IEEE GEOSCIENCE and REMOTE SENSING Newsletter

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Editor: David Kunkee

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

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As incoming editor of the GRS-S Newsletter, the first announcement that is in order is to acknowledge the excellent work of our outgoing editor, Dr. Adriano Camps. During his four years as editor, Dr. Camps grew the Newsletter to a publication containing typically over 35 pages, including a diverse selection of quality feature articles emphasizing tutorials and education. And he was able to do this on time every month. A great achievement! I wish him the best of luck in his new positions in the GRS-S as AdCom member and Webpage editor. Looking forward, I would like to welcome Dr. William (Bill) Blackwell, our new Associate Editor for Organizational and Industrial Profiles. He is a member of the technical staff at MIT Lincoln Laboratories involved with atmospheric remote sensing so we anticipate having continued close contact with private industry in remote sensing.

As I explore ways to evolve the Newsletter and to keep it current with GRS-S, one of the most relevant and closely related activities is the Society's web-site development. The GRS-S website has changed significantly in the past two years, beginning with an updated format, followed by much improvement in the availability of current information and web-based interaction such as "What's New", current activities of GEOSS, and a technical resources page with "Ask an Expert". We have even provided an example of the GRS-S website on page 18 of this issue. The GRS-S website development is an exciting activity that I hope will provide increased interaction with, and value to, the GRS-S membership.

Inside this issue of the Newsletter you will find an in-depth article on the Atmospheric Radar Research Center at the University of Oklahoma, organized by Prof. Robert Palmer. In addition, you will find reports from the Society's Publicity Chair, Prof. David Weissman, and the Strategic Planning Chair, Prof. Andy Blanchard. In the GRS-S Members Section it is always good to hear about member upgrades, achievements and awards. Please also notice the call for nominations for the GRS-S AdCom and IEEE awards. And finally in this

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President's Message

Dr. Leung Tsang
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The public awareness of and concern for global warming has gained tremendous momentum over the last few years. The movie "An Inconvenient Truth", in which US former vice president Al Gore shows that global warming is not a political issue but a global challenge facing mankind, has been a big hit. A focus area of study of global warming is the remote sensing of cold land processes. The melting of glaciers, ice sheets and ice caps contribute to rise in sea level. Mass-balance of the Greenland ice sheet remains one of the greatest uncertainties in predicting future sea level changes. Satellite measurements show thinning of the ice sheet in Greenland over the past 40 years. Rising temperatures not only melt ice, but also change the geography of the coastline. Will Steger, well known for his expeditions, said "The phenomenon of an island all of a sudden appearing out of nowhere— is a real common phenomenon now." Using MODIS data, GRSS member scientists showed that during the period of most-active melt, the mean, clear-sky surface temperature of the ice sheet was highest. From WINDSAT passive microwave polarimetric data, GRSS member scientists also observed very uncommon large thermal emission of the 4th Stokes parameters. Arctic sea-ice has also become thinner in recent decades, with an Arctic-wide average thickness reduction. Using QuikScat scatterometer data, it was shown by GRSS member scientists that the extent of perennial sea-ice in the East Arctic Ocean has decreased sharply by about the size of Texas. GRSS member scientists used passive microwave and AVHRR data to demonstrate that although Arctic winter sea-ice

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Cover Information: Photograph of one of the two Shared Mobile Atmospheric Research & Teaching Radars (SMART) radars during a downdraft haboob event in Arizona. One of the SMART radars will soon be upgraded with dual-polarization capability allowing many new research areas. (see page 10)

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issue of the Newsletter, it is sad to report the passing of Prof. D'Auria, from the University Rome "La Sapienza". Prof. D'Auria was the conference chair of the first "Specialist Meeting on Microwave Radiometry and Remote Sensing Applications" which has come to be known as MicroRad.

(President's Message continued from page 3)

was stable until 2005, it decreased significantly in the last two years. Satellite remote sensing and observations of cold land processes are some of the important topics that will be presented and discussed in the upcoming IGARSS 2007 in Barcelona, Spain in July 23-27, 2007 (http://www.igarss07.org). We hope you can attend the Conference. For IGARSS'07 (http://www.igarss07.org/frontal/Fees.asp), we are able to keep the early member registration fees at a moderate cost of 540 Euros. This is significantly lower than the 780 Euros for non-members. Note that to join the GRSS Society as an affiliate member, the annual fee is only $84 USD. I would like to encourage you to join GRSS if you are not yet a member.

The GRSS Society continues to strongly support GEO. Recently, GEO released the GEO 2007-9 working plan. Many of our members are participating in the implementation of the plan. At the Third Plenary Session of the GEO that was held in November 2006 in Bonn, Germany, Dr. Ellsworth LeDrew was appointed as the co-chair of the User Interface Committee. This is in recognition of his work with the Energy Community of Practice and his contributions to the user activities. Dr. Siri Jodha is spearheading the IEEE activity to lead the GEO standards registry and the creation of a Standards and Interoperability forum. Besides launching a new journal, we are also launching an IEEE sponsored magazine for the web, "Earthzine.org". Paul Racette, as editor, is enlisting associate editors. Please support him with suggestions for contributors and editorial staff.

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William J. Blackwell received the B.S. degree in electrical engineering from the Georgia Institute of Technology, Atlanta, in 1994, and the S.M. and Sc.D. degrees in electrical engineering from the Massachusetts Institute of Technology (MIT), Cambridge, in 1995 and 2002. He is currently a member of the technical staff at MIT Lincoln Laboratory. His research interests are in the areas of atmospheric remote sensing and estimation and signal processing theory. Dr. Blackwell held a National Science Foundation Graduate Research Fellowship from 1994 to 1997 and is a member of Tau Beta Pi, Eta Kappa Nu, Phi Kappa Phi, and Sigma Xi, and is chapter chair of the Boston section of the IEEE Geoscience and Remote Sensing Society.

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GRS-S MEMBERS HIGHLIGHTS

Dr. Raney Receives the 2007 IEEE Dennis J. Picard Medal for Radar Technologies and Applications

The 2007 IEEE Dennis J. Picard Medal for "*Radar Technologies and Applications*" recipient is Dr. Russell Keith Raney, Principal Staff and Assistant Supervisor, Ocean Remote Sensing Group at Johns Hopkins University Applied Physics Laboratory: "*For exemplary conceptual innovation and technical leadership in the implementation and application of earth-observing and planetary radars*." Dr. Raney is best known as the principal technical architect of Canada's Radarsat, a C-Band Synthetic-Aperture Radar (SAR) satellite launched in 1994, operating successfully in its twelfth year.

Dr. Raney received the B. Sc. (Cum Laude) from Harvard University, Cambridge, MA, a Master of EE degree from Purdue University, West Lafayette, IN, and the Ph.D. degree from the University of Michigan, Ann Arbor, MI. He continued his post-doctoral training at the University of Michigan, Institute of Science and Technology and at the Environmental Research Institute of Michigan (Ann Arbor) until 1976.

In 1976, Dr. Raney was invited to join the Canadian Centre for Remote Sensing in order to help initiate a new national program in radar remote sensing. This objective was achieved, thanks in part to the Canadian Parliament's interest in sovereignty and the environment, and in no small part to Dr. Raney's technical leadership. Radarsat was Canada's first remote sensing satellite system, and by far the world's most advanced and capable civilian Earth-imaging radar asset of the time. Radarsat data now account for more than 38% of all Earth-observing imagery sales.

After returning to the United States in 1994, Dr. Raney joined the Applied Physics Laboratory at Johns Hopkins University and became the inventor and principal investigator for the airborne D2P proof-of-concept instrument, which is the world's first radar altimeter to incorporate coherent processing, and it is the prototype for ESA's CryoSat. Dr. Raney's innovative leadership has led to several new radar concepts, as well as many keynote speaker invitations, and requests to participate on radar-focused science teams, technical committees, review committees, and symposia.

Dr. Raney's numerous awards include the Gold Medal Award of the Canadian Remote Sensing Society in 1999, and The Johns Hopkins University Applied Physics Laboratory 1999 Outstanding Publication Award for a chapter entitled Radar Fundamentals: Technical Perspective, in *Principles and Applications of Imaging Radar*, John Wiley and Sons, New York, 1998, and a Canadian Space Agency Special Award, for contributions to Radarsat and the Canadian microwave radar program in 2003. He has authored or coauthored over 350 refereed publications.

Dr. Raney is a Life Fellow of the IEEE, and has been an active participant in the IEEE GRS-S since 1980 as an Associate Editor, and the IEEE Proceedings Editorial Board (2003 – 2005). He served on the GRSS AdCom (1984 – 1992), as Vice President (1987), and as President (1988 – 1989). He is a recipient of the GRS-S outstanding service award (1990), the IEEE GRS-S Distinguished Achievement award (1993), the 1998 Transactions Prize award, and the IEEE Third Millennium Medal in 2000.

