of its Editor, Prof. Lorenzo Bruzzone, is a great success. Because of its success, the GRSS is exploring turning the Newsletter into a magazine, which could potentially happen in the next few years.

The IEEE President, Prof. Moshe Kam, participated in the opening session of IGARSS 2011 and congratulated the GRSS on leading the way in many important initiatives. As an example, President Kam took note of the fact that IGARSS 2011 was the first IEEE conference to be broadcast live in its entirety over the internet. This means that all 10 parallel oral sessions and the plenary and opening sessions were video broadcast over the internet. This truly pioneering initiative was organized by GRSS Vice President of Information Resources, Prof. Steve Reising, who also trained a group of volunteers to do the task. We appreciate the help of the University of British Columbia (UBC) which recruited a local team of over 75 volunteers. As an example of the success of the live broadcast, 1900 unique users watched it over the five days.

My congratulations and sincere thanks go to all of our colleagues involved in the organization and running of IGARSS 2011. A special note of thanks goes to Prof. Yoshio Yamaguchi and Prof. Ya-Qui Jin who did a terrific job as co-chairs of the IGARSS technical program. With excellent planning by a highly dedicated organizing committee under the outstanding leadership of General Chair Prof. Motoyuki Sato, IGARSS 2011 became a great success.

During the IGARSS Awards Banquet, Prof. Motoyuki Sato made the hand off to the next IGARSS Co-Chairs, Prof. Alberto Moreira and Dr. Yves-Lois Desnos. IGARSS 2011 will be held in Munich, Germany, July 22–27, 2012. I wish the IGARSS 2012 team great success in getting the organization going underway and I am very much looking forward to meeting you in Munich next year. The abstract submission deadline is January 12, 2012.

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

REPORTS

IGARSS IN VANCOUVER, JULY 25–29, 2011-GRSS MAJOR AWARDS AND FELLOW RECOGNITIONS AT THE PLENARY SESSION

Martti Hallikainen, Werner Wiesbeck, IEEE GRSS Awards Committee Co-Chairs

IGARSS 2011 was originally planned to be held in Sendai, Japan, from August 1 through 5. The severe problems Japan faced after the Tsunami in March 2011 forced the conference local organizers and the GRS Society Administrative Committee to shift the location of the venue from Sendai to Vancouver.

The Welcome Reception was held on Sunday, July 24th in the Vancouver Convention Centre (VCC) providing the attendees an opportunity to meet each other.

IGARSS 2011 was officially opened with the Opening Session and Plenary Session on Monday morning, July 25th. General Chair Motoyuki Sato told about the sad events in the Sendai region using satellite images acquired before and after the tsunami, which hit the area on March 11th. He also reviewed the process to change the venue from Sendai to Vancouver. GRSS President Jon Benediktsson presented the activities of the Geoscience and Remote Sensing Society, which has developed very positively in the recent years. IEEE President Moshe Kam provided information on IEEE, which is the world's largest professional association advancing technology for the benefit of humanity. It supports the professional interests of more than 400,000 members. Monique Bernier, National Chair of Canadian Remote Sensing Society, gave a welcome speech on behalf of CRSS.

Figure 1. The Vancouver Convention Centre (VCC) served as venue for IGARSS 2011.

The Opening Session was chosen for the recognition five 2011 IEEE GRSS Fellows (another five were not able to be present) as well as for presentation of three IEEE GRSS Major Awards and the IEEE Judith A. Resnik Award Award by IEEE President Moshe Kam and GRSS President Jon Atli Benediktsson. The Awards Ceremony was conducted by GRSS Awards Co-Chair Martti Hallikainen.

Figure 2. IGARSS 2011 General Chair Motoyuki Sato opens the Symposium.

Figure 3. President Jon Atli Benediktsson provides an insight to our GRS Society.

Figure 4. IEEE President Moshe Kam introduces IEEE and its recent developments.

Figure 5. National Chair of Canadian Remote Sensing Society Monique Bernier discusses CRSS activities.

IEEE Judith A. Resnik Award

The IEEE Judith A. Resnik Award was established by the IEEE Board of Directors in 1986 to recognize an individual or a team for outstanding contributions to space engineering, within the fields of interest of the IEEE. The Award is named in honor of IEEE Member Judith Resnik, who was a Mission Specialist on the NASA Space Shuttle Challenger, which exploded in 1986. In the evaluation process, the following criteria are considered: developments, inventions, systems or methods of significance in the field of space engineering for which candidate deserves principal credit, and the quality of the nomination. The award consists of a bronze medal, certificate and honorarium.

In 2011 the **IEEE Judith A. Resnik Award** is presented to **Prof. Kamal Sarabandi,** Director of the Radiation Laboratory, University of Michigan, MI, USA with the citation

"For contributions to space-based, microwave and millimeter polarimetric radar remote sensing of the Earth's surface for civilian and military applications."

Kamal Sarabandi (S'87–M'90–SM'92–F'00) received the B.S. degree in electrical engineering from the Sharif University of Technology, Tehran, Iran, in 1980, the M.S. degree in electrical engineering in 1986, and both the M.S. degree in mathematics and the Ph.D. degree in electrical engineering from the University of Michigan at Ann Arbor, in 1989.

He is currently the Director of the Radiation Laboratory and the Rufus S. Teesdale Professor of Engineering in the Department of Electrical Engineering and Computer Science, The University of Michigan at Ann Arbor. His research areas of interest include microwave and millimeter-wave radar remote sensing, Metamaterials, electromagnetic wave propagation, and antenna miniaturization. He possesses 25 years of experience with wave propagation in random media, communication channel modeling, microwave sensors, and radar systems and leads a large research group including two research scientists, 14 Ph.D. students. He has graduated 35 Ph.D. and supervised numerous post-doctoral students. He has served as the Principal Investigator on many projects sponsored by the National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory (JPL), Army Research Office (ARO), Office of Naval Research (ONR), Army Research Laboratory (ARL), National Science Foundation (NSF), Defense Advanced Research Projects Agency (DARPA), and a large number of industries. Currently he is leading the Center for Microelectronics and Sensors funded by the Army Research Laboratory under the Micro-Autonomous Systems and Technology (MAST) Collaborative Technology Alliance (CTA) program. He has published many book chapters and more than

Figure 6. The Opening Session is well attended. In the foreground is Prof. Martti Tiuri, IEEE GRSS Fellow and member of the Finnish Parliament for many years.

180 papers in refereed journals on miniaturized and onchip antennas, metamaterials, electromagnetic scattering, wireless channel modeling, random media modeling, microwave measurement techniques, radar calibration, inverse scattering problems, and microwave sensors. He has also had more than 420 papers and invited presentations in many national and international conferences and symposia on similar subjects.

Dr. Sarabandi served as a member of NASA Advisory Council appointed by the NASA Administrator in two consecutive terms from 2006–2010. He is serving as a vice president of the IEEE Geoscience and Remote Sensing Society (GRSS) and is a member of the Editorial Board of the Proceedings of the IEEE. He was an associate editor of the IEEE Transactions on Antennas and Propagation and the IEEE Sensors Journal. He is a member of Commissions F and D of URSI and is listed in American Men and Women of Science, Who's Who in America, and Who's Who in Science and Engineering. Dr. Sarabandi was the recipient of the Henry Russel Award from the Regent of The University of Michigan. In 1999 he received a GAAC Distinguished Lecturer Award from the German Federal Ministry for Education, Science, and Technology. He was also a recipient of the 1996 EECS Department Teaching Excellence Award and a 2004 College of Engineering Research Excellence Award. In 2005 he received the IEEE GRSS Distinguished Achievement Award and the University of Michigan Faculty Recognition Award. He also received the best paper Award at the 2006 Army Science Conference. In 2008 he was awarded a Humboldt Research Award from The Alexander von Humboldt Foundation of Germany and received the best paper award at the IEEE Geoscience and Remote Sensing Symposium. He was also awarded the 2010 Distinguished Faculty Achievement Award from the University of Michigan. The IEEE Board of Directors announced him as the recipient of the 2011 IEEE Judith A. Resnik medal.

Figure 8. Kamal Sarabandi (left) receives the IEEE Judith A. Resnik Award from IEEE President Moshe Kam. GRSS President Jon Atli Benediktsson is in the background.

In the past several years, joint papers presented by his students at a number of international symposia (IEEE APS'95, '97,'00,'01,'03,'05,'06,'07; IEEE IGARSS'99,'02,'07; IEEE IMS'01, USNC URSI'04,'05,'06,'10, AMTA '06, URSI GA 2008) have received best paper awards.

IEEE Fellow Awards

The grade of IEEE Fellow recognizes unusual distinction in the profession and shall be conferred only by invitation of the IEEE Board of Directors upon a person of outstanding and extraordinary qualifications and experience in IEEE designated fields. The IEEE Bylaws limit the number of members who can be advanced to Fellow grade in any one year to one per mil, that is 1 in 1.000, of the Institute membership, exclusive of students and affiliates. To qualify, the candidate must be a Senior Member and be nominated by an individual

Figure 7. GRSS Awards Co-Chair Martti Hallikainen chaired the Awards Ceremony.

Figure 9. Adriano Camps (middle) receives his recognition from IEEE President Moshe Kam (left) and GRSS President Jon Atli Benediktsson (right).

familiar with the candidate's achievements. Endorsements are required from at least five IEEE Fellows and an IEEE Society best qualified to judge. The IEEE Fellow Committee, comprising 50 IEEE Fellows, carefully evaluates all nominations and presents a list of recommended candidates to the IEEE Board of Directors for the final election.

