Proposal for Special Issue of the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (JSTARS)

October 12, 2012

Proposed Title:

Reflectometry using GNSS and Other Signals of Opportunity

Guest Editors:

Prof. James L. Garrison
Associate Professor
School of Aeronautics and Astronautics
School of Electrical and Computer Engineering (by courtesy)
School of Environmental and Ecological Engineering (by courtesy)
Purdue University
701 W. Stadium Ave.
West Lafayette, IN, 47907-2045
Phone: 765-427-6583
Email: jgarriso@ecn.purdue.edu

Member, IEEE.
Conference Chair, GNSS+R 2012

Dr. Stephen J. Katzberg
Distinguished Research Associate
NASA Langley Research Center
South Carolina State University
300 College Ave
Orangeburg, SC 29117-0001

Email: Stephen.J.Katzberg@nasa.gov
Phone: 803-516-4875
Technical Program Chair, GNSS+R 2012

Prof. Scott Gleason
Department of Electrical & Computer Engineering
Concordia University
1455 de Maisonneuve Boulevard West,
Montreal, Quebec H3G 1M8 CANADA

Phone: 514-848-2424 Ext. 3122
Email: scott@encs.concordia.ca
Member, IEEE  
Publications Chair, GNSS+R 2012

**Dr. Estel Cardellach**  
Institute for Space Sciences (ICE-CSIC/IEEC)  
Campus U.A.B., Fac. Ciencies, Torre C5par, 2on  
08193 Barcelona, Spain

Phone: +34 93 581 4358  
Email: estel@ieec.uab.es

Member, IEEE  
Member of Technical Program Committee, GNSS+R 2012
Background:

Reflectometry using signals of opportunity is an emerging new field of microwave remote sensing in which existing digital signals, transmitted for other purposes, are re-utilized as sources of illumination. Although a unique technique in its own right, reflectometry embodies some features of active radar scatterometry, passive radiometry, and altimetry.

The first reflectometry demonstration of ocean winds measurements, using Global Navigation Satellite System (GNSS) signals, was published 14 years ago. In the decade that followed, GNSS reflectometry (“GNSS-R”) has been used to sense soil moisture, ocean altimetry, and ice properties.

Airborne and ground-based experiments have been used to develop the fundamental measurement principles of GNSS-R and derive empirical model functions for the retrieval of geophysical data. The UK-DMC satellite, launched in 2003, performed a limited collection of experimental GNSS reflections from orbit. ESA has initiated Phase A of the Passive Reflectometry and Interferometry System In-Orbit Demonstration (PARIS-IOD) project in June, 2011. Recently, NASA has approved the Cyclone Global Navigation Satellite System (CYGNSS) mission as part of the Earth System Science Pathfinder program. With the selection of this mission, interest in GNSS-R remote sensing has been steadily increasing within the Earth sciences community.

GNSS signals are particularly well adapted to reflectometry, a result of their embedded range coding. GNSS-R applications are limited, however, due to low transmitted power and a restriction to L-band. Recently, some researchers have begun to investigate the application of reflectometry methods to digital signals from communication satellites. Early experiments using S-band and Ku-band transmissions from commercial direct broadcast satellites have shown promising results, with the expectation that reflectometry methods may soon be extended to all frequencies allocated for space to Earth transmission. There are nearly 400 communication satellites orbiting the Earth at present, with most transmitting signals at substantially higher powers than GNSS, in order to enable high-bandwidth data communications with low bit-error rates.

Early reflectometry experiments were conducted by a small but diverse group of researchers, with their publications dispersed through multiple journals and conferences. To better coordinate activities and disseminate knowledge, a series of specialist workshops have been organized by researchers working in the field. These are listed below in reverse-chronological order.

- **Workshop on Reflectometry using GNSS and Other Signals of Opportunity (GNSS+R)**, Purdue University, West Lafayette, IN, USA, October 10-11, 2012
These ad hoc meetings have been held in the United States and Europe, starting with a NASA-Sponsored meeting at the Woods Hole Oceanographic Institution (WHOI) in 2002. It was not until 2010, with the GNSS-R meeting in Barcelona, that a major technical society (IEEE) sponsored a conference dedicated to reflectometry.

