

Guest Editorial

Foreword to the Special Issue on Synthetic Aperture Radar (SAR) Technologies and Techniques

THIS Special Issue is associated with the 6th European Conference on Synthetic Aperture Radar (EUSAR), which was held in Dresden, Germany, in May 2006. For the last ten years, EUSAR has accompanied the worldwide evolution of high-resolution imaging radar, both airborne and spaceborne, and has helped to establish an international community of SAR engineers and scientists. As in previous years, EUSAR'06 provided a forum for exchanging information and discussion on a wide variety of research topics representing the latest SAR developments. The EUSAR'06 conference represents the continuation of the biennial EUSAR series of scientific symposia devoted to the technology, techniques, and applications of SAR remote sensing. EUSAR is organized by the German Association for Electrical, Electronic and Information Technologies/Information Technology Society, German Aerospace Center (DLR), Forschungsgesellschaft für Angewandte Naturwissenschaft (FGAN), European Aeronautic Defence and Space Company (EADS), and EADS Astrium, and is technically sponsored by the IEEE Geoscience and Remote Sensing Society (GRS-S), IEEE Aerospace and Electronic Systems Society (AESS). During EUSAR'06, we had 49 sessions in three days of conference, including 22 invited sessions, full-day tutorials on topical themes, an industrial exhibition, as well as the awards presentation during the closing session at the last day of the conference.

SAR is an indispensable source of information in Earth observation since SAR is the only spaceborne sensor that has high-resolution all-weather day-and-night imaging capability. SAR already plays a major role in a wide spectrum of applications as for 2-D and 3-D mapping, environmental monitoring, retrieval of biophysical/geophysical parameters of land, ocean, and ice surfaces, hazard and disaster monitoring, as well as reconnaissance and security-related applications. Information extraction has achieved a mature and operational level in a number of different fields, making the contributions of SAR systems to present and future programs like GMES and GEOSS a very essential one.

Today, we stand at the threshold to a new era of spaceborne and airborne SAR systems. New satellite systems like TerraSAR-X, SAR-Lupe, CosmoSkymed, Radarsat-2, TanDEM-X, and Sentinel-1 will provide radar images with a resolution cell up to a hundred times smaller than with conventional SAR systems. They will also outperform by far

existing systems with respect to their imaging flexibility and interferometric modes.

The objective of this Special Issue, which was open to all researchers and contributors, was to select outstanding papers on recent advances in the field of SAR, bringing together participants from the research, industrial, and academic communities who are engaged in projects on the technologies and techniques of SAR. Within the next ten years, more than 20 spaceborne SAR systems from different nations will be launched, and tremendous advances are being achieved in this area. For example, driven by the user requirement for enhanced performance and system flexibility, several new ideas and technological innovations have been presented during the EUSAR'06 conference in the field of digital beamforming, bistatic SAR, polarimetry, and polarimetric SAR interferometry.

For this TGARS Special Issue, we obtained an excellent resonance from the Call for Papers with a total of 53 papers submitted. As a result of a careful review process, 23 papers have been accepted for publication. These papers cover the most topical research areas in SAR techniques and technologies as bistatic SAR, innovative system concepts, polarimetric systems and data analysis, polarimetric SAR interferometry, as well as advanced processing techniques for image generation and information extraction.

We would like to thank all the reviewers for their time and dedication to the review process. The Guest Editors are also very grateful to Prof. Jon Atli Benediktsson, Editor of IEEE TGARS, for his encouragement and support in preparing this Special Issue.

ALBERTO MOREIRA, *Guest Editor*
Microwaves and Radar Institute
German Aerospace Center (DLR)
82230 Oberpfaffenhofen, Germany

DAVID HOUNAM, *Guest Editor*
Microwaves and Radar Institute
German Aerospace Center (DLR)
82230 Oberpfaffenhofen, Germany

WERNER WIESBECK, *Guest Editor*
University Karlsruhe (TH)
76131 Karlsruhe, Germany



Alberto Moreira (M'92–SM'96–F'04) received the B.S.E.E. and M.S.E.E. degrees from the Aeronautical Technological Institute, Sao Jose dos Campos, Brazil, in 1984 and 1986, respectively, and the Eng. Dr. degree (Honors) from the Technical University of Munich, Munich, Germany, in 1993.

In 2003, he received a full professorship from the University of Karlsruhe, Karlsruhe, Germany, in the field of microwave remote sensing. As its Chief Scientist and Engineer, he managed from 1996 to 2001 the SAR Technology Department of the Microwaves and Radar Institute, German Aerospace Center (DLR). Under his leadership, the DLR airborne SAR system, E-SAR, has been upgraded to operate in innovative imaging modes like polarimetric SAR interferometry and SAR tomography. Since 2001, he has been the Director of the Microwaves and Radar Institute, DLR. The Institute contributes to several scientific programs and space projects for actual and future airborne and spaceborne SAR missions. Recently, the mission proposal TanDEM-X lead by his Institute has been approved for the realization phase. He is the initiator and Principal Investigator for this mission, which will be the first bistatic radar interferometer in space. His professional interests and research areas encompass radar end-to-end system design and analysis, innovative microwave techniques and system concepts, signal processing, and remote sensing applications.