The following GRSS members were elevated to the Fellow status effective January 1st 2011:

- **Prof. Adriano Camps from the Technical University of Catalunya, Barcelona, Spain**
- **Prof. Anthony Milne from the University of South Wales, Sydney, Australia**
- **Prof. Eric Pottier from the University of Rennes 1, Rennes, France**
- **Dr. Paul Rosen from the Jet Propulsion Laboratory, Pasadena, CA, USA**
- **Dr. Masanobu Shimada from Japan Aerospace Exploration Agency, Tsukuba, Japan**

Prof. Adriano Camps received his Fellow Award with the citation:

***"For contributions to microwave remote sensing of* land and sea surfaces."**

Adriano Camps (S'91–A'97–M'00–SM'03–F'11) was born in Barcelona, Spain, in 1969. He received the degree in telecommunications engineering and Ph.D. degree in telecommunications engineering from the Universitat Politècnica de Catalunya (UPC), Barcelona, Spain, in 1992 and 1996, respectively. In 1991 to 1992, he was at the ENS des Télécommunications de Bretagne, France, with an Erasmus Fellowship. Since 1993, he has been with the Electromagnetics and Photonics Engineering Group, Department of Signal Theory and Communications, UPC, where he was first Assistant Professor, Associate Professor in 1997, and Full Professor since 2007. In 1999, he was on sabbatical leave at the Microwave Remote Sensing Laboratory, of the University of Massachusetts, Amherst. Since 1993, he has been deeply involved in the European Space Agency SMOS Earth Explorer Mission, from the instrument and algorithmic points of view, performing field experiments, and more recently studying the use of GNSS-R techniques to perform the sea state correction needed to retrieve salinity from radiometric observations. His research interests are focused in microwave remote sensing, with special emphasis in microwave radiometry by aperture synthesis techniques and remote sensing using signals of opportunity (GNSS-R).

Dr. Camps was Chair of uCal 2001, Technical Program Committee Co-Chair of IGARSS 2007, and Co-Chair of GNSS-R '10. Currently, he is Associate Editor of *Radio Science* and the IEEE Transactions on Geoscience and Remote Sensing, and President-Founder of the IEEE Geoscience and Remote Sensing Society Chapter at Spain. In 1993, he received the Second National Award of University Studies; in 1997, the INDRA award of the Spanish Association of Telecommunication Engineers to the best Ph.D. in Remote Sensing; in 1999 the Extraordinary Ph.D. Award at the Universitat Politècnica de Catalunya; in 2002, the Research Distinction of the Generalitat de Catalunya for contributions to microwave passive remote sensing; and in 2004 he received a European Young Investigator Award, and in 2009 the ICREA Academia award. Moreover, as a member of the Microwave Radiometry Group, UPC, he received in 2000, 2001, and 2004: the 1st Duran Farell and the Ciutat de Barcelona awards for Technology Transfer, and the "Salvà i Campillo" Award of the Professional Association of Telecommunication Engineers of Catalonia for the most innovative research project for MIRAS/SMOS related activities, and in 2010 the 7th Duran Farell award for Technological Research for the work on GNSS-R instrumentation and applications. He has published more than 100 papers

Figure 10. Anthony Milne (middle) receives his Fellow recognition from IEEE President Moshe Kam (left) and GRSS President Jon Atli Benediktsson (right).

Figure 11. Eric Pottier (middle) receives his recognition from IEEE President Moshe Kam (left) and GRSS President Jon Atli Benediktsson (right).

in peer-reviewed journals, and more than 230 international conference presentations.

Prof. Antony Milne received his Fellow Award with the citation:

"For leadership in remote sensing applications."

Anthony Milne (M'99-SM'05) received a B.A. in Geography from the University of New England (Australia) in 1968; a M.A.(Hons) in Geomorphology from the University of Sydney in 1972 and a Ph.D. in Geography and Remote Sensing from the University of Colorado in 1977. He taught at the University of New South Wales in Sydney and was the University Director of the Office of Postgraduate Studies from 1990–2001. From 2003–2009 he was the Remote Sensing Science Manager of the Australian Cooperative Research Centre for Spatial Information. From 2004–2008 he acted as a Science Advisor to the Council of the International Society of Photogrammetry and Remote Sensing.

He is now Visiting Professor of Geography and Remote Sensing in the School of Biological, Earth and Environmental Sciences at the University of New South Wales and Co-Director of a private company, Horizon Geoscience Consulting Pty. Ltd., founded in 2002.

Anthony Milne has been a Principal Investigator in international research programs including: the NASA SIR-B and SIR-C radar missions, AIRSAR (USA), ERS-1 and ERS-2, ENVISAT(ESA), JERS-1, ALOS PALSAR (Japan) and MOMS (Germany) and was Co-Chairman of three NASA AIRSAR Missions to Australia, South East Asia and the Pacific between 1994 and 2000 involving some18 Asian-Pacific countries. He is currently a member of the Science Team for the Japanese Space Agency's ALOS Kyoto and Carbon Initiative Research Program. His research interests lie in radar remote sensing, vegetation assessment and the mapping of wetlands. Recent research projects include Papua New Guinea Forest Assessment; GEOSS related forest and carbon assessment programs in Tasmania, and radar research into mapping flood patterns, vegetation condition and the distribution of coastal and semi-arid riverine wetlands. He was President of IEEE-GRSS during 2008 and 2009.

Prof. Eric Pottier received his Fellow Award with the citation:

"For contributions to polarimetric specific absorption rate"

Eric Pottier (M'95, SM'06, F'11) received the MSc and Ph.D. in signal processing and telecommunication from the University of Rennes 1, respectively in 1987 and 1990, and the Habilitation from the University of Nantes in 1998.

Since 1999, he has been a Full Professor at the University of Rennes 1, France, where he is currently the Deputy Director of the Institute of Electronics and Telecommunications of Rennes (I.E.T.R – CNRS UMR 6164) and also Head of the Image and Remote Sensing Group – SAPHIR Team. His current activities of research and education are centered

Figure 12. Paul Rosen (middle) receives his recognition from IEEE (President Moshe Kam (left) and GRSS President Jon Atli Benediktsson) (right)).

in the topics of analog electronics, microwave theory and radar imaging with emphasis in radar polarimetry. His research covers a wide spectrum of areas from radar image processing (SAR, ISAR), polarimetric scattering modeling, supervised/unsupervised polarimetric segmentation and classification to fundamentals and basic theory of polarimetry.

Since 1989, he has supervised more than 45 research students to graduation (MSc and PhD) in Radar Polarimetry covering areas from theory to remote sensing applications. He has chaired and organized more than 50 sessions in International Conferences and was member of the Technical and Scientific Committees of more than 35 International Symposium or Conferences. He has been invited to present 48 presentations in International Conferences. He has published 9 chapters in books, more than 50 papers in refereed journals and presented more than 340 papers during International Conferences, Symposiums and Workshops. He has presented advances courses and seminars on Radar Polarimetry to a wide range of organizations (DLR, NASDA, JRC, RESTEC, IECAS, INPE, ASF) and events (ISAP2000, EUSAR04-06-10, NATO-04-06, PolInSAR05-11, JAXA06, IGARSS03-05-07-08-09-10-11).

He has published a book co-authored with Dr. Jong-Sen Lee: *Polarimetric Radar Imaging: From basics to applications*", CRC Press, Taylor & Francis editor, 397 pages, January. 2009, ISBN: 978-1-4200-5497-2. He was presented the Best Paper Award at the Third European Conference on Synthetic Aperture Radar (EUSAR2000) and received the 2007 IEEE GRSS Letters Prize Paper Award. He is a recipient of the 2007 IEEE GRSS Education Award "*In recognition of his significant educational contributions to Geoscience and Remote Sensing*"

Figure 13. Masanobu Shimada (middle) receives his recognition from IEEE President Moshe Kam (left) and GRSS President Jon Atli Benediktsson (right).

Dr. Paul Rosen received his Fellow Award with the citation:

"For contributions to Earth and planetary radar remote sensing."

Paul Rosen is currently the manager of the Radar Science and Engineering Section and acting as Pre-Project Scientist for the DESDynI Mission at the Jet Propulsion Laboratory, where he has been on staff since 1992. He is also a visiting faculty member and lecturer at the Division of Geological and Planetary Sciences at Caltech, and has served on the UCLA Extension Program faculty. He was recently elected Fellow of the IEEE, and is a member of the American Geophysical Union. He has authored and co-authored over 40 journal and book chapter publications, and over 100 conference papers. His assignments at JPL have centered on scientific and engineering research and development of radar instruments and applications, notably applications and techniques for repeat-pass interferometry. Dr. Rosen was a team leader on the Shuttle Radar Topography Mission, for which he received NASA's Exceptional Service Medal (2001) and NASA's Exceptional Achievement Medal (2002). Prior to JPL, Dr. Rosen spent two years as a Research Associate at Kanazawa University, Kanazawa, Japan. He received a PhD in Electrical Engineering from Stanford University and his M.S. and B.S in Electrical Engineering from University of Pennsylvania.

Dr. Masanobu Shimada received his Fellow Award with the citation:

"For contributions to radar remote sensing technologies."