At the conclusion of the 2010 meeting, plans were made to continue with bi-annual, IEEE co-sponsored, meetings. Recognizing the burgeoning new class of reflectometry measurements made possible using communications signals, while still maintaining a connection with the extensive heritage of GNSS-R, the conference acronym of “GNSS+R” was defined. The “+” indicates an expansion to signals potentially available in nearly all microwave frequencies, from the approximately 400 communication satellites presently orbiting the Earth. The 2012 meeting, now titled “Workshop on Reflectometry using GNSS and Other Signals of Opportunity,” or GNSS+R 2012, was held on October 10-11, at Purdue University in West Lafayette, IN. The following three objectives were set for that meeting:

- Provide a rigorous, peer-reviewed, forum for technical interchange of new findings in reflectometry theory, experiments, techniques, applications and mission concepts.
- Meet as a community to define development roadmaps and develop advocacy for the future support of reflectometry.
- Make the broader Earth sciences community aware of the potential of reflectometry measurements.

A total of 27 oral presentations and 6 posters were given at the conference. Based upon the quality and originality of work presented, the technical program committee (TPC) decided to pursue a special issue of the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (JSTARS) for archival publication of the best papers presented at GNSS+R 2012. If the final number of accepted papers is not sufficient for a dedicated special issue, a special section would be pursued instead.
Rationale for Special Issue:

Several substantial developments within the field of reflectometry have been made, between the 2010 Barcelona meeting and GNSS+R 2012. Approvals of the CYGNSS mission by NASA and PARIS-IOD Phase A by ESA are expected to expand the community of remote sensing engineers working in the reflectometry field and Earth scientists using reflectometry data. Recent publication of results showing the application of reflectometry to communication satellite signals is also expected to broaden the scope of research in this field. Thus, the time is right for the production of an archival publication collecting recent results presented at the GNSS+R 2012 meeting. This could serve as a definitive reference for Earth scientists who may use reflectometry data, as well as research engineers working to develop new reflectometry methods.

Potential Contributors:

An informal survey of all authors of presented papers at GNSS+R 2012 was conducted by email to estimate the level of interest in submitting a manuscript to a special issue. Twelve (12) responses, with the following preliminary manuscript titles, were received.


2. “Multi-Frequency Remote Sensing of Soil Moisture with SoOps,” Yao-Cheng Lin, Guoliang Sun, and James Garrison

3. “PAU Aboard INTA MicroSAT-1: Initial Results of the FM Model from an Airborne Experiment,” Alberto Alonso, Adriano Camps, Daniel Pascual, Hyuk Park, Antonio Alcayde, Sergio Chavero, Luis Crespo, Manuel Angulo, and Antonio Rius


5. “Performance Analysis of GNSS-Based Altimetry Using Airborne Experimental Data,” Kegen Yu, Chris Rizos, and Andrew Dempster


11. “A study of polarization correlations in GNSS-R sensing of the sea surface,” Jeff Ouellette and Joel Johnson


We anticipate between 8 and 12 final papers to be published in the special issue, based upon this response.

Target Dates:

- Manuscript Deadline: April 1, 2013
- Peer review first cycle complete: June 1, 2013
- Author revisions complete: August 1, 2013
- Secondary review and revision (if necessary): October 1, 2013
- Final manuscript submission to press: December 1, 2014
- Page proofs to authors: January 1, 2014
- Page proofs returned: February 1, 2014
- Publication: first quarter 2014

Call Procedure:

All authors of oral or poster sessions presented at GNSS+R 2012 will be invited to submit a manuscript for the special issue. Authors will receive a series of emails, approximately once per month, commencing upon the approval of the special issue and continuing until the due date of April 1, 2013. Only papers presented at the conference will be considered for the special issue.
Review Procedure:

A well-qualified pool of reviewers for the special issue can be drawn from the standard TGRS database of reviewers and from experts from the remote sensing and GNSS communities. All papers will be reviewed by at least three reviewers. Care will be taken to avoid conflicts of interest among authors. Potential reviewers are listed in the following table.

Provisional List of Reviewers: GNSS+R 2012 Special Issue

Akos, D.
Axelrad, P.
Beyerle, G.
Callahan, P.
Camps, A.
Cardellach, E.
Dempster, A.
Deiner, S.
Esterhuizen, S.
Egido, A.
Garrison, J.L.
Gleason, S.
Gommenginer, C.
Helm, A.
Hoeg, P.
Katzberg, S.J.
Larson, K.
Lowe, S.
Martin-Neira, M.
Meehan, T.
Masters, D.
Park, H.
Piepmeier, J.
Ruf, C.
Rizos, C.
Rius, A.
Unwin, M.
Wickert, J.
Young, L.
Yueh, S.
Zavorotny, V.
Financial Issues:

The proposed guest editors understand that special issues incur an allocation of the page budget to a specific science and technology topic, and that this page budget allocation indirectly represents a monetary outlay by the publisher. Unfortunately, no financial resources are directly available to compensate the publisher in this instance. The individual authors will be encouraged to cover the voluntary page charges and they will be required to pay for any charges they incur due to overlength page charges, color figures, reprints, etc.