The IEEE Dennis J. Picard Medal is sponsored by the Raytheon Corporation and named in honor of Dennis J. Picard whose lifetime of work at the Raytheon Corporation helped make them a leader in tactical missile systems. Dr. Raney will receive the award at the 2007 IEEE Honors Ceremony, and he will be honored also during the Plenary Session of IGARSS-07.

GRS-S MEMBERS HIGHLIGHTS

In Memoriam: Professor Giovanni D'Auria

The fields of Remote Sensing and Radio Propagation, as well as Engineering Education, have lost one of their pioneers with the death of Prof. Giovanni D'Auria. He was born in Rome, Italy, on June 23, 1931, and died in the same city on December 6 2006. He received the degree in Electrical Engineering and the Libera Docenza degree from the University of Rome "La Sapienza" in 1956 and 1964, respectively. He served in the Italian Air Force, working in the ITAV Laboratories, and then moved to the Fondazione Ugo Bordoni as Researcher in the Antennas and Propagation Laboratory. He joined the Department of Electronics, University "La Sapienza" in 1962 as an Assistant Professor, teaching Applied Electronics. In 1976, he was appointed Professor in the Chair of Antennas and Propagation and had been teaching until his retirement in November of 2006. His research interests were on antennas in real environments and, in particular, on the performance of antennas in random fields, on EM propagation in turbulent atmospheres, microwave remote sensing of the troposphere and earth's surface, and microwave radiometry of the atmosphere, particularly of cloud systems.

During propagation experiments in the early 70's, his interest was on the effects of the atmosphere on electromagnetic wave and in particular on how the medium affected the degree of coherence of the propagating wave. The coherence was being measured to predict the performance of large antennas. Being intrigued by the observed behavior of the received field, as caused by the medium in front of the antenna, and trying to imagine how its temperature, moisture and turbulence acted on the propagating wave, his interest progressively shifted from the effects of the propagating medium on the wave to the inference of the state of the medium from the observed features of the wave, i.e., from propagation ("direct problem") to remote sensing ("inverse problem"). The conceptual frame was realized in 1983 when his department, with Prof. D'Auria as the Conference Chairman, decided to hold a specialist meeting on microwave radiometry. This conference was intended not just for propagation measurements, as was common at that time, but to include "remote sensing applications." The resulting conference "Specialist Meeting on Microwave Radiometry and Remote Sensing Applications" has become one of the most successful conferences in our remote sensing field, and its 10th meeting will be held in Florence, Italy, in 2008.

In addition to his scientific and educational activities, Prof. D'Auria was an excellent gourmet cook, and an experienced and passionate farmer, who produced good wine, olive oil, and many other products on his villa in the Roman countryside. He was a unique and unconventional producer rooted in the Roman heritage, and his main advisors were his vineyard neighbours rather than skilled oenologists. He was more interested in maintaining the habit and flavours typical of places that have been cultivated for centuries. The pleasure of reproducing and maintaining those habits and flavours was apparent each time he organised his famous "Mimosa Party" at Monte Cornazzano, the most beloved part of his countryside estate. Perhaps, because of his love and appreciation of nature, the last years of Prof. D'Auria's scientific career were spent in the study of radiative behaviour of precipitating clouds and the use of microwave radiometers for retrieving cloud properties and, namely, precipitation.

Giovanni was straightforward and frank, never conventional, deeply rational, and his thoughts were focused on nature, whose mechanisms he was always sought to understand, whether they were of physical or human origin. His teachings always emphasized the rigorous approach both of electromagnetic theory, and of the statistics of the environmental mechanisms. It was a rare experience to know a master of rigor in electromagnetism and a farsighted educator, who, at the same time, was completely comfortable in his vineyard producing wine and oil, in his cellars ageing them properly, and in the kitchen providing for others the fruits of his labors.

Domenico Solimini, Nazzareno Pierdicca, Patrizia Basili, Piero Ciotti, Frank Silvio Marzano, Paolo Pampaloni, and Ed R. Westwater.

GRS-S Members Elevated to the Grade of IEEE Fellow, November 2006

Dr. Paris Vachon "for contributions to operational marine applications of imaging radar"

Professor K. S. Chen "for contributions to remote sensing image and signal processing"

Professor Melba Crawford "for applications of satellite data and airborne LIDAR imagery"

GRS-S Members Elevated to the Grade of Senior Member From August to December 2006

August: Hitoshi Mikada

September: Monique Bernier, Mohan Lal Nirala

November: Scott J. Hills, Fuqin Li, Li Li, Richard Norland, Simonetta Paloscia, Thomas Russel, M J Ryan, Douglas Vandemark

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

Call For Nominations For The GRS-S Administrative Committee

The Nominations Committee calls upon our membership to nominate members to serve on the GRSS AdCom. A nominating petition carrying a minimum of five names of Society members, excluding students, shall automatically place that nominee on the slate although the Nominations Committee may choose to include a name on the slate regardless of the number of names on the nominating petition. Your nominees should confirm in writing their willingness to stand for election. Candidates must be current members of the IEEE and the GRSS.

A brief biography of the nominee, similar to that used for TGARS authors, will be required and should be submitted with the nominating petition by May 25, 2007 to the GRS-S Nominations Committee, c/o Dr. David G. Goodenough, Nominations Chair, Pacific Forestry Centre, 506 Burnside Road West, Victoria, British Columbia, Canada V8Z 1M5; Fax: 1-250-363-0775; E-mail: dgoodeno@nrcan.gc.ca.

The slate derived by the Nominations Committee shall be presented to the Society membership at large via mail ballot, and the three candidates receiving the greatest number of votes shall be elected. The Administrative Committee shall hold an Annual Meeting in November 2007 after the results of this vote are known at which time elections will be held to fill the remaining three regular vacancies in the Administrative Committee with successful candidates to start on January 1, 2008.

Our AdCom consists of 18 elected persons, each of whom serves for three years. Their terms are overlapping to assure continuity. Additional information on the Society and the AdCom is available at http://www.grss-ieee.org/.

UNIVERSITY PROFILE

Atmospheric Radar Research Center - ARRC University of Oklahoma, USA

Robert Palmer[1], Guifu Zhang[1], Michael Biggerstaff[1], Phillip Chilson[1], Jerry Crain[2], Sebastian Torres[3], Mark Yeary[2], Tian-You Yu[2], Yan Zhang[2]

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1. Introduction

The Atmospheric Radar Research Center (ARRC) at the University of Oklahoma (OU) is focused on weather radar research and education. This center is a result of a significant investment by the university to accelerate research and learning in an area of great importance to Oklahoma and to the meteorological community in Norman. The ARRC is comprised of a growing research faculty, comprehensive test facilities, and an established, multidisciplinary education program at both the graduate and undergraduate levels. Faculty members and students from the OU Schools of Meteorology (SoM) and Electrical and Computer Engineering (ECE), and from the Cooperative Institute for Mesoscale Meteorological Studies (CIMMS) comprise the ARRC and are actively engaged in collaborative research in pursuit of defining the next generation of weather radar sensors.

The study of the atmosphere using remote sensing techniques cuts across traditional disciplinary boundaries. Therefore, the breadth of research topics investigated within the ARRC is multi-disciplinary by necessity. An artist's depiction of these topics is provided in Figure 1. Weather radar is the centerpiece technology, which focuses the ARRC activities. Close collaborations with NOAA's National Severe Storms Laboratory (NSSL) and Radar Operations Center (ROC) enable the ARRC to participate in a diversity of projects. Ongoing research topics include radar polarimetry, phased array radar, profiling radar, advanced signal processing, retrieval algorithms, clutter mitigation, severe storm observations and detection, quantitative precipitation estimation, and general studies of atmospheric physics.

Members of the ARRC are deeply committed to the underlying theme of interdisciplinary education. ARRC faculty members have developed a rather unique curriculum focused on weather radar. Section 3 describes the program, which exploits the expertise represented within the SoM and ECE. Meteorology and engineering experts at NSSL and the ROC are often called upon to provide lectures in our formal OU courses. As a result, our students are afforded an enriched educational opportunity in the field of instrumented studies of the atmosphere.

