

THE BEEET



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Tucson Meeting Sponsored by Student Branch of Microwave Theory and Techniques:

Electromagnetic Scattering Theory for Coherent Change Detection in Complex Environments

Speaker: Edwin A. Marengo, Northeastern University

LOCATION: University of Arizona, Room ECE 102

DATE: Tuesday Oct 1, 6:00 pm

Refreshments Provided (pizza and soft drinks)

The optical theorem is a fundamental result that describes energy conservation in wave scattering phenomena. The form of this theorem for homogeneous plane wave excitation and free space background media is well known. Recently we have generalized this theorem to arbitrary fields and media, including both reciprocal and nonreciprocal lossless background media. In this presentation we show that for reciprocal media, the optical theorem principles can be combined with time reversal focusing ideas in order to detect targets and changes to the local environment in rather complex wave propagation media.

Here we propose a new coherent detection scheme for the active acoustic, electromagnetic, or optical detection of unknown targets embedded in unknown complex background media. The proposed coherent detection approach is rooted on the optical theorem, which permits the interpretation of scattering data from time reversal mirrors or cavities energetically. A detector of scattering targets, or of changes in a given medium or environment, is proposed that is based on the estimation, from time reversal sensor data, of the total extincted (scattered plus dissipated) power associated to the scattering by the target. This new detection scheme has immediate applications as a new sonar- or radar-based approach to the surveillance of indoor facilities, caves, tunnels, and in general complex environments exhibiting significant reverberations that can be exploited via time reversal ideas.

In this talk we discuss the physical detection principles behind this new approach to detecting unknown targets in unknown media, and propose two variants of a new optical-theorem-based coherent detector. The statistical performance of the new detection approach is examined for additive Gaussian noise in the rigorous framework of detection theory. The new detection scheme is compared with the alternative approach called "energy detection" which is used in the detection of unknown signals. In

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contrast to the energy detector which is based on a "mathematical" energy or L_2 , the new detector is based on real physical energy or power. Also, while the energy detector does not use phase information and is then "incoherent", our new approach exploits phase information and is "coherent". Numerical results are presented which illustrate the practical applicability of the proposed approach, and show its advantages and disadvantages relative to the conventional energy detection scheme.

BIOGRAPHY

Edwin A. Marengo received a B.S in Electromechanical Engineering (Valedictorian and Summa Cum Laude) from the Technological University of Panama, in 1990, and the M.S. and Ph.D. degrees in Electrical Engineering from Northeastern University in 1994 and 1997. From 1997 to 2004 he did post-doctoral work at Northeastern University, University of Arizona, Technological University of Panama, and Arizona State University, covering a broad spectrum of topics in electrical engineering, physics and mathematics. Since 2004 he has been with the Department of Electrical and Computer Engineering at Northeastern University as an Associate Professor. His research focuses on theoretical and computational challenges in electromagnetics, optics, imaging, signal processing, and wireless communications. Among other areas, he works on electromagnetic wave scattering and inverse scattering, physics-based signal processing, electromagnetic information theory, wireless communications, and compressive optics. Dr. Marengo is a member of the International Union of Radio Science, a senior member of the IEEE and a member of the Optical Society of America, as well as a member of Phi Kappa Phi, Eta Kappa Nu, and Tau Beta Pi. He is an associate editor for the IEEE Transactions on Image Processing, and has been an invited speaker at many conferences and universities in the USA, Panama, Great Britain, Italy, Sweden, Finland, and Chile. He has been a Fulbright scholar sponsored by the U.S. Department of State, and is a recipient of the NSF CAREER award.

Message to the Tucson Section

By Joseph Wu

I'd like to invite everyone in the Tucson Section to participate in IEEE. In the last year, we've conducted activities for schools, the University of Arizona, and for you, the membership. These activities are a great way to get involved in IEEE and show the impact of engineers in our community.

We have a great core of volunteers but we could always use your help. I'm asking people to get involved. With more people the Tucson Section could do so much more for the membership and this community.

If you're interested in helping out or becoming an officer, contact us through the following website:

<http://ewh.ieee.org/r6/tucson/>

Become an IEEE Senior Member!

Do you want to become a senior member of the IEEE? The IEEE wants to promote qualified candidates to senior membership! If you have 10 years of professional experience of which five years of significant professional performance, you are qualified for a senior member upgrade. Educational experience such as a bachelor's degree in an IEEE-designated field counts 4 years to that number, a master's degree counts 5 years and a doctorate counts 6 years. In order to find out more, point your web browser to www.ieee.org and search for senior membership!

Senior Membership:

<http://www.ieee.org/web/membership/senior-members/>

Applications can be found online. You will need the references of three current senior members or fellows. If you need assistance, contact Joseph Wu at joewu@ieee.org.

Save the date....

The next meeting is set tentatively for:

Date: Oct. 22 2013

Time: 6:00 PM to 7:30 PM

Location: ECE 102, University of Arizona

“Convex Optimization for Optimal Design and Analysis of Small Antennas”

Mats Gustafsson

Department of Electrical and Information Technology, Lund University, Sweden

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Other News

Upcoming Conferences

2014 IEEE International Workshop Technical Committee on Communications Quality and Reliability

18 May - 23 May 2014

Westward Look Wyndham

Tucson, AZ

www.ieee-cqr.org

2014 IEEE International Symposium on Parallel & Distributed Processing Symposium (IPDPS)

19 May - 23 May 2014

Arizona Grand Resort

Phoenix, AZ

www.ipdps.org

U of A Student Branches

In the Tucson Section, there are active student branches. The Student Branch Chapter of the MTT frequently brings in speakers from the distinguished lecturer series.

The U of A main student branch is also active. They have been running an open lab space in the ECE department, helping out various senior projects, and even putting together an Arduino workshop in their spare time.

If you're interested in finding out what they do, or want to help out with a donation go to:

<http://uaieee.com>

<http://www2.engr.arizona.edu/~mtt/>

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Other record changes (typographical errors)

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Other membership issues including subscriptions

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General IEEE Information

1-800-678-IEEE(4333)

We need to hear from you!

How can we make IEEE a better organization? We can only do it with your help. As a volunteer organization, IEEE depends on your participation to accomplish all of our goals.

As you can see from this newsletter, there are lots of activities where you can actively contribute. Are you good at organization? Volunteer to head one of our Chapters or to help organize our general meetings. Want to show off or improve your internet skills? Volunteer to help with our Web site. Interested in promoting our field to the next generation of engineers? Help with Engineers Week, or as a judge for any of our student competitions.

Even if you only have a little bit of time, there's sure to be an IEEE opportunity that will interest you. Even if you have no free time at all, but have ideas for meetings or activities that promote engineering and the IEEE, let us know! We'd like to hear from you. Please contact Joseph Wu at joewu@ieee.org.

We're on the Web!

Visit us at:

<http://ewh.ieee.org/r6/tucson>