Masanobu Shimada (M'97-SM'04-F'11) received the BS and MS degrees in aeronautical engineering from Kyoto University in 1977 and 1979, and the PhD degree in electrical engineering from the University of Tokyo in 1999. He joined the National Space Development Agency of Japan (NASDA, former Japan Aerospace Exploration Agency (JAXA)) in 1979, and he designed NASDA scatterometer by 1985. From 1985 to 1995, he developed data processing systems for optical and SAR data (MOS-1, SPOT, and JERS-1) at the Earth Observation Center. He was a one-year visiting scientist at the Jet Propulsion Laboratory in 1990. After launch of JERS-1 in 1992, he was in charge of the

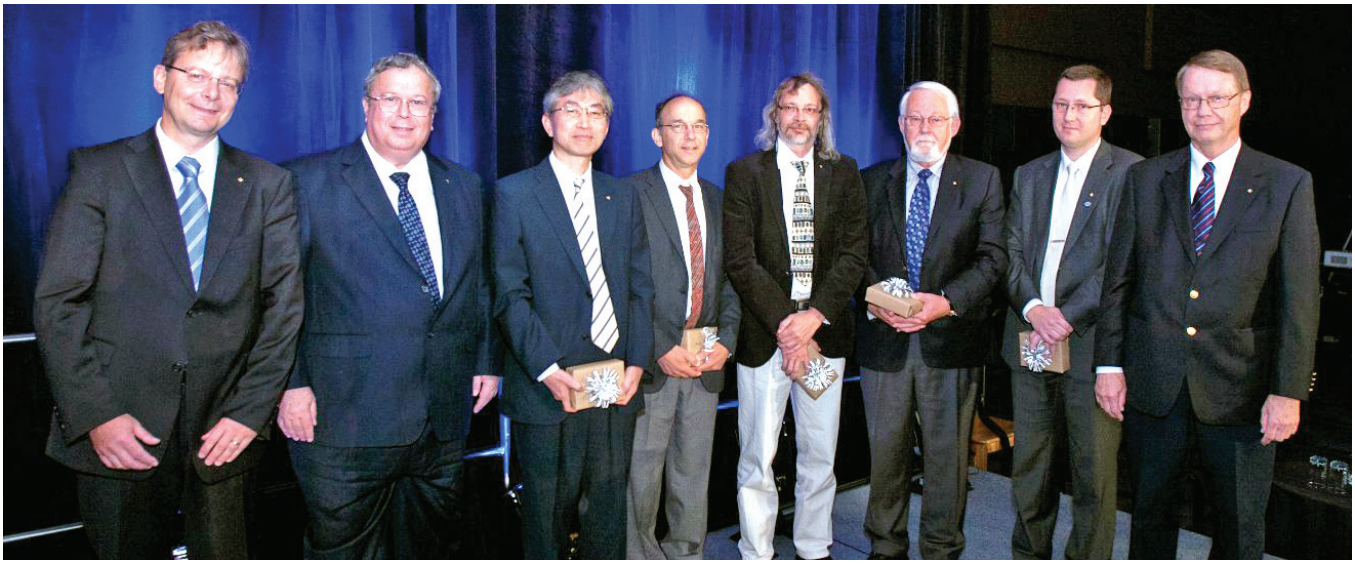


Figure 14. The five 2011 IEEE GRSS Fellows Masanobu Shimada, Paul Rosen, Eric Pottier, Anthony Milne and Adriano Camps with GRSS President Jon Atli Benediktsson (left), IEEE President Moshe Kam (second from left), and GRSS Awards Co-Chair Martti Hallikainen (right).

JERS-1 SAR calibration and validation. From 1995, he has been assigned duties at Earth Observation Research Center (EORC), where he is in charge of the JERS-1 Science project (Global rainforest and boreal forest mapping project and SAR interferometry project). He also developed a polarimetric airborne SAR and calibrated the Ocean Color Temperature Scanner (OCTS) and AVNIR of Advanced Earth Observing Satellite (ADEOS). In the late 1990s he initiated the ALOS science project, which contains the calibration and validation of the ALOS sensors. He mainly focuses on the PALSAR calibration, validation, and application. He also initiated the Kyoto and Carbon Initiative project for monitoring the forest and wetland using the time series PALSAR mosaics, to where JAXA's systematic ALOS observation scenario strip processing and mosaicking technologies mainly contribute. His main outputs are the global SAR mosaics showing the annual deforestation change and large-scale land surface deformations. After 2008, he has been an Associate Principal Researcher of JAXA and leading the ALOS and ALOS-2 science projects. His current research interests are high resolution imaging for spaceborne and airborne SARs, calibration and validation, and SAR applications including polarimetric SAR interferometry (crustal deformation detection, ionospheric disturbance, polarimetric calibration, and biomass estimation). His own coded SAR processor, SIGMA-SAR, is installed at JAXA standard processing facilities and operationally processes most of the SARs. He has been a member of the CEOS SAR CAL/VAL subgroup since 1992, and served once the chairman in 2001–2003

The following 2011 IEEE Fellows are members of the GRS Society, but were evaluated by another IEEE Society and chose another venue for their recognition:

Dr. Donald Barrick, with citation:

"For development of high-frequency radars and applications."

Dr. Paul Gader, with citation:

"For contributions to computational intelligence algorithms for landmine and explosive object detection."

Dr. Maria Greco, with citation:

"For contributions to non-Gaussian radar clutter modeling and signal processing algorithms."

Dr. Arun Hampapur, with citation:

"For contributions to video indexing, video search and surveillance systems."

Dr. Eric Mokole, with citation:

"For leadership and contributions to ultra-wideband radar, waveform diversity, and transionospheric space radar."

IEEE GRSS Major Awards

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

Figure 15. The 2011 IEEE GRSS Distinguished Achievements Award recipient Thomas Jackson (left) receives from GRSS President Jon Atli Benediktsson a plaque and a certificate.

IEEE GRSS Distinguished Achievement Award

The **Distinguished Achievement Award** was established to recognize an individual who has made significant technical

Figure 16. The 2011 IEEE GRSS Outstanding Service Award recipient Masanobu Shimada (left) with GRSS President Jon Atli Benediktsson.

Figure 17. Richard Bamler (left) receives the 2011 IEEE GRSS Education Award from GRSS President Jon Atli Benediktsson.

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

The **2011 IEEE GRSS Distinguished Achievement Award** is presented to **Dr. Thomas Jackson** from U. S. Department of Agriculture, ARS Hydrology and Remote Sensing Lab, Maryland, USA with the citation:

"For significant contributions to the development of soil moisture remote sensing."

Thomas J. Jackson is a research hydrologist with the U. S. Department of Agriculture, Agricultural Research Service, Hydrology and Remote Sensing Lab. He received a Ph.D. degree from the University of Maryland in 1976. His research involves the application and development of remote sensing technology in hydrology and agriculture, primarily microwave measurement of soil moisture. His investigations have ranged from theory to application and have involved extensive field experimentation utilizing tower, aircraft, and satellite platforms. He is or has been a member of the science and validation teams of the Aqua, ADEOS-II, Radarsat, Oceansat-1, Envisat, ALOS, SMOS, Aquarius, GCOM-W, SAOCOM, and the Soil Moisture Active Passive (SMAP) remote sensing satellites. For SMAP he is the Science Development Team Lead for calibration and validation. He is a Fellow of the IEEE, the Society of Photo-Optical Instrumentation Engineers, the American Meteorological Society, and the American Geophysical Union. In 2003 he received the William T. Pecora Award (NASA and Dept. of Interior) for outstanding contributions toward understanding the Earth by means of remote sensing and the AGU Hydrologic Sciences Award for outstanding contributions to the science of hydrology. Dr. Jackson is a member of the IEEE Geoscience and Remote Sensing Administrative Committee.

IEEE GRSS Outstanding Service Award

The **Outstanding Service Award** was established to recognize an individual who has given outstanding service for the benefit and advancement of the Geoscience and Remote

Figure 18. The three IEEE GRSS Major Award recipients pose with GRSS President Jon Atli Benediktsson (left) and GRSS Awards Co-Chair Martti Hallikainen (right); Richard Bamler, Masanobu Shimada and Thomas Jackson.

Sensing Society. The award shall be considered annually but will not be presented unless a suitable candidate is identified. The following factors are suggested for consideration: leadership innovation, activity, service, duration, breadth of participation and cooperation. GRSS membership is required. The awardee receives a certificate.

The **2011 Outstanding Service Award** is presented to **Dr. Masanobu Shimada** from the Japan Aerospace Exploration Agency (JAXA), EORC, Tsukuba, Ibaraki, Japan with the citation:

"**In recognition of his outstanding service for the benefit and advancement of the IEEE Geoscience and Remote Sensing Society.**"

Masanobu Shimada (M'97-SM'04-F'11) received the BS and MS degrees in aeronautical engineering from Kyoto University in 1977 and 1979, and the PhD degree in electrical engineering from the University of Tokyo in 1999. He joined the National Space Development Agency of Japan (NASDA, former Japan Aerospace Exploration Agency (JAXA)) in 1979, and he designed NASDA scatterometer by 1985. From 1985 to 1995, he developed data processing systems for optical and SAR data (MOS-1, SPOT, and JERS-1) at the Earth Observation Center. He was a one-year visiting scientist at the Jet Propulsion Laboratory in 1990. After launch of JERS-1 in 1992, he was in charge of the JERS-1 SAR calibration and validation. From 1995, he has been assigned duties at Earth Observation Research Center (EORC), where he is in charge of the JERS-1 Science project (Global rainforest and boreal forest mapping project and SAR interferometry project). He also developed a polarimetric airborne SAR and calibrated the Ocean Color Temperature Scanner (OCTS) and AVNIR of Advanced Earth Observing Satellite (ADEOS). In the late 1990s he initiated the ALOS science project, which contains the calibration and validation of the ALOS sensors. He mainly focuses on the PALSAR calibration, validation, and application. He also initiated the Kyoto and Carbon Initiative project for monitoring the forest and wetland using the time series PALSAR mosaics, to where JAXA's systematic ALOS observation scenario strip processing and mosaicking technologies mainly contribute.

Figure 19. IGARSS 2011 Technical Program Co-Chair Yoshio Yamaguchi gives an introduction to the Symposium.

Figure 20. Happy faces of Plenary speakers, chairs and awardees (from left): Martti Hallikainen, David Goodenough (Chair of Plenary Session), Melba Crawford (Chair of Opening Session), Jon Atli Benediktsson, Motoyuki Sato, Monique Bernier, Kamal Sarabandi, Shoichiro Fukao, Luc Brûlé, and Yoshio Yamaguchi.

His main outputs are the global SAR mosaics showing the annual deforestation change and large-scale land surface deformations. After 2008, He has been an Associate Principal Researcher of JAXA and leading the ALOS and ALOS-2 science projects. His current research interests are high resolution imaging for spaceborne and airborne SARs, calibration and validation, and SAR applications including polarimetric SAR interferometry (crustal deformation detection, ionospheric disturbance, polarimetric calibration, and biomass estimation). His own coded SAR processor, SIGMA-SAR, is installed at JAXA standard processing facilities and operationally processes most of the SARs. He has been a member of the CEOS SAR CAL/VAL subgroup since 1992, and served once the chairman in 2001–2003.