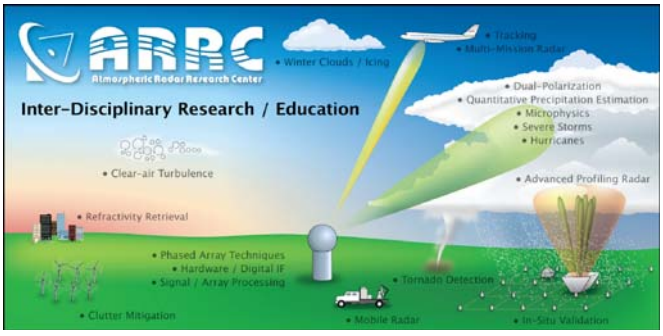


Figure 1. Illustration of the breadth of research topics represented within the ARRC at the University of Oklahoma. Although quite wide in scope, activities focus on the use of advanced weather radars for studies of the atmosphere.

2. People

The multi-disciplinary field of radar meteorology, composed of both the technical aspects of radar design/algorithm development and the observational use of radar data, is an important strategic research area at OU. As such, emphasis has been placed in recent years on developing a critical mass of scientists and engineers who can work synergistically to achieve the goals of the program. The ARRC is continually growing with a current membership of nine faculty members, over 20

graduate students, and several postdoctoral fellows, including engineering, computer, and secretarial support staff. The following is a list of faculty members, who make up the ARRC scientific leadership, along with their academic positions, and general research areas.

- Dr. Michael Biggerstaff, Associate Professor (SoM), polarimetric radars, mobile radars, cloud physics and electrification, hurricanes, severe local storms, storm dynamics
- Dr. Phillip Chilson, Associate Professor (SoM), Adjunct Associate Professor (ECE), atmospheric radar interferometry, upper-atmospheric physics, wind profiler technology, atmospheric dynamics
- Dr. Jerry Crain, Professor (ECE), phased array antennas and radar, radomes, microwave antennas, and electro-magnetic systems
- Dr. Robert Palmer, ARRC Director, Professor (SoM), Adjunct Professor (ECE), atmospheric radar signal/array processing, imaging (phased array) radar design, radar interferometry, clutter mitigation
- Dr. Sebastian Torres, Adjunct Assistant Professor (ECE), radar signal processing, design of embedded DSP systems
- Dr. Mark Yeary, Assistant Professor (ECE), radar signal processing, real-time hardware development, next-generation digital receiver design, and radar tracking algorithm development
- Dr. Tian-You Yu, Assistant Professor (ECE), Adjunct Assistant Professor (SoM), Radar signal and array processing, weather radar interferometry, knowledge-based algorithms for detection of severe weather
- Dr. Guifu Zhang, Associate Professor (SoM), Adjunct Associate Professor (ECE), remote sensing theory/technology/application, weather radar polarimetry and interferometry
- Dr. Yan Zhang, Assistant Professor (ECE), intelligent radio and radar sensing, RF-microwave system and instrumentation, random-noise radar, real-time system implementation on FPGA and DSP

As a unique feature of this group, many of the ARRC faculty members in both ECE and SoM hold courtesy appointments in the partner department. These appointments help to facilitate interdisciplinary advising and teaching, and have been made possible through the cooperation of the department-level administrators and other OU entities, such as the Graduate College, which strongly encourages interdisciplinary endeavors.

It should be emphasized that the ARRC has several joint projects with the NOAA laboratories in Norman, many of which are facilitated and administered by CIMMS. NSSL has a significant research program in weather radar and for decades has brought many important radar innovations to the meteorology community. Currently, NSSL operates two S-band weather radar systems - the polarimetric KOUN radar and the Phased Array Radar (PAR), which is the centerpiece of the National Weather Radar Testbed (NWRT). In addition, NSSL is a partner with OU, Texas A&M, and Texas Tech Universities, on the development and operation of two C-band mobile radars, which are appropriately named the Shared Mobile Atmospheric Research & Teaching Radars (SMART-R). NSSL is also working with OU on the development of a mobile X-band dual-polarimetric radar that will be completed this summer. The ROC is located in Norman and is an integral component of NOAA's National Weather Service (NWS) network of WSR-88D weather radars. Its mission is the development, maintenance, and operation of the entire network. In addition to numerous other scientific partners across the country and around the world, members of the ARRC have developed mutually beneficial collaborations with both NSSL and the ROC. Many of the major projects within the ARRC would not be possible without this close relationship.

The ARRC is located on the Research Campus of OU in the recently completed 244,00-square-foot National Weather Center (NWC) building shown in Figure 2. This unique facility brings together numerous OU units, including the SoM and CIMMS, with several NOAA and other government organizations. For example, the weather radar group of NSSL is located on the same floor as the ARRC and is in close proximity to the Applications Branch of the ROC. The NWC building has been instrumental in facilitating the collaboration between the ARRC and NOAA.

Figure 2. Photograph of the National Weather Center building located on the campus of the University of Oklahoma. This state-of-the-art facility houses the several university and government entities, including the Atmospheric Radar Research Center – ARRC.

3. Education

One of the fundamental goals of the ARRC is providing our students with a comprehensive and challenging education in the area of radar meteorology, which emphasizes both the engineering and meteorological aspects of the field. The following provides a brief description of the over-arching goals of our educational program and more specific information on course offerings.

3.1 General Philosophy and Goals

We achieve our educational goals, in part, by the creation and continual maintenance of a synergistic curriculum that syn-

thesizes the complementary disciplines of meteorology and electrical/computing engineering. As an integral component of the Weather Radar and Instrumentation Curriculum, an innovative and coherent sequence of radar-related courses has been developed which serves both our undergraduate and graduate educational goals. The undergraduate phase of the program is the ideal time to excite students about pursuing graduate studies in the general area of instrumented observations of the atmosphere and in particular weather radar. This novel curriculum is not independent of the more traditional curricula of the two disciplines, but rather forms an important and integral component of them.

Given the importance of weather radar for many observational studies of atmospheric phenomena, it is essential to include a significant hands-on experience for the students. Our curriculum provides a complete theoretical framework with which to understand weather radar theory while also providing access to local weather radar systems. We have developed laboratory modules for many of the radar courses using the SMART radars, the PAR, and the KOUN polarimetric Doppler radar. Experimental design, operation, data analysis, and interpretation are emphasized. It should be noted that the educational activities, within the ARRC, have been partially supported by the National Science Foundation's Division of Undergraduate Education through its Course, Curriculum, and Laboratory Innovation (CCLI) program.

With the goal of facilitating interdisciplinary participation, the courses that comprise this curriculum are generally cross-listed between ECE and SoM. By doing so, the standard requirements of each department are satisfied while allowing students the opportunity to participate in this program. Many of our radar courses could be considered difficult, even within ones own discipline. When taught by a faculty member from another department or when the emphasis is on an unfamiliar discipline, it is often difficult to fully engage in the course. As a conscious design decision in our courses, every effort is made to review necessary material during class with the goal of encouraging educational diversity among the students. Our faculty consists of scientists and engineers who have engaged in interdisciplinary research and education for years and are fully aware of the challenges of such endeavors. More importantly, we are keenly aware of the benefits of seamlessly integrating the disciplines and have organized this unique curriculum with this in mind.

3.2 Course Development Effort

The following figure provides a summary of courses, which make up the Weather Radar and Instrumentation Curriculum at OU. As can be seen, the courses span both the undergraduate and graduate curricula. Many of the courses are new and others have been substantially modified. The specific topics for each course, and the continuity between courses, were compiled from the input of faculty members and scientists from OU, and other local interested groups. As mentioned earlier and with few exceptions, courses are cross-listed between meteorology and electrical/computing engineering. As the program develops and the research field evolves, it is anticipated that new courses may be added and others removed or significantly modified. Such changes are necessary, encouraged, and specifically designed into the administration of the curriculum.

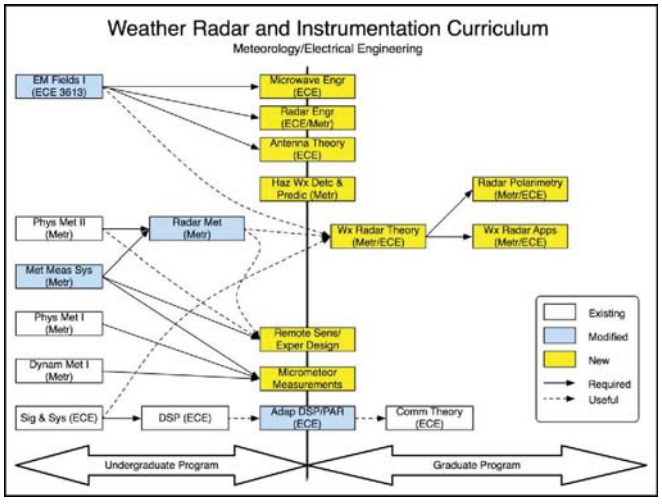


Figure 3. Weather Radar and Instrumentation Curriculum at the University of Oklahoma. The undergraduate and graduate courses are placed to the left and right of the figure, respectively. Solid and dashed arrows denote required and recommended prerequisite courses. Emphasis is placed on interdisciplinary participation and, as a result, significant class time is devoted to background material.