Prof. Moreira is a member of the IEEE Geoscience and Remote Sensing Society (GRS-S) Administrative Committee (1999–2001 and 2004–2009), is the Chair of the German Chapter of the GRS-S since 2003, and is actively serving as an Associate Editor for the IEEE GEOSCIENCE AND REMOTE SENSING LETTERS. Since 2003, he has been a member of the Board of Directors of the German Association for Electrical, Electronic and Information Technologies/Information Technology Society. He was the Recipient of the DLR Science Award in 1995. He and his colleagues were the Recipient of the GRS-S Transactions Prize Paper Awards in 1997 and 2001, respectively. He is also the Recipient of the IEEE Nathanson Award and the IEEE Kiyo Tomiyasu Award in 1999 and 2007, respectively. He has contributed to the successful series of the European SAR conferences since 1996 as a member of the Technical Program Committee, as the Technical Chairman (2000), as the Awards Chairman (2002–2004), and as the General Chairman (2006) and Vice-Chairman (2008). He is also the Vice-Chairman of the European Radar Conference (EuRAD) 2007.



David Hounam was born in Darlington, U.K., in 1944. He received the B.Sc. and M.Phil. degrees from Northern Polytechnic, now the Metropolitan University of London, London, U.K., in 1966 and 1968, respectively, both in physics, and the Ph.D. degree in engineering from the University of Stuttgart, Stuttgart, Germany, in 1997, the subject being a coded SAR transponder system.

After moving to Germany, he worked in the electronics industry and joined the German Aerospace Center (DLR), Oberpfaffenhofen, in 1971. He has worked on a variety of microwave systems, including SAR, which led him to joining the ERS-1 team of the European Space Agency as the SAR engineer in 1983. He returned to DLR in 1988, working in the Microwaves and Radar Institute, where he successively headed the Microwave Technology and Microwave Systems departments. He has worked on various SAR projects, including ENVISAT/ASAR, X-SAR, and TerraSAR-X. In an early retirement scheme, he received leave of absence in 2006, and since has been a Consultant on radar technology.



Werner Wiesbeck (SM'87–F'94) received the Dipl.-Ing. (M.S.E.E.) and Dr.-Ing. (Ph.D.E.E.) degrees from the Technical University Munich, Munich, Germany, in 1969 and 1972, respectively.

From 1972 to 1983, he was with AEG-Telefunken as the Head of R&D of the Microwave Division, Flensburg, and the Marketing Director of the Receiver and Direction Finder Division, Ulm. During this period, he had product responsibility for millimeter-wave radars, receivers, direction finders, and electronic warfare systems. Since 1983, he has been the Director with the Institut für Höchstfrequenztechnik und Elektronik at the University of Karlsruhe, Karlsruhe, Germany, where he had been a Dean of the Faculty of Electrical Engineering. His research topics include radar, remote sensing, wireless communication, and antennas. In 1989 and 1994, respectively, he spent a six-month sabbatical at the Jet Propulsion Laboratory, Pasadena, CA.

Prof. Wiesbeck is a member of the IEEE Geoscience and Remote Sensing Society (GRS-S) Administrative Committee (1992–2000), the Chairman of the GRS-S Awards Committee (1994–1998 and 2002–present), the Executive Vice-President of the IEEE GRS-S (1998–1999), the President of the IEEE GRS-S (2000–2001), an Associate Editor of the IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION (1996–1999), and a past and present Treasurer of the IEEE German Section (1987–1996 and 2003–2007). He was the General Chairman of the '88 Heinrich Hertz Centennial Symposium and the '93 Conference on Microwaves and Optics, the Technical Chairman of the International mm-Wave and Infrared Conference 2004, and the Chairman of the German Microwave Conference 2006. He has been a member of the scientific committees and technical program committees of many conferences. For the Carl Cranz Series for Scientific Education, he serves as a permanent Lecturer for radar system engineering, wave propagation, and mobile communication network planning. He is an Honorary Life Member of the IEEE GRS-S, a member of the Heidelberger Academy of Sciences, and a member of Acatech (German Academy of Engineering and Technology). He is also a member of an Advisory Committee of the EU Joint Research Centre (Ispra/Italy) and is an Advisor to the German Research Council (DFG), to the Federal German Ministry for Research (BMBF), and to industry in Germany. He is the Recipient of the IEEE Millennium Award, the IEEE GRS Distinguished Achievement Award, the Honorary Doctorate (Dr. h.c.) from the University of Budapest, Budapest, Hungary, and the Honorary Doctorate (Dr.-Ing. E.h.) from the University of Duisburg, Duisburg, Germany.