IEEE GRSS Education Award

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

The **2011 Education Award** is presented to **Prof. Richard Bamler** from the German Aerospace Center (DLR), Oberpfaffenhofen, Germany with the citation:

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

Richard Bamler (M'95–SM'00–F'05) received his Diploma degree in Electrical Engineering, his Doctorate in Engineering, and his "Habilitation" in the field of signal and systems theory in 1980, 1986, and 1988, respectively, from the Technische Universität München, Germany.

He worked at the university from 1981 to 1989 on optical signal processing, holography, wave propagation, and tomography. He joined the German Aerospace Center (DLR), Oberpfaffenhofen, in 1989, where he is currently the Director of the Remote Sensing Technology Institute.

In early 1994, Richard Bamler was a visiting scientist at Jet Propulsion Laboratory (JPL) in preparation of the SIC-C/X-SAR missions, and in 1996 he was guest professor at the University of Innsbruck. Since 2003 he has held a full professorship in remote sensing technology at the Technische Universität München as a double appointment with his DLR position. His teaching activities include university lectures and courses on signal processing, estimation theory, and SAR. Currently he is supervisor to 18 PhD students. Since 2010 he has been a member of the executive board of Munich Aerospace, a newly founded research and education project between Munich universities and extramural research institutions, incl. DLR.

Since he joined DLR Richard Bamler, his team, and his institute have been working on SAR and optical remote sensing, image analysis and understanding, stereo reconstruction, computer vision, ocean color, passive and active atmospheric sounding, and laboratory spectrometry. They were and are responsible for the development of the operational processors for SIR-C/X-SAR, SRTM, TerraSAR-X, TanDEM-X, ERS-2/GOME, ENVISAT/SCIAMACHY, MetOp/GOME-2, and EnMAP.

Richard Bamler's current research interests are in algorithms for optimum information extraction from remote sensing data with emphasis on SAR. This involves new estimation algorithms, like sparse reconstruction and compressive sensing. He has devised several high-precision algorithms for mono-static and bi-static SAR processing, SAR calibration and product validation, GMTI for traffic monitoring, SAR interferometry, phase unwrapping, persistent scatterer interferometry, and differential SAR tomography.

Richard Bamler is the author of more than 200 scientific publications, among them about 45 journal papers, a book on multidimensional linear systems theory, and holds eight patents and patent applications in remote sensing.

After the break three keynote presentations were given. Dr. Masanobu Shimada, JAXA Principal Scientist and Science Program Leader of ALOS and ALOS-2, gave a talk entitled "ALOS, Earth monitoring, and 'Sayonara'"; Dr. Shoichiro Fukao, Fukui University of Technology / Research Institute for Sustainable Humanosphere, Kyoto University, discussed "Advances in science and techniques for ground-based radar remote-sensing of the Earth's atmosphere"; and Mr. Luc Brûlé, Director General, Space Utilization, Canadian Space Agency, discussed "The evolution of Earth Observation in Canada – A perspective".

Finally, IGARSS 2011 Technical Program Co-Chair Yoshio Yamaguchi provided practical information on the Symposium. He also gave some preliminary figures concerning Symposium attendance: 2222 submitted papers, 1496 presentations in 248 sessions, 173 oral sessions out of which 58 invited, and 75 interactive sessions. Based on the country of the first author, China and the U.S. are by far the most active countries, followed by Japan, Italy, France, Germany, Canada, and Spain.

IGARSS 2012 will be held in Munich, Germany. This is exactly 30 years after IGARSS was held in Munich in 1982. Munich is a wonderful city and IGARSS 2012 is a must for all of us!

MULTITEMP 2011

6th International Workshop on the Analysis of Multi-Temporal Remote Sensing Images
http://www.multitemp2011.org/

Francesca Bovolo and Lorenzo Bruzzone, Department of Information and Communication Technologies, University of Trento, Italy

The 6th International Workshop on the Analysis of MultiTemporal Remote Sensing Images (MultiTemp 2011) was held at the University of Trento, Italy, from 12 to 14 July 2011. This series of workshops was established in Trento in 2001. Since that, a new edition has been organized every 2 years in different countries. From Trento, MultiTemp moved to the Joint Research Centre of the European Commission in Ispra in 2003, to Biloxi in Mississippi (US) in 2005, to Provinciehuis Leuven (Belgium) in 2007, and to Mystic in Connecticut (US) in 2009. Then MultiTemp came back to Trento, Italy, after 10 years for the 6th edition in 2011. In these ten years, as pointed out in the opening talk of the workshop, we had a significant increase in the interest on topics related to the analysis of multitemporal remote sensing images and of time series. In greater detail, we observed a sharp increase in the number of scientific outcomes and products related to multitemporal data. This can be easily realized by considering: i) the high number of papers published on these topics on the major international remote sensing journals; ii) the many special sessions organized on multitemporal topics at international conferences; and iii) the relevant number of projects related to multitemporal images and time series. For the same reasons, the scientific community involved in the MultiTemp workshops had a significant growth in the last years.

The goal of MultiTemp 2011, as that of the previous editions, was to provide a forum of discussion of scientific, methodological, and application issues related to multitemporal remote sensing data analysis. In particular, the workshop aimed at: i) pushing novel methodologies and solutions for technical problems related to the analysis of multitemporal data; ii) promoting the use of the time series in an ever increasing number of scientific studies and challenging applications; and iii) strengthening the connection between the scientific community and the end-users.

The 6th edition of MultiTemp registered more than 100 participants from 25 different countries worldwide.

A total of 107 extended abstracts were submitted to MultiTemp 2011. Each of them was carefully revised by at least 2 members of the Scientific Committee. According to the reviewers' evaluations 78 papers were included in the final program. Table I gives an overview on how accepted papers were distributed among the workshop topics. Among the 78 presented papers we had:

- 2 keynote plenary talks;
- 52 oral presentations distributed among 12 sessions;
- 24 posters distributed among 3 sessions.

Keynote talks were given by outstanding scientists of space agencies and were focused on the new satellite missions that will generate in the future new opportunities for the analysis of multitemporal data and for the study of land-cover dynamics. In detail, Dr. Pier Giorgio Marchetti from European

Figure 1. MultiTemp 2011 participants during one session.

Table I. Number of accepted papers for the different workshop topics.

Topic	# of papers
Image calibration, correction and registration techniques	3
Multitemporal image analysis techniques	6
Classification of multitemporal data	5
Analysis of time series	12
Change detection methods	8
Multitemporal SAR and InSAR data analysis	8
Fusion of multitemporal data	3
Land-cover and land-use dynamics	10
Phenology monitoring	10
Applications of multitemporal data and time series	11
New satellite missions for acquiring time series	2

Figure 2. Welcome reception location in an ancient Augustinian cloister nowadays head office of the Oecd Leed Trento Centre for Local Development, Trento, Italy.

Space Agency gave a talk on "The GMES Sentinel Missions: New Opportunities for Multitemporal Research", whereas Dr. Gerard Dedieu from CNES, France, gave a talk on "The Time Dimension: New Missions and New Processing Chains for Innovative Products and Services".

Among the other 52 oral presentations, 2 were invited overview talks about challenges in the analysis of multitemporal data. The first one was related to the "Status and the Challenges of Multitemporal EO Data Analysis: the Potential of Information Mining" and was given by prof. Mihai Datcu, DLR, Germany. The second one, entitled "Techniques for the Analysis Multitemporal SAR Images: Current Status and Challenges," was focused on the analysis of multitemporal SAR data and was given by prof. Emmanuel Trouvé, Université de Savoie, France.

The Technical Program has been enriched with one time slot for discussion on each day of the workshop, for a total of 3 slots. Thanks to the active contribution of many attendees

Figure 3. Social dinner was in a Castle on Lake Toblino, Trento, Italy.

Figure 4. MultiTemp2011 participants.

we had very interesting and rich discussions, comments and observations on multitemporal topics.

MultiTemp 2011 was organized by the Remote Sensing Laboratory of the University of Trento, received the technical sponsorship from the IEEE Geoscience and Remote Sensing Society, and financial support from the University of Trento, the European Space Agency (ESA), and Vision on Technology (VITO), Belgium.

Beside the Technical Program, MultiTemp2011 offered a great social program. Welcome reception was organized in an ancient Augustinian cloister nowadays head office of the Oecd Leed Trento Centre For Local Development (Figure 2). Social dinner was held in the amazing Toblino Castle, an ancient castle built on the river of Lake Toblino (Figure 3). The participants enjoined the environment and the delicious food. Moreover many attendants decided to enjoy Trento and Italy after the conference.

MultiTemp2011 proceedings are published by IEEE and are thus available on IEEEXplore. In addition, ten years after the first MultiTemp in 2001 and the related first special issue of the IEEE Transactions on Geoscience and Remote Sensing on "Analysis of Multitemporal Remote Sensing Images", MultiTemp 2011 organizers are promoting a new Special Issue of the IEEE Transactions on Geoscience and Remote Sensing on "Analysis of Multitemporal Remote Sensing Data". The call for papers is open to Multitemp 2011 contributors and also to all the scientists developing new techniques for the analysis of multitemporal data, as well as using the results obtained from the automatic analysis of time series on scientific studies and applications. See page 47 of this GRSS Newsletter for details about the call for papers.

We would like to thank all the steering Committee and Scientific Committee members for the effort devoted to revision of the contributions submitted to the workshop. We are grateful to the Local Committee members of the Remote Sensing Laboratory and to the Conference Office of the University of Trento for the valuable support and the great job carried out.

Finally, we encourage everybody to start to work on novel methodologies and applications related the analysis of multitemporal data in order to be ready for the 7th edition of the International Workshop on the Analysis of Multi-Temporal Remote Sensing Images in 2013.