4. Research

Designed synergistically with its educational program, the ARRC's research activities are broad and represent the interdisciplinary nature of the group. The following provides only a brief outline of some of the topics being investigated within the ARRC.

4.1 Radar System Design

The focus of the radar system design effort within the ARRC is to develop customized radar technologies hand-in-hand with the ARRC scientists and engineers, who process and interpret the radar data. By leveraging this interdisciplinary approach, the next-generation of remote sensing systems can be developed with the ultimate goal of improved forecasting, hazardous weather prediction, and convective storm tracking, for example. Supporting these efforts is the ARRC's Radar Innovations Laboratory (RIL), which is depicted in the backdrop of Figure 4. The RIL is functionally dedicated to support RF engineering, customized embedded signal processing systems, and development of hardware solutions for synergistic

instrumentation, microphysics experiments, scattering studies, and intelligent processing for scientific discovery. This 4000+ sq. ft. laboratory is located on OU's research campus, near the National Weather Center. Thus, the RIL and its partners are in a position to provide end-to-end radar design, fabrication, and data collection/analysis. The RIL is an interdisciplinary, shared laboratory facility that is designed to be a focal point for partnerships between federal, university, and private enterprise in radar related research, development, manufacturing, training, maintenance, and support.

Figure 4. The ARRC's new Radar Innovations Laboratory is being used to facilitate the design of customized hardware to support the complete cycle of data collection through analysis.

Faculty members within the ARRC are currently applying advanced radar technologies to weather-related hazard monitoring. One aspect of this research is an indoor experimentation facility for hydrometeor scattering characterization under controlled environmental conditions. This unique facility is located within the RIL and is called the Electromagnetics-Microphysics Laboratory (EML). Following these advanced theoretical and experimental studies of wave scattering and propagation, traditional design techniques are used to develop reliable radar systems. One unique system currently under development uses modular receiving elements based on reconfigurable arrays of patch antennas. As analog-to-digital converters become faster, this will allow digital circuits to replace many analog circuit functions. This advancement will provide many additional degrees of freedom to radar processing and allow innovative software-defined-radio techniques to influence the design of digital receivers that follow these antennas. The combination of high-performance computing and distributed sensing provide new tools for researchers to observe the natural world at a fidelity that could only be imagined a few years ago. Activities in the RIL and EML are focused on uniting advanced digital hardware and software to yield computationally intelligent systems for the next-generation of atmospheric remote sensing.

4.2 Phased Array Radar

The nation's first phased array radar deployed for the sole purpose of weather observations is located in Norman, Oklahoma (see left panel of Figure 5). The PAR is an S-band Doppler weather radar recently developed by a government/university/industry consortium consisting of NSSL, Lockheed Martin Corporation, ROC, Office of Naval Research, FAA, BCI, OU, and the other government and private entities. It is envisioned that this prototype radar will serve as a testbed for studies of the feasibility of multi-mission capability, which would provide better utilization of radar resources for weather surveillance, aviation control and target detection/tracking. Collaborating with NSSL's engineers and scientists, ARRC members have been actively working on optimizing scanning strategies, developing and implementing radar interferometry, and advancing radar tracking and imaging techniques, for example.

The PAR has pulse-to-pulse beam steering capability that allows accurate measurements in a shorter dwell time than with a mechanically rotating dish. A novel scanning strategy termed beam multiplexing (BMX) was recently developed and implemented on the PAR with the goal of providing high quality data with fast update times through the collection of independent samples while maximizing the use of radar resources. As a result, the radar beam is steered agilely from one location to another as shown in Figure 5b. Recent experimental results from the PAR indicate that BMX can improve the data update time by a factor of 2 to 4, while maintaining the data accuracy of a mechanically rotating dish. These results are consistent with theoretical projected values. Various BMX-based scanning strategies are currently under development and it is envisioned that BMX data will soon be assimilated into numerical models to determine optimal scan strategies for improved weather forecasts.

The PAR uses an antenna from the AN/SPY1-A radar of the Navy's Aegis system, which uses a phase-comparison monopulse system. This system provides signals of the sum, azimuth difference, and elevation difference channels as shown in Figure 5c. With access to both the sum and difference channels, the monopulse tracking capability will soon be activated, allowing the implementation of advanced tracking algorithms, such as Kalman and particle filtering techniques. In addition to tracking, the sum and difference signals can be used to form the signals from the left and right, and upper and lower, sides of the antenna, allowing measurements of angular shear, and turbulence along the beam, and within the radar's resolution volume using Spaced Antenna Interferometry (SAI) shown in Figure 5d. As scatterers move

across the beams, there is a time delay between the two received signals, which is used to determine the crossbeam wind. The SAI technique is being implemented on the PAR via a high-speed RF switch, which is used to receive the signals alternatively between the sum and difference antenna ports. A wave scattering theory has been formulated for weather radar interferometry to retrieve crossbeam wind in the presence of shear and turbulence. It is shown that SAI measures an apparent crossbeam wind and can separate angular shear and turbulence.

The PAR also includes six sidelobe cancellation elements (two are depicted in Figure 5d) that allow the application of adaptive clutter mitigation schemes. Using both the PAR and advanced radar simulations, the ARRC is actively involved in the development of novel array processing schemes, many of which are designed to mitigate both stationary and non-stationary clutter. In addition, these processing methods have been shown to provide enhanced spatial resolution over what is expected from traditional radar theory. Many of these concepts are being actively pursued for implementation on future phased array systems and hold promise to revolutionize remote sensing of the atmosphere.

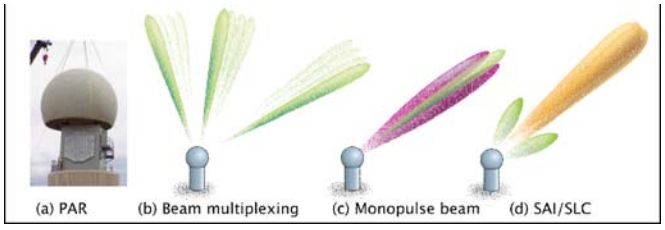


Figure 5. The NWRT phased array radar, (a) photograph of the installation of the radomes of the PAR, (b) sketch of BMX principle, (c) sketch of monopulse beams for target tracking, and (d) sketch of SAI beams for wind measurement along with two sidelobe canceling elements.

4.3 Radar Signal Processing

ARRC members are actively engaged with the development and implementation of novel signal processing techniques to enhance radar performance and data quality in both research and operational settings. Recently, the ARRC has developed several techniques to enhance range and angular resolution using oversampling. The redundant information from overlapped radar resolution volumes are used to adaptively deconvolve oversampled signals to resolve structures and dynamics at a scale smaller than typical resolution. Some of the techniques are applicable to future phased array radar systems, which could provide a cost-effective solution for multi-mission needs.

In addition to higher resolution, range oversampled signals can be transformed via decorrelation to increase the number of independent samples in order to estimate their corresponding Doppler spectrum, its moments, as well as several polarimetric variables on pulsed radars. This technique can be exploited in a combination of faster data temporal acquisition and denser spatial sampling as needed to satisfy some of the evolutionary requirements for the NEXRAD network as well as future multi-mission radar systems. Preliminary results have demonstrated that techniques employing range oversampling are capable of maintaining data quality without sacrificing acquisition time, which lend themselves to future enhancements of the national network of weather surveillance radars. ARRC members are also engaged in research related to clutter mitigation for weather radars and wind profilers through the development and implementation of novel filtering techniques in the time, frequency, and spatial domains. Furthermore, in most weather radars the range and Doppler velocity ambiguity problems are coupled such that trying to alleviate one simply worsens the other. To address this long-standing problem, the two techniques of system phased coding and staggered pulse repetition time have emerged as viable candidates for the NEXRAD network. The two techniques are complementary since they offer advantages at specific elevation angles; hence, they can be simultaneously incorporated into the same volume coverage pattern (or scanning strategy). Both techniques reduce the amount of purple haze obscuration currently encountered during the observation of severe phenomena, as shown in Figure 6.

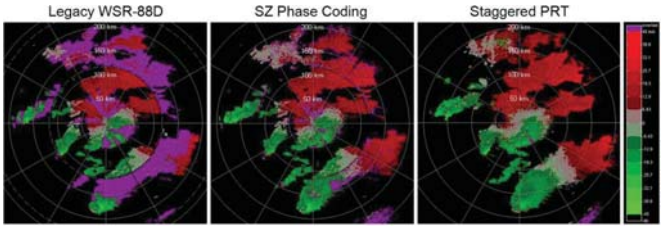


Figure 6. Doppler velocity PPI displays of severe storms in central Oklahoma obtained using legacy signal processing (left panel), systematic phase coding (center panel), and staggered PRT (right panel) algorithms. Purple color denotes an unrecoverable Doppler velocity due to overlaid echoes. Both systematic phase coding and staggered PRT techniques remove significant amounts of purple haze, resulting in displays with larger areas of recovered Doppler velocities.

The ARRC has also worked closely with the local weather forecasting office to develop automated radar algorithms to improve warning of severe storms. A hybrid tornado detection algorithm based on fuzzy logic and neural networks has been developed and tested within the ARRC, and was sponsored through NOAA's CSTAR program. It has been shown that the neuro-fuzzy detection algorithm (NFTDA) can provide improved detection with lower false alarm rates and extended detection range. Preliminary results are shown in Figure 7 for the May 9, 2003 tornado near Oklahoma City.

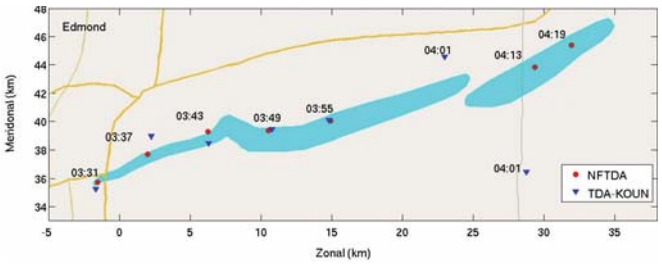


Figure 7. Comparison of tornado detection results from NFTDA (red circles) and operational detection algorithm (TDA, blue triangles). The x-axis is the east-west distance from the radar and the y-axis denotes the north-south distance. Tornado damage paths of May 9, 2003 tornadoes in Central Oklahoma are denoted by the blue shaded regions. It is evident that NFTDA produces more accurate and robust results, especially at 0413 and 0419 UTC, while the conventional Tornado Detection Algorithm (TDA-KOUN) did not report any tornado.

4.4 Observational Studies of the Atmosphere

Atmospheric research within the ARRC embodies a diverse spectrum of topics covering a wide range of spatial and temporal scales. Areas of investigation extend from the Earth's surface upwards to heights of 100 km. Consequently, the members of the ARRC incorporate observations from a variety of radar platforms and radar techniques into their investigations. For example, we are using long wavelength radars located above the Arctic Circle to study the evolution of plasma trails left by meteors as they enter the Earth's atmosphere and ablate (at heights between 80 and 100 km). From these observations, it is possible to estimate the temperature, chemical composition, and wind field representative of the heights at which the meteors disintegrate. Additionally, upper atmosphere radars are used to study ice clouds that form at high latitudes around 85 km above the Earth. Although very little water vapor is present at these heights, the temperatures can be as low as 100 K, which is well below the frost point for the formation of ice particles. There has been a noticeable increase in the occurrence of the upper altitude clouds, which some scientists attribute to an increase in greenhouse gases.

In contrast to these measurements, the ARRC boundary layer radar (BLR) is being used to investigate the dynamic and thermodynamic properties of the daytime convective boundary. The boundary layer is that layer of the atmosphere, which is most strongly coupled with the planetary surface. Measurements from the 33-cm radar are being combined with high spatial and temporal resolution large eddy simulation data, which together provide valuable information on the evolution of the boundary layer depth, its turbulence properties, and how it interacts with the free troposphere above. The BLR is additionally being used in a detailed study of precipitation microphysics. For example, this vertically pointing radar can observe the transition of precipitation from snow into rain as it falls through the height of the freezing level.

Observations from the BLR are being studied in conjunction with measurements from weather radars and in-situ instrumentation. These radars include the mobile SMART radars (see Figure 8), which are currently being upgraded to provide polarization diversity that can improve quantitative rainfall estimation and yield insight into the microphysical structure of clouds, and the mobile NSSL-OU X-band dual-polarimetric (NO-XP) radar. Since lightning depends on the charge separated through the collisions of ice and supercooled water particles above the freezing level, polarization diversity radars are important tools in cloud electrification studies. The mobile C-band Doppler radars have also been used to study severe thunderstorms, including tornadoes, and the evolution of the fine-scale structure of land-falling hurricanes. Hence, research conducted within the ARRC spans micro-scale to hurricane-scale phenomena from the Earth's boundary layer through the mesosphere.

Figure 8: Photograph of one of the two SMART radars during a downdraft haboob event in Arizona. One of the SMART radars will soon be upgraded with dual-polarization capability allowing many new research areas.

4.5 Atmospheric Quantification/Validation and Forecast

Accurate radar measurements allow improved quantification and forecasting of the atmosphere in both clear-air and active weather conditions. Scientists within the ARRC have developed refined methods of retrieving atmospheric refractivity, which is related to moisture, from the radar signal phase of stationary ground targets. These investigations have led to innovative methods for implementation on shorter wavelength radars. Furthermore, statistical studies have been undertaken on the robustness of these refractivity measurements using extremely short dwell times, allowing the possibility for multi-mission capability on phased array radars.

ARRC members are also studying cloud and precipitation microphysical properties and their parameterization based on video disdrometer, wind profiler, and polarimetric radar observa-

tions. The S-band polarimetric KOUN radar is located on OU's north campus and provides measurements of reflectivity, differential reflectivity, co-polar cross-correlation coefficient, and differential phase. The ARRC's two-dimensional video disdrometer (2DVD) is deployed at the OU Kessler Farm Field Laboratory (KFFL), which lies approximately 30 km south of the radar, and measures detailed information about the size, shape, and density of precipitating particles on the ground. Also located at KFFL is a vertically pointing profiling radar (ARRC BLR) and a dense network of rain gauges. The profiling radar is used for investigation of precipitation (or clear-air) characteristics as a function of height. Together, these instruments provide a valuable source of validation and inter-comparison for the dual-polarization measurements of KOUN. ARRC members have developed a related algorithm, which can be used to retrieve hydrometeor drop size distributions (DSD) from polarimetric and profiling radar measurements. Working with the numerical modeling group at OU, ARRC members have used the disdrometer and radar-derived DSDs to improve the parameterization of microphysical processes such as evaporation and accretion. These advanced parameterization schemes have been used to enhance numerical weather forecasting. Furthermore, validation studies of the parameterization schemes are planned using the nascent EML.

Collaborating with NCAR scientists, ARRC members have investigated the impact of microphysics parameterization in the Variational Doppler Radar Analysis System (VDRAS) for convective storm initialization and prediction as shown in Figure 9. Results of 30-min forecasts are compared to those from the Marshall-Palmer (M-P) DSD model used by the original VDRAS and to radar estimates. The top-left panel is the water content estimated from the polarization radar (S-Pol) measurements of Z and ZDR. The top-right panel is reflectivity-based rainwater estimates from the KMLB radar. The water content forecasted using the new model is consistent with the S-Pol radar estimate while the M-P model-based results do not agree with the estimates using either radar. It is found that improved parameterization and accurate initialization improve weather forecasts. As mentioned previously and to better understand cloud and precipitation physics and physical processes, the EML is currently under development within the ARRC.

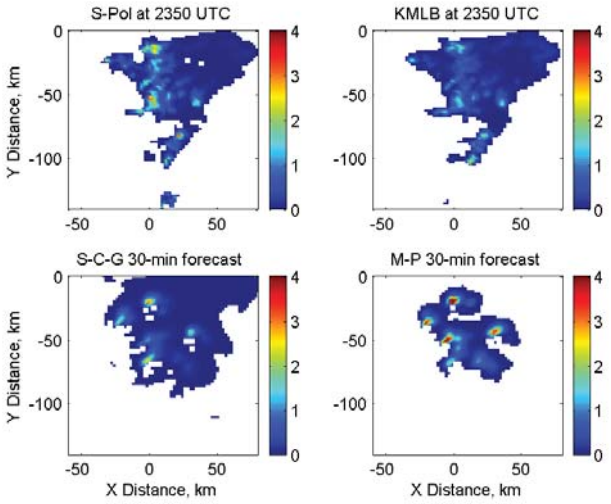


Figure 9. A comparison of low-level rain water content (g m-3) estimated by radars (upper panel) and model forecasts with VDRAS (lower panel) using the new (simplified constrained gamma: S-C-G) and Marshall_Palmer (M_P) DSD models.