WHISPERS 2011

3rd Workshop on Hyperspectral Image and Signal Processing – Evolution in Remote Sensing
http://www.ieee-whispers.com

José Manuel Bioucas-Dias, Instituto Superior Técnico (IST), Lisbon, Portugal, Antonio Plaza, University of Extremadura, Spain, Jocelyn Chanussot, Grenoble Institute of Technology, France

The Third Workshop on Hyperspectral Image and Signal Processing – Evolution in Remote Sensing (WHISPERS) was held on June 6–9, 2011 at the Instituto Superior Técnico (IST), the largest and most reputed school of Engineering, Science and Technology and Architecture in Portugal. WHISPERS 2011 received the technical sponsorship of the IEEE Geoscience and Remote Sensing Society (GRSS), financial sponsorship from the European Community's Marie Curie Research Training Networks Programme, and support from other institutions, including the Instituto de Telecomunicaçoes at IST, the University of Extremadura, Spain, and the WHISPERS Foundation. Organized in two parallel tracks over three days, the workshop was a great success, gathering around 160 researchers from many different countries worldwide.

After a careful review process, in which each submission received an average of 2.5 anonymous reviews, 126 papers were accepted for presentation and publication in the proceedings of WHISPERS 2011. Of these, 92 were orally presented, while the remaining 34 were presented as posters. Three special sessions were organized on advanced topics for hyperspectral data exploitation, including spectral unmixing, machine learning, and target detection. In addition, WHISPERS 2011 comprised fourteen carefully arranged regular sessions (five on signal and image processing, three on physical modeling, two on sensor design, and five on applications) covering a wide spectrum of techniques. All the papers published at WHISPERS 2011 are available on IEEE Xplore.

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

- Dr. Melba Crawford, from Purdue University, USA, delivered a talk entitled "Nonlinear Manifolds for Feature Extraction: Opportunities and Challenge."
- Dr. Alexander Held, from CSIRO Division of Marine and Atmospheric Research, Canberra Australia, delivered the talk "Coordination of International Spaceborne Imaging Spectroscopy Missions."
- Dr. James Burger, from BurgerMetrics, Riga, Latvia, delivered the talk "The Interplay of Chemometrics and Hyperspectral Chemical Imaging."

A panel discussion on "Data Sets & Performance Measures" was organized by Dr. Paul Gader, from the University of Florida, USA, with other distinguished panelists including

Figure 1. WHISPERS gathered around 160 attendees from many different countries worldwide.

Dr. Jon Atli Benediktsson (President, GRSS), from the University of Iceland, Dr. Melba Crawford (Executive Vice-President, GRSS), from Purdue University, USA, and Dr. David Goodenough, from the University of Victoria / Pacific Forestry Centre, Canada. The discussion focused on standardizing hyperspectral data sets and performance measures for algorithm evaluation and comparison.

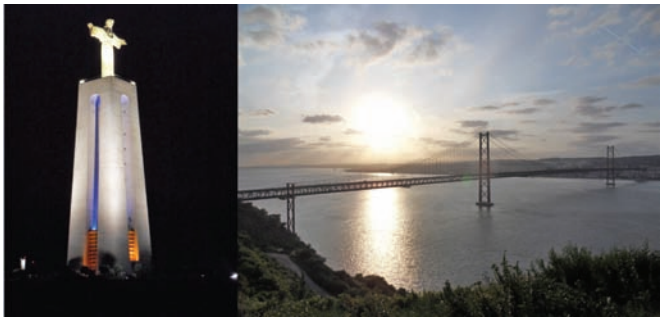


Figure 2. The banquet was held in Almada, next to the Sanctuary of "Cristo Rei" and "25th of April" suspended bridge over Tagus River.

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

- Tsung-Han Chan, Wing-Kin Ma, Arulmurugan Ambikapathi and Chong-Yung Chi for their outstanding contribution "Robust Endmember Extraction Using Worst-Case Simplex Volume Maximization."
- Olga Rajadell, Pedro García-Sevilla, Robert P. W. Duin and Viet C. Dinh for their outstanding contribution "Semi-Supervised Hyperspectral Pixel Classification Using Interactive Labelings."
- Benoit Rivard, Jilu Feng, Vivek Bhushan and Michael Lipsett for their outstanding contribution "Infrared Reflectance Hyperspectral Features of Athabasca Oil Sand Ore and Froth."

In addition, two public PhD defenses of distinguished candidates (Dr. Jun Li, from IST and the University of Extremadura, and Dr. Alberto Villa, from GIPSA-Lab, Grenoble Institute of Technology, and the University of Iceland) were organized during WHISPERS 2011, addressing cutting-edge advances in image and signal processing applied to remotely sensed hyperspectral imaging.

Finally, it is worth noting that a special issue of the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (IEEE-JSTARS) associated to WHISPERS 2011 (but open to everyone working on hyperspectral image and signal processing) will be published. The Guest Editors of the special issue are Dr. Antonio Plaza, University of Extremadura, Spain, Dr. Jose M. Bioucas-Dias, IST, Portugal, Dr. Anita Simic, INRA, EMMAH-Climat, France, and Dr. William J. Blackwell, MIT Lincoln Laboratory, USA.

The aim of the WHISPERS workshop is to bring together all the people involved in spectroscopy and hyperspectral data processing, generally speaking. By "*data*", we mean : **signals**, as provided by spectrometers and processed individually, **images**, from the ground using microscopes and spectrometers to airborne or satellite sensors, up to astrophysical data and **models**: models of the sensors or of the sensed scene, including physical considerations. By "*processing*", we mean everything from the acquisition, the calibration to the analysis. People were invited to submit new research results on the following suggested topics: spectrometers and hyperspectral sensors (design and calibration), physical modeling, physical analysis, noise estimation and reduction, dimension reduction, unmixing, source

Figure 3. Our warmest thanks to our three prestigious plenary speakers: Melba Crawford, Alexander Held and James Burger.

Figure 4. WHISPERS is a venue for cross-fertilization between industrial partners and researchers from the academic world. We would like to thank the companies sponsoring and/or exhibiting their latest products during the event.

separation, endmember extraction, segmentation, classification, high performance computing and compression. Applications-oriented papers were also welcome. As a matter of fact, spectrometry is now used in a wide range of domains, including: airborne and satellite remote sensing, monitoring of the environment, pollution, precision agriculture, chemistry, biomedical imagery, defense application, industrial inspection, food safety, astrophysics.

WHISPERS is also a venue for cross-fertilization between **industrial partners** and researchers from the academic world. We would like to thank the companies sponsoring and/or exhibiting their latest products during the event (Analytical Spectral Devices, Inc., Bonsai Advanced Technologies, Headwall Photonics, HySpex, IM Publications, ITRES, Specim, SpecTIR, Spectral Evolution). They are the leaders in the field and we were very happy to welcome them in Lisbon.

Beyond the technical program, whose quality was highly appreciated by all the attendees, the workshop included some remarkable social events, including an icebreaker reception at IST, and a banquet held at "Quinta Pau de Bandeira" in a Panoramic Tent close to the Sanctuary of "Cristo Rei" and "25th of April" suspended bridge, Almada, South Bank of Tagus River. After a memorable and joyful evening, which included the awards ceremony, an outstanding Fado performance by Teresa Tapadas (regarded as one of the most important Fado performers in Portugal), and a birthday surprise for Dr. Jose Manuel Bioucas-Dias, the participants could enjoy a breathtaking view over Lisbon and the Tagus River.

Lisbon is the city of light. The almost constant presence of sunshine and the River Tagus give rise to a myriad of beautiful color spectra, highlighting the city's unique architecture and beauty. Lisbon is also a historic capital where 800 years of cultural influences mixed with modern trends and different life styles created spectacular contrasts. There are so many things to see and do in Lisbon: simply enjoying its gastronomy, walking through the city, visiting its monuments, mainly from medieval (Romanesque and Gothic) till Baroque and modern periods, visiting the River Tagus, whose riverfront is dedicated to leisure activities and links the monumental zone of Belém with the modern area of the Parque das Nações, and enjoying its landscapes with small mountains and sea shore with nice sandy beaches and beautiful cliffs.

We would like to thank the members of the program committee for their detailed reviews, which enabled a careful selection, ensuring a high quality workshop. We would also like to thank the organizers of the special sessions: they gathered outstanding contributions. Last but not least, we would like to thank everyone from the organizing committee and particularly the volunteers. They are the new generation of hyperspectral imaging and it has been a wonderful experience working with a great team.

After fruitful WHISPERS meetings in Grenoble, France (2009), Reykjavik, Iceland (2010), and Lisbon, Portugal (2011), we are very happy to announce that the 2012 WHISPERS will move from Europe to Asia and will be held in China, in June 2012. It will be hosted by Dr. Qian Du and Prof. Liangpei Zhang. The usual policy will be used: submission of full 4-pages papers and anonymous peer-review to ensure the optimal quality of the technical contributions.

See you in China in June 2012 for the GRSS premier event in the hyperspectral world!