5. Summary

The University of Oklahoma has established the Atmospheric Radar Research Center (ARRC), which is an interdisciplinary group of engineers and scientists from the School of Meteorology and the School of Electrical & Computer Engineering. The ARRC is leading OU's educational activities in radar meteorology with the advent of its unique curriculum and emphasis on hands-on participation of the students. Closely coupled with its educational activities, ARRC research is quite broad but follows along the general thrusts of radar system design, phased array radar, signal/array processing, observational studies, and quantitative measurements of the atmosphere. Since its establishment, ARRC members have been able to put forth numerous radar innovations in terms of both algorithms/theory and unique system designs and fabrication.

In our academic setting at the NWC, ARRC members are currently working with numerous groups outside the Norman scientific community and fully welcome new partnerships. In addition, our active research and educational environment allows students (engineering and meteorology) to thrive and grow to their full potential. For more detailed information on the ARRC, see our website at http://arrc.ou.edu or contact us directly for further information.

REPORTS

IEEE FOUNDATION FUNDS GRSS COLLABORATION WITH MUSEUM PROJECT

In growing numbers, institutions involved in the field of "informal education" (which we all know as museums and similar venues) are trying to create experiences for their visitors that closely simulate engineering endeavors and activities. Our purpose is to contribute to this field in a novel way. We will demonstrate how leading experts within the IEEE, and specifically within GRSS can develop partnerships with professionals at these institutions, whose expertise is in developing and building their exhibits. This new type of relationship can enlarge the resources of an individual museum without adding significant internal costs. We see this as an opportunity to provide a realistic impression of what engineering activity is like, so that young people can sense the intellectual challenge and enjoyment of creating systems that have an important function and fill a societal need.

As a member of the GRSS ADCOM, Dr. David Weissman has obtained a Grant from the IEEE Foundation that will support the development of an exhibit that will display the engineering aspects of an important subject of general interest. This project has a two year timeline, and will be conducted in collaboration with Mr. Paul Orselli, of the Paul Orselli Workshop, Baldwin, New York

From the viewpoint of the IEEE Foundation, this project will demonstrate how the resources of IEEE and museums can be brought together to educate pre-college students as to the nature of engineering endeavors. It will create an exhibit that can teach young people about one area of engineering through innovative presentations that encourage visitor interaction. It will show, by focusing on one subject area from a particular IEEE society (Geoscience and Remote Sensing), how students can participate in engineering activities within the context of a museum exhibit. The Weather Radar Portable Engineering Educational Kiosk (WRAPEEK) will be designed to show students and family groups how radar instruments observe rain and collect data about weather systems. This project meets the aims of the Foundation as the content and activities of WRAPEEK are meant to increase the user's interest and understanding of the engineering behind these technologies. We hope to motivate other IEEE societies to use their expertise in similar ways.

WRAPEEK will be an interactive exhibit designed to show students and family groups how a radar instrument collects data about precipitation. Exhibit users will learn how useful information is acquired using engineering methods, and how it is made available to the responsible authorities and the general public. The exhibit will be created so as to display the actual properties of a radar beam, the reflection from raindrops, the identification of the location of the precipitation and its intensity. The student-observers will be permitted to control and alter some parameters of the radar system, as if they were engineering developers of an optimum configuration. The primary goal for WRAPEEK is to produce a portable exhibit related to the NEXRAD weather data collection system that is used by the National Weather Service stations across the United States. Secondarily, we would make our content and construction information available in an "open source" format to allow others to replicate the WRAPEEK material. During the design and development phase, the project team will finalize content through the input of IEEE experts in the field of weather measurement, and their related institutions. Paul Orselli will develop proof-of-concept exhibit prototypes and test them to evaluate the effectiveness of the content delivery to a variety of audiences (students, family groups, travelers, etc.) in different environments (schools, museums, airports, etc).

We view WRAPEEK as one example of how the IEEE can contribute to the motivation of young people towards engineering careers. The exhibit will present users with realistic content and provide them with a personal experience through an activity that they are likely to remember because it deals with a subject (rain and similar weather systems) that is relevant to their daily life. For the most part, museums do not employ experienced engineers on their exhibit development staffs that could initiate the type of program we are presenting here. WRAPEEK can illustrate a new method by which the IEEE can outreach to the general public. A successful demonstration of this concept can be a model for others who wish to create engineering based museum exhibits.

GRS-S Strategic Planning Update:

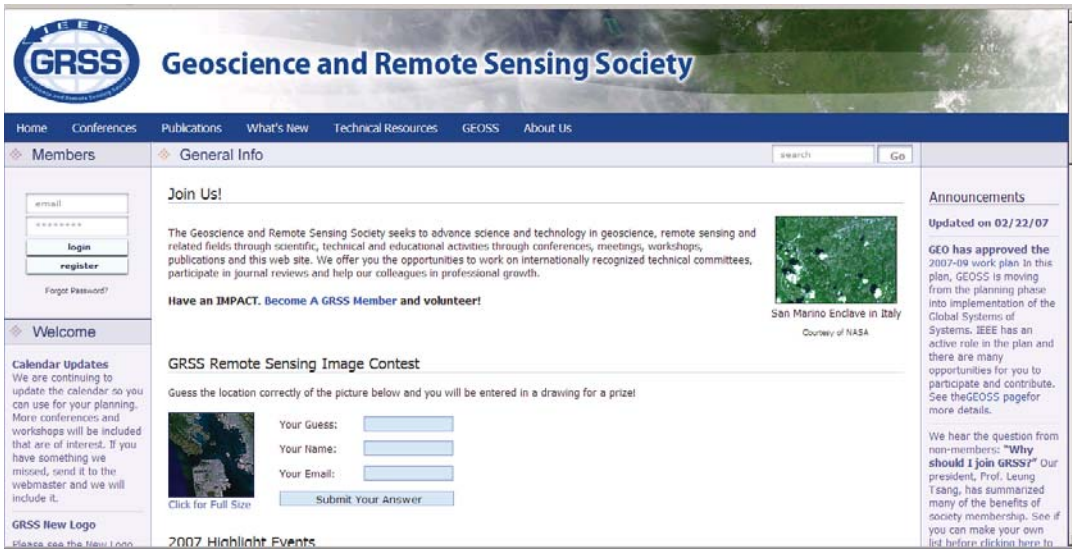
The GRSS Administrative Committee has recently finished a review of its strategic planning which is now planned to occur every five years. The focus of this cycle is to provide the membership with improved benefits and more access to technical and professional information. The Society is convinced that service to the broader remote sensing community is critical to the inherent service to its members. The Society has included the following objectives in its revised strategic planning document:

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

In connection with these objectives are several initiatives the Society is undertaking in order to support our members' professional and personal interests. We believe our members will begin to recognize more value in products delivered by GRS-S including IGARSS symposia and associated proceedings and journal publications. There has been a concerted effort on our part to provide an additional forum focused on geoscience and remote sensing applications. The new journal is currently in the approval process within IEEE TAB. We have also increased our offerings of tutorials at IGARSS and have begun offering some of these on the GRS-S website. Our participation in IEEE ICEO and the more global GEOSS activities, will improve our ability to respond to international societal issues.

Our new initiatives have been structured to provide improved services to the membership. We will improve the AdCom's ability to function within its face-to-face meeting and allow it to conduct business between its three yearly meetings. We will invest significant resources to improve web-based interfaces for both AdCom members and members of GRS-S. We shall also look to a more aggressive IGARSS placement strategy to improve community access. We have increased the number of GRS-S sponsored workshops and conferences. Finally we will restructure AdCom functionality to streamline effectiveness and improve our ability to deliver to the membership.

Our strategic initiatives are located on the GRSS member Website and we encourage comments and suggestions from the membership to help us improve the process.



Do you want to be informed about Remote Sensing?
Do you want to read the GRS-S Newsletter as soon as it goes to print?
Do you want to know the history of IGARSS?
Do you want to participate in the GRSS Remote Sensing Image Contest?
Are you looking for Remote Sensing tutorials?
This, and much more, available at the IEEE Geoscience and Remote Sensing Society web site!!
http://www.grss-ieee.org/

CALL FOR PAPERS

Fourth International Workshop on the Analysis of Multitemporal Remote Sensing Images – MULTITEMP-2007

July 18-20, 2007
Provinciehuis, Leuven, Belgium

The Fourth International Workshop on the Analysis of Multi-temporal Remote Sensing Images (MULTITEMP-2007) will continue the objective of the previous editions to assess the state-of-the-art in the analysis of multi-temporal remote sensing and geospatial data. The workshop will have oral and interactive presentations dealing with both the theoretical and applied issues surrounding the use of multi- and hyper-temporal information in support of the sustained management of earth's resources.