OVERVIEW AND RECENT ACTIVITIES OF THE IEEE GRSS FREQUENCY ALLOCATIONS IN REMOTE SENSING (FARS) TECHNICAL COMMITTEE

William J. Blackwell, Chair, MIT Lincoln Laboratory, E-mail: wjb@ll.mit.edu
Ian S. Adams, Vice-Chair, Naval Research Laboratory, E-mail: ian.adams@nrl.navy.mil

I. Introduction

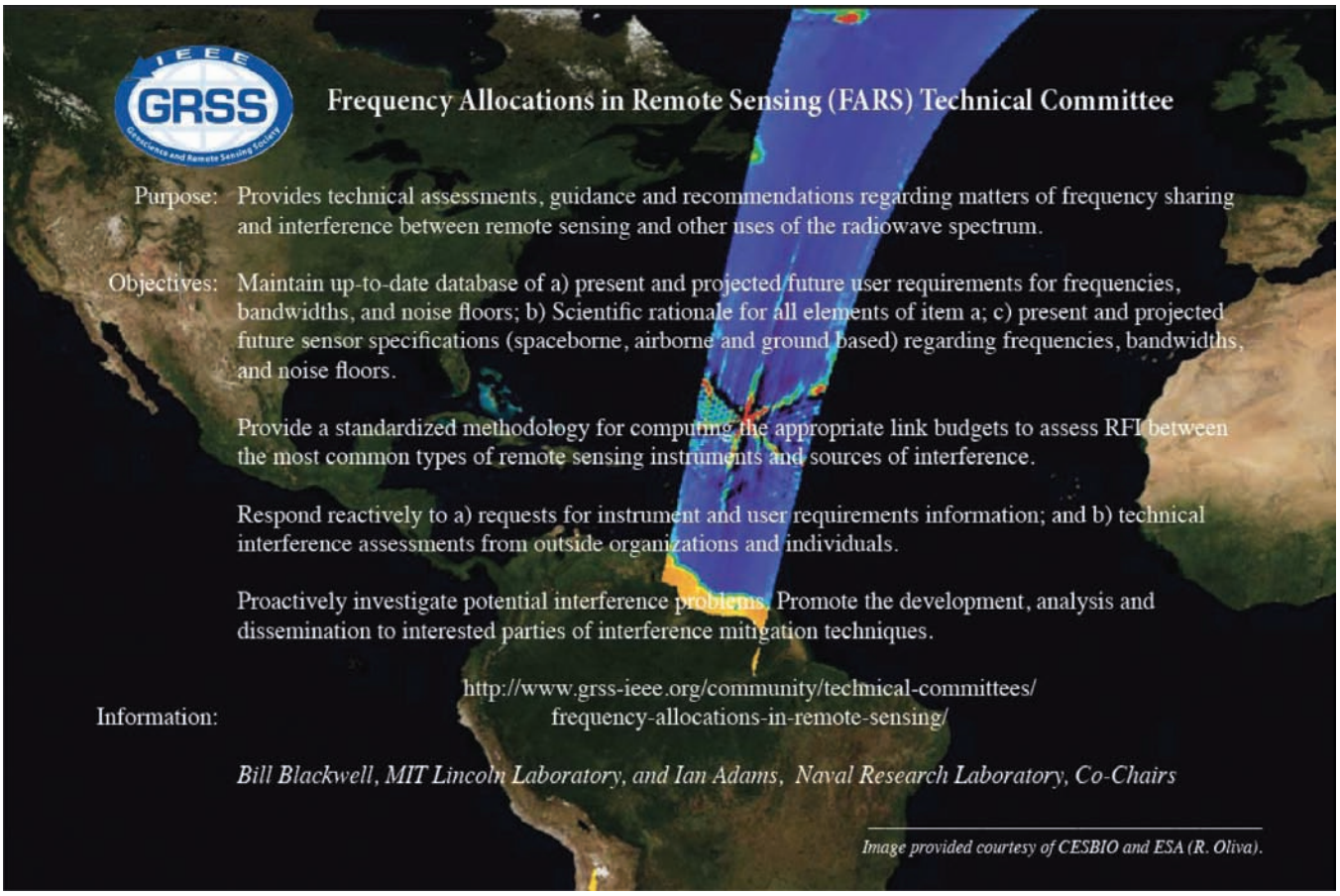
The IEEE GRSS Frequency Allocations in Remote Sensing (FARS) technical committee (hereafter, "FARS") was created in 2000 and is charged with facilitating the GRSS role in the frequency management process by fostering, archiving, and disseminating relevant technical information. FARS also serves as an interface between GRSS and the regulatory process by providing information to members and by organizing member efforts when appropriate. International frequency allocation and interference issues do not fall within the purview of IEEE Standards, but rather are matters of regulation by international treaty. Assessments by the FARS technical committee thus fill a critical gap between IEEE Standards and International Telecommunications Union (ITU) regulations. FARS currently has 78 members in ten countries from government, industry, and academic institutions. This article reviews FARS objectives and summarizes recent and future efforts.

II. Education and Outreach

A fundamental FARS objective is to educate the GRSS membership on current frequency management issues. Given the scientific need and significant investment in spaceborne microwave remote sensing, particularly for frequencies below 40 GHz, it is critical that remote sensing scientists and engineers understand external factors affecting the availability of usable spectrum for remote sensing and Earth science measurements. Several examples of FARS articles illuminating spectral management issues include "Impacts of Mobile Radar and Telecommunications Systems on Earth Remote Sensing in the 22–27 GHz Range," (Gasiewski, Ruf, and Wiesbeck, IGARSS 2002), "Frequency Management for Remote Sensing," (Kunkee, GRSS Newsletter, June 2005), and "FARS Technical Committee Report on Potential for Future Interference to Remote Sensing Observations in the 57–64 GHz Band," (GRSS Newsletter, June 2008). In addition to articles and reports disseminated to the public, FARS also holds two events at each IGARSS that are open to conference attendees: a FARS Technical Committee meeting with informal discussions of current issues and FARS organizational matters, as well as a technical session highlighting recent radio frequency interference (RFI) research. The IGARSS 2011 FARS Special Session in Vancouver, BC, Canada, included presentations focusing on the detection and mitigation of RFI in L- and C-bands, with particular attention on ESA's Soil Moisture and Ocean Salinity (SMOS) mission launched in November 2009. The IGARSS 2011 FARS Technical Committee meeting focused primarily on several current RFI issues, with most discussion centered on potential GPS interference presented by the LightSquared initiative. LightSquared is a company that plans to develop a wholesale 4G-LTE (Long Term Evolution) wireless broadband communications network integrated with satellite coverage across the United States. The slides presented at the technical committee meeting, as well as meeting minutes and links for more information on the LiqhtSquared issue, are available on the GRSS FARS web site: http://www.grss-ieee.org/community/technical-committees/frequency-allocations-in-remote-sensing/.

III. Advocacy

A second FARS objective is to represent GRSS in international meetings and working groups relevant to spectrum management. FARS representatives attended two recent meetings: the Committee on Radio Frequencies (CORF) meeting held on May 16–17, 2011 in Washington, DC and the Space Frequency Coordination Group (SFCG) meeting held on June 7–15, 2011 in San Francisco, CA. CORF, operating under the auspices of The National Academies, considers the needs for radio frequency requirements and interference protection for scientific and engineering research, coordinates the views of the U.S. scientists, and acts as a channel for representing the interests of U.S. scientists in the work of the Scientific Committee on Frequency Allocations For Radio Astronomy and Space Science (IUCAF) of the International Council for Science. The CORF Spring meeting topics included discussion of the National Broadband Plan and implications for remote sensing and radio astronomy research, the Enhancing Access to the Radio Spectrum (EARS) initiative of the NSF, proliferation of automotive radars operating near 24–29 and 76–81 GHz, oceanographic radar operating near 4–40 MHz, LightSquared (mentioned above), cognitive radio, and 60-GHz short-haul wireless communications.



The SFCG is an informal group comprising the major civil space agencies and related national and international scientific organizations. Its main objectives are to 1) provide working level coordination of international RF spectrum usage among users of the science services, 2) adopt agreements that optimize the use of the allocated bands, and 3) identify long-term targets related to potential changes to the international regulations (ITU-R, WRC, Regional Groups). At the SFCG-31 meeting in San Francisco, 62 inputs papers were discussed by at least one of four working groups (ITU Matters and Preparation for WRC-12, General Frequency Management, Earth Environmental Satellites and MetSat, Coordination Issues and Databases). Meeting outcome papers were prepared comprising action items (to be completed for next SFCG meeting), resolutions (to express action for SFCG members), and recommendations (to express action, to be pursued by SFCG members outside the group, e.g. within member agencies and administrations). Highlights of the SFCG-31 meeting relevant to FARS include a detailed discussion of the LightSquared issue, a request to help populating a database of sensor passband characteristics, fixed service out-of-band vs. EESS passive usage in the 86–92 GHz band, 1400–1427 MHz RFI recent issues (SMOS), and a discussion of emerging needs for communication services to support small/nano-satellite missions. FARS members are now working to support the SFCG request for sensor passband characteristics.

IV. Future Initiatives

There are a number of future FARS initiatives that are currently in the works. First, a concerted effort is underway to build upon existing relationships with CORF, SFCG, and other emerging groups (for example, AMS frequency allocation initiative and GEOSS task AR-06-11). Second, the FARS center of gravity has tended toward observing systems, and a recent objective has therefore been to engage more of the applications-oriented community, including for example AGU remote sensing working groups. Third, a certificate of recognition for outstanding FARS-related work will be presented annually, and the inaugural award will be presented at IGARSS 2012 in Munich at the evening FARS meeting. Finally, a special issue of IEEE TGRS is planned to highlight recent RFI research that has improved or enabled some aspect of remote sensing. Comments and suggestions for other worthwhile future activities, as well as enquiries related to membership, are highly encouraged.

CHAPTERS CORNER

BOSTON SECTION OF THE GEOSCIENCE AND REMOTE SENSING SOCIETY

Bill Blackwell, Boston Section Chair, Lincoln Labs, Lexington, MA USA

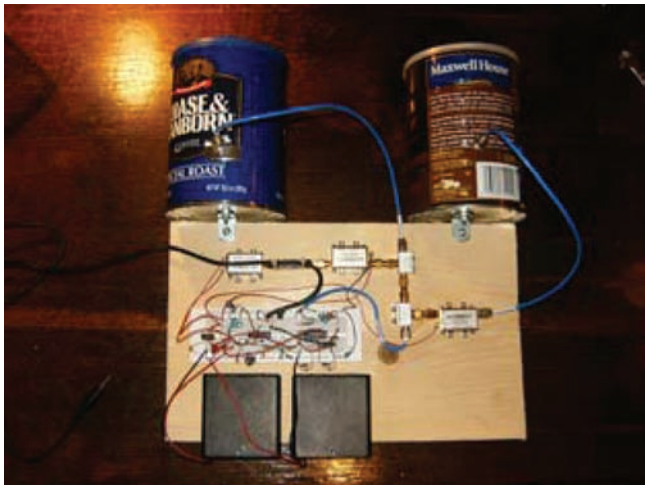
The Boston Section of GRSS currently has approximately 60 members and maintains an email distribution list of almost 300 interested parties throughout the greater Boston area. The Boston Section enjoys a vibrant relationship with many of the area universities, and this note highlights a recent project led by Dr. Greg Charvat (MIT Lincoln Laboratory) and co-sponsored by GRSS.

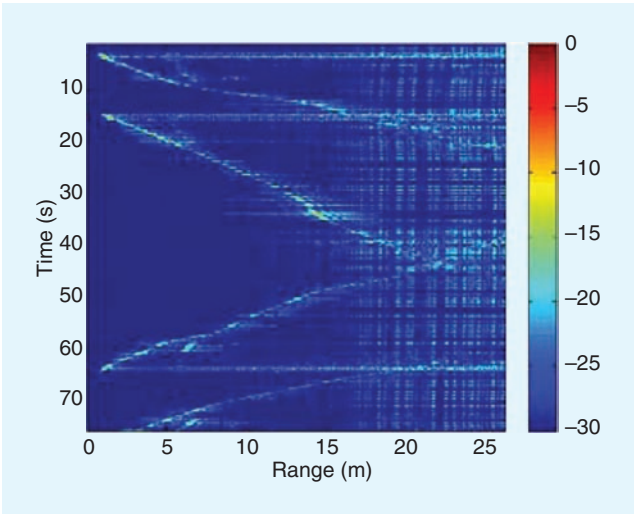
Recently MIT Lincoln Laboratory sponsored a short radar course at MIT main campus during the January 2011 Independent Activities Period (IAP). The objective of this course, "The MIT IAP 2011 Radar Course: Build a Small Radar System Capable of Sensing Range, Doppler, and Synthetic Aperture Radar (SAR) Imaging[1]," taught by G. L. Charvat, J. H. Williams, A. J. Fenn, S. M. Kogon, and J. S. Herd, was to generate student interest in applied electromagnetics, antennas, RF, analog, signal processing, and other engineering topics by building a capable short-range radar sensor and using it in a series of field tests. The underlying philosophy being that students have a vested interest in making their own radar work properly, causing them to dig deeper into these subjects on their own volition thereby providing a self-motivated learning experience. A series of lectures on the basics of radar, modular RF design, antennas, pulse compression and SAR imaging were presented. Teams of three students received a radar kit. Nine teams participated in the course.

The radar kit was an S-band coherent frequency modulated continuous wave (FMCW) radar centered at 2.4 GHz with less than 20 mW of transmit power developed by the authors. To reduce cost, the antennas (transmit and receive) were made from coffee cans in an open-ended circular waveguide configuration. To clearly show the RF and analog signal chain, all components were mounted on a block of wood similar to an early 1920's radio set. The microwave signal chain was made from six Mini-Circuits coaxial components. The analog signal chain was implemented on a solderless breadboard for quick fabrication and easy modification. The video output and transmit synchronization pulses were fed into the right and left audio inputs of any laptop computer. To make the kit portable it runs on eight AA batteries. The total cost of each kit was $360.

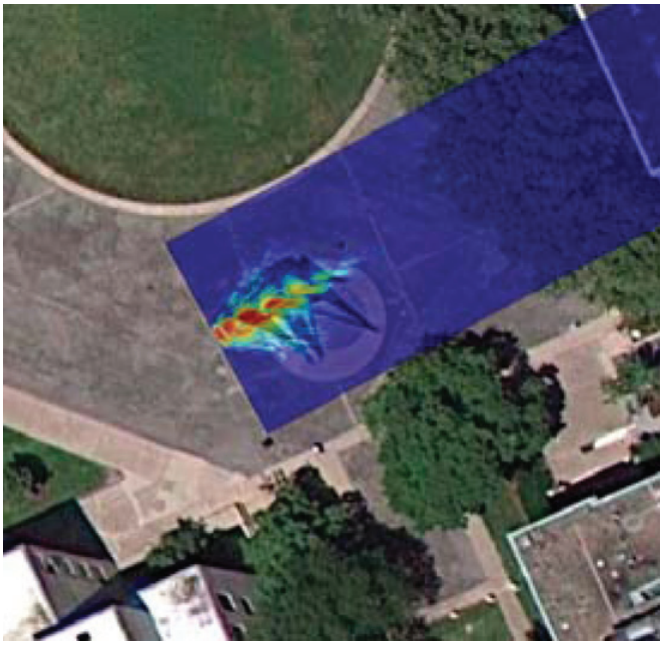
The radar operates in three modes; doppler vs. time, range vs. time, and Synthetic Aperture Radar (SAR) imaging. To record data a student uses the .wav recorder program in the laptop. MATLAB scripts read the .wav data and form the appropriate plots.

Of the nine student groups all succeeded in building their radar, acquiring doppler vs. time and range vs. time plots. Seven of the nine groups succeeded in acquiring at least one SAR image. Some groups improved their radar sets by improving the signal processing algorithms, developing real-time radar graphics user interfaces (GUI's), and by making a more robust chassis.





[1] This work is sponsored by the Department of the Air Force under Air Force Contract #FA8721-05-C-0002. Opinions, interpretations, conclusions and recommendations are those of the authors and are not necessarily endorsed by the United States Government.



Most students were from MIT but a small contingent were from Northeastern University and one student built this radar as an independent study at Michigan State University. Great enthusiasm was generated after each field test. Students were engaged throughout the course and they continue to ask questions about how to improve the performance of their radar sets and how to make more sophisticated systems. Many students discussed scattering theory at length when trying to interpret their SAR imagery.

In summary, it is difficult to introduce the current generation of students to the field of applied electromagnetics, RF, analog, and signal processing because of the numerous challenging prerequisites needed before the rewards can be realized. By presenting these difficult topics at a high level while at the same time making a radar kit and performing field experiments, students became self motivated to explore these topics. In the long term, courses using this continuous engagement philosophy could help fill the gap as the current generation of radar engineers continues to retire.

Course materials are available online: http://ocw.mit.edu/resources/res-ll-003-build-a-small-radar-system-capable-of-sensing-range-doppler-and-synthetic-aperture-radar-imaging-january-iap-2011/index.htm

Gregory L. Charvat grew up in the metro Detroit area, where the hands-on approach to engineering within the automotive culture was a great influence on his life. He earned his PhD in electrical engineering in 2007, his MSEE in 2003, and BSEE in 2002 from Michigan State University where he worked as a graduate research assistant for the Electromagnetics Research Group. He is currently a technical staff member at MIT Lincoln Laboratory since September of 2007. Dr. Charvat is an IEEE member and served as a chair on the 2010 IEEE Symposium on Phased Array Systems and Technology steering committee and is currently serving as chair of the IEEE Antennas and Propagation Society (AP-S) Boston Chapter.

CALL FOR PAPERS

IEEE Transactions on Geoscience and Remote Sensing

Special Issue on "The Chinese FengYun (FY)-3 Satellite Instrument Calibration and Applications"

In the Chinese weather satellite program, the first two research and experiment satellites FengYun-3A (FY-3A) and FengYun-3B (FY-3B) were successfully launched into orbit on May 27, 2008 and November 5, 2010, respectively, and the remaining five operational satellites will be launched once every two years. FY-3A/B satellites cover the mid-morning and afternoon orbits. The following eleven instruments are on board both FY-3A and FY-3B: (1) Visible and InfRared Radiometer (VIRR); (2) MEdium ReSolution Imager (MERSI); (3) InfRared Atmospheric Sounder (IRAS); (4) MicroWave Temperature Sounder (MWTS); (5) MicroWave Humidity Sounder (MWHS); (6) MicroWave Radiation Imager (MWRI); (7) Solar Backscatter Ultraviolet Sounder (SBUS); (8)Total Ozone Mapping Unit (TOU); (9) Earth Radiation Measurer (ERM); (10) Solar Irradiation Monitor (SIM); and (11) Space Environment Monitor (SEM).

Since FY-3A/B satellites were successfully launched into orbit, the instrument science teams has been working on the calibration and validation of all the instruments. User communities from the major numerical weather prediction (NWP) center have conducted some data assimilation experiments and shown some positive impacts of FY-3 data on the global medium-range forecasts. Hence we would like to invite contributions covering the following topics:

Contributions for this special issue are welcome from the research community. The research areas include the state-or-the art calval algorithms, cross-calibration with other operational and research sensors, advanced product applications.

List of topics

- Calibration and performance monitoring of the FY-3A/B instruments;
- First results of calibration and validation and scientific studies using FY-3A/B data;
- Algorithms for retrieving the environmental and geophysical parameters;
- Assimilation of FY-3 data into NWP models; and
- Other advanced applications of FY-3 data in research and operations

Paper submission deadline: 31 October 2011

Submission guidelines

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

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IEEE Transactions on Geoscience and Remote Sensing

Special Issue on "Inter-Calibration of Satellite Instruments"

The ability to detect and quantify changes in the Earth's environment using remote sensing is dependent upon sensors providing accurate and consistent measurements over time. A critical step in providing these measurements is establishing confidence and consistency between data from different sensors and putting them onto a common radiometric scale. However, ensuring that this process can be relied upon long term and that there is physical meaning to the information requires traceability to internationally agreed, stable, reference standards ideally tied to the international system of units (SI). This requires robust on-going calibration, validation, stability monitoring, and quality assurance, all of which need to be underpinned and evidenced by comparisons involving a reference standard or sensor and a methodology with defined uncertainty (in an absolute or temporal sense). This process can be used to provide calibrations to other sensors (i.e. Inter-calibration).