MULTITEMP-2007 is soliciting papers in the following topic areas:

- Registration, calibration and correction techniques for multi-temporal data
- Multi-temporal classification techniques
- Multi-temporal compositing schemes
- Change detection algorithms
- Time-series and hyper-temporal analysis
- Change detection performance assessment
- Data fusion in multi-temporal imagery
- LIDAR multi-temporal data analysis
- SAR and InSAR multi-temporal data analysis
- Monitoring dynamics of land cover and land use
- Plant production system monitoring and modeling
- Novel approaches to multi-temporal data handling
- Novel multi- and hyper-temporal applications

Contributions are welcome from the scientific community dealing with innovation as well as from the applications' sector focusing on using the resulting methods in practical settings. The workshop will include papers accepted for oral and interactive presentation and all accepted papers will appear in the workshop proceedings.

Workshop Chairs:
Pol Coppin, Katholieke Universiteit Leuven, Belgium
Niko Verhoest, Universiteit Gent, Belgium

Abstract submission:
Before January 31, 2007
2-page extended abstract
Email to
multitemp-2007@biw.kuleuven.be

Registration fees:
€ 250

Web Address:
www.biw.kuleuven.be/multitemp2007

Multi Temp 2007

BREAKING NEWS!!!

OCEANS'07 Aberdeen* AND *EurOCEAN 2007
In conjunction in Aberdeen, Scotland from 18-22 June 2007
First Time for either in the UK!

These major OCEANS AND MARINE CONFERENCES will join forces to bring the World-wide marine community of scientists, engineers, technologists and policy makers together in a frame work of easy and informed discussion.
An EXHIBITION of oceanic industry and research institutions will run side-by-side in the state-of-the-art
Aberdeen Exhibition and Conference Centre (AECC)

The theme of *Oceans'07 Aberdeen*, ***"Marine Challenges: Coastline to Deep Sea"***, highlights the significant challenges; from the shallowest waters around our coasts to the deepest subsea trenches, which face marine and oceanic engineers in our drive to understand the complexities of the world's oceans and our ability to utilise, explore and preserve this unique environment. Oceans will run from 18-21 June 2007.

The focus of *EurOCEAN 2007* will be a consultation, discussion, and analysis of the European Commission's recently published Green Paper on a future ***"Maritime Policy"*** for the EU. This policy is aimed at optimising the economic value of all maritime sectors in a socially and environmentally sustainable way. *EurOCEAN 2007* will take place on 22 June 2007 and will play a major role in the consultation process with the marine RTD community.

The Chairs of *Oceans07 Aberdeen* and *EurOCEAN 2007* invite you to participate in this unique event. Aberdeen has a long and distinguished pedigree in maritime affairs stretching back a thousand years through exploration, shipbuilding, fishing and science and engineering to its position now as the "oil and gas capital of Europe". It is fitting that Aberdeen is the first UK city to be chosen to host both *Oceans* and *EurOCEAN* and the first to host the joint event.

For further information on *Oceans07 Aberdeen* and *EurOCEAN 2007* go to our websites
www.oceans07ieeeaberdeen.org
www.eurocean2007.com

IEEE Electromagnetics Award

The deadline for nomination has been extended to July 1, 2007

For more information and a nomination form please visit the website at:
http://www.ieee.org/portal/pages/about/awards/sums/electro.html

ANNOUNCEMENT: Professor Mikio Takagi Student Prize

Professor Mikio Takagi, Chairman of the 1993 International Geoscience and Remote Sensing Symposium held in Tokyo, and a former Administrative Committee member of the IEEE Geoscience and Remote Sensing Society (GRSS), passed away in February 2006. A very fitting Memorial tribute honoring his lifetime contributions was published in the September 2006 Issue, page 7 of the GRSS Newsletter.

To honor his contributions to education, the Professor Mikio Takagi Student Prize was established with funds from friends and family of Mrs. Atsuko Takagi. A $500 honorarium will be given to the student presenting the best paper at the IEEE GRSS International Symposium. The funds are held by the IEEE Foundation, and the presentation of the Prize is under the jurisdiction of the IEEE Geoscience and Remote Sensing Society. The Prize will be given for the first time at the International Geoscience and Remote Sensing Symposium in Barcelona, Spain in July 2007.

CALL FOR PAPERS

UPCOMING SPECIAL ISSUE – DATA FUSION

Submission deadline: May 31, 2007

Data fusion emerged as a new topic in the late ’80, but it was only by the first half of the following decade that the availability of remotely sensed data in digital form by different sources allowed considering remote sensing data fusion. At that point, the Data Fusion Technical Committee of GRSS recognized the need for a Special issue of TGARS about “Data Fusion”, which was published in May 1999. That pioneering issue brought to the attention of many researchers the need for an increased effort towards the joint exploitation of multiple data or information sources.

In the following years, and until now, some of the fields highlighted in that issue came to a full maturity. Many other research fields have however emerged, as results of the continuous improvement in data quality and quantity, and the fast changing electronic and optical technologies, that allow recording, transmitting and storing of huge information amounts. For instance, spatial and spectral resolution of remotely sensed data are steadily increasing, going towards very high resolution (VHR) sensors, both in the spatial and in the spectral sense. This requires combined spectral and spatial analysis, and fusion of features extracted and selected at different scales. Moreover, the third dimension is no more an option for remotely sensed data, and multiple bi-dimensional view analysis of the same area, as well as multiple three-dimensional data comparison and combination, are some new faces of the same data fusion problem. At a higher level, feature fusion has been also increased by the larger CPU power and memory capacity of modern processors, still to be pushed by the use of multiple CPUs and grid/distributed computing.

New research fields are emerging, and new forces are working towards new data fusion algorithms, architectures and solutions. The Special Issue will give them an option to discuss their achievements and set a further mileage stone in the Data Fusion Technical Committee history.

Papers are solicited on Multi-scale/view/resolution data fusion, applications of data fusion approaches to hyperdimensional and multi-source data, feature extraction and pre-processing methods for data fusion, and Information fusion approaches. Submissions are encouraged however in a broad range of algorithms which demonstrate substantive use of data fusion remote sensing methodologies.

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

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

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University of Pavia
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E-Mail: jocelyn.chanussot@lis.inpg.fr

Important Dates

Abstract Submission System Online	1 December 2006
Invited Abstract Deadline	5 January 2007
General Abstract Deadline	12 January 2007
Abstract Status Available Online	19 March 2007
Full Paper Submission & Registration Fee	27 April 2007
Publishing Author Registration Deadline	27 April 2007
Early Registration Deadline	31 May 2007
Presenting Author Registration Deadline	31 May 2007
Conference Hotel Rates Expire	check hotel websites

29th Review of Atmospheric Transmission Models

13-14 June 2007
Museum of Our National Heritage
Lexington, Massachusetts

CALL FOR PAPERS

The conference will provide scientists, engineers, and technical managers from academia, industry, government, and the military with a forum to present their research and exchange ideas on all aspects of atmospheric science as it effects radiative transfer and the retrieval of atmospheric and surface properties. Papers on phenomenologies associated with diverse aspects of earth-atmospheric radiative transfer, including cloud and aerosol effects, surface characterization, solar illumination, littoral interfaces, and polarization, are especially welcome. This will be an unclassified meeting featuring renowned keynote speakers and technical program sessions.

Abstract Deadline: 01 May 2007

For more information, visit www.grss-ieee.org or contact steintammy@sbcglobal.net.

4th GRSS/ISPRS Joint Workshop on Remote Sensing and Data Fusion over Urban Areas

6th International Symposium on Remote Sensing of Urban Areas

URBAN REMOTE SENSING JOINT EVENT 2007

11-13 April 2007
ENST, Paris, FRANCE

URBAN2007 Chair:
Paolo Gamba, Univ. of Pavia, Italy

UR2007 Chair:
Carsten Juergens, Univ. of Bochum, Germany
Derya Maktav, Technical Univ. Istanbul,. Turkey

Abstract submission:
Before September 30, 2006
2-pages abstract, no less than 600 words
Email: urban_2007@unipv.it

Web Address: http://tlc.unipv.it/urban-remote-sensing-2007/

3rd International Conference on
Recent Advances in Space Technologies
Space for a More Secure World
RAST 2007

14-16 June 2007, Istanbul, TURKEY
www.rast.org.tr

Organized by:
Aeronautics and Space Technologies Institute (ASTIN),
Turkish Air Force Academy, Turkey
Bo_aziçi University, Turkey
Istanbul Technical University, Turkey
Marmara University, Turkey
Bahçe_ehir University, Turkey

Co-sponsored by:
AIAA (American Inst. Aero. & Astro.)
Scientific and Technical Research Council of Turkey (TUBITAK), Turkey

In Technical Co-operation with:
IEEE Aerospace & Electronic Systems Society
IEEE Geoscience & Remote Sensing Society
AAAF Groupe Régional Centre, France
ASCE-Aerospace Division
ISPRS (Int.Soc.Phot.Rem.Sen.)