Inter-calibration and comparisons between sensors have become a central pillar in calibration and validation strategies of national and international organizations. The Global Space-based Inter-Calibration System (GSICS) is an international collaborative effort initiated by World Meteorological Organization (WMO) and the Coordination Group for Meteorological Satellites (CGMS) to monitor and harmonize data quality from operational weather and environmental satellites. The Infrared Visible Optical Sensors (IVOS) sub-group of the Committee on Earth Observation Satellites (CEOS) Working Group on Calibration and Validation (WGCV) extends this vision to include all Earth observation sensors and satellite operating agencies. Inter-calibration techniques provide a practical means of correcting biases between sensors and bridging any potential data gaps between non-contiguous sensors in a critical time-series and the inter-calibration reference serves as a transfer standard. It is expected that promotion of the use of robust inter-calibration techniques will lead to improved consistency between satellite instruments, reduce overall costs, and facilitate accurate monitoring of planetary changes.

List of topics

Contributions for this special issue are welcome from the research community. This special journal issue will focus on how inter-calibration and comparison between sensors can provide an effective and convenient means of verifying post-launch sensor performance and correcting the differences. The guest editors invite submissions that explore topics including, but not limited to, pseudo-invariant calibration sites, instrumented sites, simultaneous nadir observations and other ray-matching comparisons, lunar and stellar observations, deep convective clouds, liquid water clouds, Rayleigh scattering and Sun glint. The inter-calibration results should focus on rigorous quantification of bias and associated sources of uncertainty from different sensors, crucial for long-term studies of the Earth. The goal of this special journal issue is to capture the state-of-the-art methodologies and results from inter-calibration of satellite instruments, including full end-to-end uncertainty analysis. Accordingly, it will become a reference anthology for the remote sensing community.

Paper submission deadline: 31 January 2012

Submission guidelines

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

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CALL FOR PAPERS

IEEE Transactions on Geoscience and Remote Sensing

Special Issue on "Analysis of Multitemporal Remote Sensing Data"

In the last decade a large number of new satellite remote sensing missions has been launched resulting in a dramatic improvement in the capabilities of acquiring images of the Earth surface. This involves an enhanced possibility to acquire multitemporal images of large areas of the Earth surface, with improved temporal and spatial resolution with respect to traditional satellite data. Such new scenario significantly increases the interest of the remote sensing community in the multitemporal domain, requiring the development of novel data processing techniques and making it possible to address new important and challenging applications. Nonetheless, the properties of the images acquired by the last generation sensors (e.g. very high geometrical resolution, large time series of images, etc.) pose new methodological problems that require the development of a new generation of methods for the analysis of multitemporal images and temporal series of data. This is common to both passive (multispectral, hyperspectral, etc.) and active (synthetic aperture radar, lidar, etc.) sensors. The potentials of the technological development are strengthen from the increased awareness of the importance of monitoring the Earth surface at local, regional and global scale. Assessing, monitoring and predicting the dynamics of land covers and of antrophic processes is at the basis of both the understanding of the problems related to climate changes and the definition of politics for a sustainable development. The enhanced capability to perform multitemporal analysis of local areas at a very detailed scale is put beside these global themes and represents another strategic area of application.

Contributions for this special issue are welcome from the research community developing new techniques for the analysis of multitemporal data, as well as from the application community using the results obtained from the automatic analysis on the following topics.

List of topics

- Multitemporal image calibration, correction and registration techniques;
- Multitemporal image analysis techniques;
- Classification of multitemporal data;
- Analysis of time series;
- Data mining in time series;
- Change detection methods;
- Change detection accuracy assessment;
- Multitemporal SAR and InSAR data analysis;
- Fusion of multitemporal data;
- Land-cover and land-use dynamics;
- Phenology monitoring;
- Applications of multitemporal data and time series;
- New satellite missions for acquiring time series.

Paper submission deadline: 29 February 2012

Submission guidelines

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

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IGARSS 2012

IEEE International Geoscience and Remote Sensing Symposium
Remote Sensing for a Dynamic Earth

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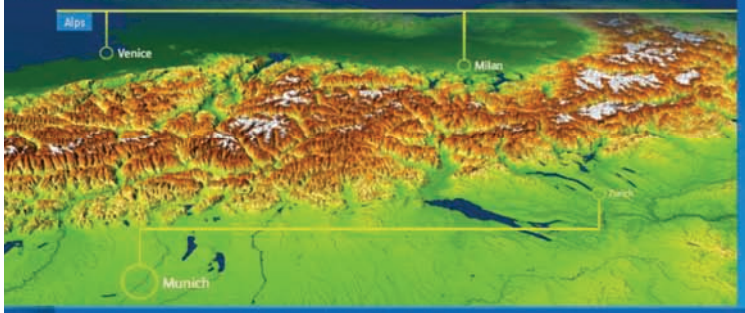


Important dates

7 October 2011	Invited Session Proposal Deadline
28 October 2011	Invited Session Notification
7 November 2011	Abstract Submission System Open
15 December 2011	Tutorial Proposal Deadline
12 January 2012	Abstract Submission Deadline
12 January 2012	Travel Support Application Deadline
12 January 2012	Student Competition Full Paper Application Deadline
23 March 2012	Abstract Acceptance Announcement & Registration Open
1 June 2012	Full Paper (4 pages) Submission
July 22-27 2012	IGARSS 2012

Contacts

info@igarss2012.org

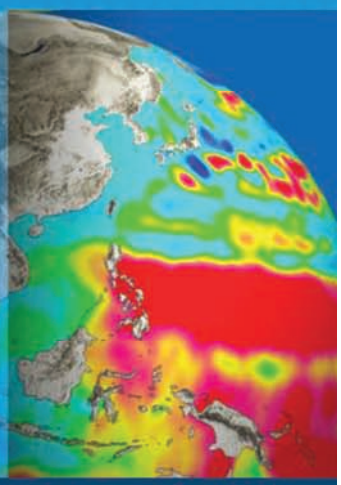
Themes

The technical programme will account for the following themes:

- Analysis Techniques
- Atmosphere
- Cryosphere
- Oceans
- Land
- Sensors and Platforms
- Data Management, Dissemination Education and Policy

In addition special scientific themes will be addressed, including:

- Dynamics of Earth Processes and Climate Change
- Data Assimilation
- Integrated Earth Observing Systems
- New Satellite Missions



Student prize competition

All IEEE student members are invited to enter the IGARSS Student Prize Paper Competition. The selection will be done by a committee and the selected students will present their papers during a special session at the symposium. All finalists will be offered partial travel support funding.

www.igarss12.org

Call for Photographs

The IEEE Geoscience and Remote Sensing Society is preparing a historical timeline per the Society's evolution and is in need of GRSS-related activity photographs over the course of the past 50 years. Although any and all photographs are welcome, photographs from the early years are most requested, including those from the Geoscience Electronics Group, 1962-1981.

Photographs should be limited to persons associated with or working within the fields of geoscience and remote sensing, and should depict such activity therein. When submitting a photograph(s), please provide the names of all persons in the photograph and a brief description of the activity, if possible.

Submission deadline is November 15, 2011.

Submissions should be made accordingly:
no more than 1MB — email to ieeegrss@ieee.org
more than 1MB, place on disk and mail to —

IEEE GRSS
3020 Pittsburgh Str • Houston TX 77005 USA

GPR 2012:
Sustainable Development of Ground Penetrating Radar for Engineering and Environment

June 4-8, 2012
Shanghai, China

Tongji University
National Natural Science Foundation of China

GPR 2012 Chair:
Prof. Yongsheng Li --Tongji University

Abstract submission:
Before November 15, 2011
Extensive abstract
Email: xiexiongyao@tongji.edu.cn
copy zhaoyh@tongji.educn

Early Bird Registration:
Before April 30, 2012

Registration fees:
CNY 4000

Web Address:
http://www.gpr2012.org

GRSS AdCom members at the July 2011 meeting in Vancouver.

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

UPCOMING CONFERENCES

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

Name: Advanced RF Sensors and Remote Sensing Instruments Workshop
Dates: September 13–15, 2011
Location: Noordwijk, The Netherlands
Contact: Dr. Martin Suess
E-mail: Martin.Suess@esa.int
URL: http://conferences.esa.int/

Name: International Conference on Space Technology (ICST 2011)
Dates: September 15–17, 2011
Location: Athens, Greece
Contact: Dr. Maria Petrou
E-mail: Maria.petrou@imperial.ac.uk
URL: http://www.icspacetechnology.com/

Name: Asia-Pacific Conference on Synthetic Aperture Radar (APSAR2011)
Dates: September 26–27, 2011
Location: Seoul, Korea
Contact: Prof. Youngkil Kwag
E-mail: ykwag@kau.ac.kr
URL: http://www.kiees.or.kr/

Name: IEEE/ISPRS workshop Computer Vision for Remote Sensing of the Environment
Dates: November 7, 2011
Location: Barcelona, Spain
URL: http://recherche.ign.fr/isprs/CVRS/

Name: 4th International Conference on GEographic Object Based Image Analysis (GEOBIA2012)
Dates: May 7–9 , 2012
Location: Rio de Janeiro, Brazil
Contact: Raul Queiroz Feitosa
E-mail: geobia2012@dpi.inpe.br
URL: http://www.inpe.br/geobia2012

Name: 14th International Conference On Ground Penetrating Radar (GPR2012)
Dates: June 7–9, 2012
Location: Shanghai, China
Contact: Dr. Xiongyao Xie
E-mail: xiexiongyao@tongji.edu.cn
URL: www.gpr2012.org

Name: 39th Scientific Assembly of the Committee on Space Research (COSPAR) and Associated Events (COSPAR 2012)
Dates: July 14–22, 2012
Location: Mysore, India
E-mail: cospar@cosparhq.cnes.fr
URL: http://www.cospar-assembly.org

Name: 2012 IEEE Geoscience and Remote Sensing Symposium (IGARSS2012)
Dates: July 22–27, 2012
Location: Munich, Germany
E-mail: info@igarss2012.org.
URL: http://www.igarss2012.org/