Honorary Chair:
Major Gen. Orhan U_urluo_lu
Commander, TuAF Academy

General Chair:
Col. Sefer Kurnaz,
Director, Aeronautics and Space Technologies Inst.

Technical Program Co-chairs:
Fuat Ince
ASTIN and Maltepe University
M. Fevzi Ünal
ASTIN and ITU

Registration fees: 300 Euros

Web Address:
www.rast.org.tr

Submission deadlines:

Submission of summaries and special session proposals	**18 November 2006**
Notification of acceptance	**05 February 2007**
Camera-ready submission of full papers	**16 March 2007**

2007 International Waveform Diversity & Design Conference

4-8 June 2007, Pisa, ITALY
http://www.waveformdiversity.org

IEEE Antennas & Propagation Society
IEEE Aerospace & Electronic Systems Society
IEEE Geoscience & Remote Sensing Society

Original contributions are invited in areas of Sensing and Communications. Specifically, topics include:

Radar Systems	Multi-function Operation	Modulation Schemes
Sonar Systems	Impulsive Systems	Multiple-access Schemes
3G/4G Communication Systems	Tomography	Multi-user Operation
Laser Systems	Ultra-wideband Operation	Bandwidth-on-Demand
Interference Suppression	Target Detection	Synchronization
RF Compatibility	Tracking	RF Imaging
Space-Time Adaptive Processing	Interferometry	Hardware Efficiency
Channel Estimation/Equalization	SAR/ISAR	Bi-static/Multi-static Operation
Software Agile Radio/Radar	MIMO Communications	Sensor Fusion
Passive Sensing Operation	RF Hitchhiking	Polarimetry
Target Adaptive Matched Filtering	Error Correction Coding	EM Phenomenology

Submission deadlines:

Submission of abstracts	**8 December 2006**
Notification of acceptance	**9 February 2007**
Submission of full papers	**30 March 2007**

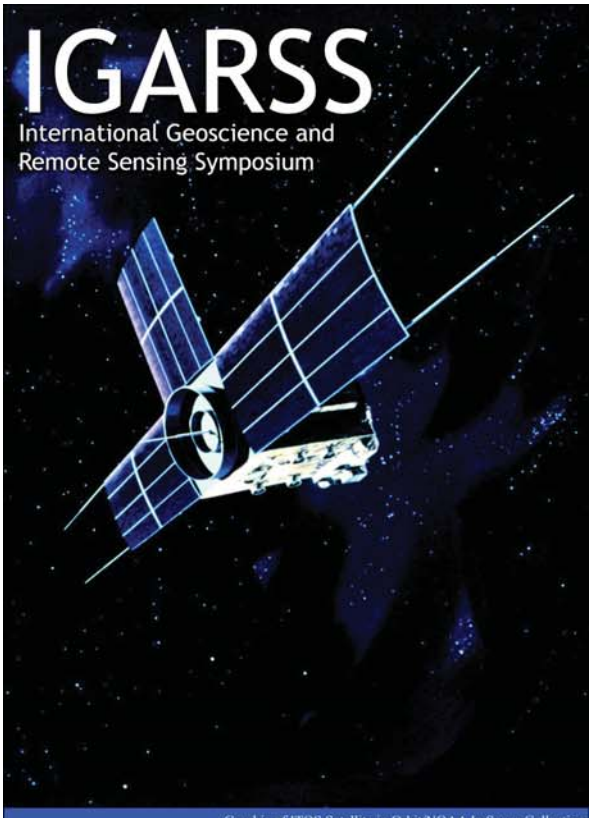
(President's Message continued from page 4)

I would like to thank Dr. David LeVine for designing a new logo for the GRSS Society. The new logo, with the society name more visible, debuts in this Newsletter and our website. In December 2006, we received word that the Society's proposal to the IEEE Foundation on "Weather Radar Portable Engineering Educational Kiosk" museum exhibit was approved. The proposal was prepared by Professor David Weismann, Publicity Chair of the GRSS_ADCOM. The exhibit will be displayed at Long Island Museum of Science and Technology. The proposed exhibit will expose the public to the use of radar instrument to observe rain and collect data for monitoring weather. The exhibit is interactive and exhibit attendees can adjust parameters of the system to achieve optimal configurations. We also plan to display this exhibit in our IGARSS Symposia, starting with the July IGARSS'08 symposium in Boston.

I congratulate Dr. Keith Raney for receiving the 2007 IEEE Dennis J. Picard Medal for Radar Technologies and Applications - "For innovation and technical leadership in the implementation and application of earth-observing and planetary radars". The IEEE Dennis J. Picard Medal for Radar Technologies and Applications was established in 1999 for outstanding accomplishments in advancing the fields of radar technologies. Dr. Raney was a Past President of GRSS and has served as an associate editor of the IEEE Transactions on Geoscience and Remote Sensing for many years. Dr. Raney is a foremost expert on the physics, design and signal processing of Synthetic Aperture Radar. He was a leader in the RADARSAT mission.

I congratulate three GRSS members who were elected IEEE Fellows in 2007. They are: Prof. K. S. Chen "for contributions to remote sensing image and signal processing", Prof. Melba Crawford "for applications of satellite data and airborne LIDAR imagery" and Dr. Paris Vachon "for contributions to operational marine applications of imaging radar".

I would like to welcome three new AdCom members, Dr. Roger King, Dr. Adriano Camps and Dr. Wooil Moon. Dr. King will serve as Co-Chair of Specialty Symposia. This is an important task as the Society plans to establish closer ties and strong collaboration with sister societies in Geoscience and Remote Sensing. Dr Adriano Camps will serve as WebMaster, a heavy responsibility as the Society seeks to increase web-based service to our members. He will work closely with Dr. Jay Pearlman, who is the VP of Information Resources, a new position created by the Society. Dr. Wooil Moon will serve as Chair of the Fellows Evaluation Committee. The GRSS has a large number of distinguished scientists and engineers that deserve to be IEEE Fellows. Dr. Moon's Fellow evaluation Committee has the difficult task of making thorough and fair evaluations. I would like to thank Drs. Kamal Sarabandi, Martti Hallikainen and Ellsworth LeDrew for taking their new roles. Dr. Sarabandi is the Editor-in-Chief of the new IEEE_GRSS book series on remote sensing. Dr. Hallikainen is the Co-Chair of the Awards Committee. Dr. Ellsworth is the new Editor-in-Chief designate of the GRSS new Journal on Remote Sensing Applications which is to be launched in 2008.



Graphic of ITOS Satellite in Orbit/NOAA In Space Collection

Future Locations

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

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

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

IGARSS 2010 • Honolulu, Hawaii
Karen St. Germain, NPOESS IPO
(karen.stgermain@noaa.gov)
and Paul Smits, ISPRA (paul.smits@jrc.it),
General Co-Chairs

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

UPCOMING CONFERENCES

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

Name: 10th Int'l Symposium on Physical Measurements and Signatures in Remote Sensing (ISPMSRS '07)
Location: Davos, Switzerland
Dates: March 12-14, 2007
URL: http://www.ispmsrs07.org

Name: 4th GRSS/ISPRS Joint Workshop on Remote Sensing and Data Fusion over Urban Areas
6th Int'l Symposium on Remote Sensing of Urban Areas
Location: Paris, France
Dates: April 11-13, 2007
Contact: Paolo Gamba (URBAN2007), Carsten Juergens, Derya Maktav (UR2007)
E-mail: urban_2007@unipv.it
URL: http://tlc.unipv.it/urban_2007/index.html

Name: IEEE/MTS International Microwave Symposium (IMS)
Location: Honolulu, HI
Dates: June 2-8, 2007
Contact: Wayne Shiroma
E-mail: shiroma@ieee.org
URL: http://www.ims2007.org

Name: 2007 International Waveform Diversity & Design Conference
Location: Pisa, Italy
Dates: June 4-8, 2007-01-21
Contact: Patricia Woodard
E-mail: patricia.woodard@rl.af.mil
URL: http://www.waveformdiversity.org

Name: 3rd International Conference on Recent Advances in Space Technologies
Location: Istanbul, Turkey
Dates: June 14-16, 2007
URL: http://www.rast.org.tr

Name: International Geoscience and Remote Sensing Symposium IGARSS 07
Location: Barcelona, Spain
Dates: July 23-27, 2007
Contact: Ignasi Corbella
E-mail: corbella@tsc.upc.edu
URL: http://www.igarss07.org

Name: International Symposium on Antennas and Propagation (ISAP 2007)
Location: Niigata, Japan
Dates: August 20-24, 2007
E-mail: isap-2007@mail.ieice.org
URL: http://www.isap07.org/

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