DoD Program Mini-Workshop on Applied Math and Analysis for Radar Data and Image

Department of Mathematics, University of Texas Pan-American
Edinburg, Texas 78539-2999, USA

Date: May 10, 2010, Monday, Time: 8:30am – 11:35am
Room: MAGC 1.410, Contact: Dr. Zhijun (George) Qiao, qiao@utpa.edu or 381-3406

Agenda

8:30 – 8:45 am	Welcome Edwin LeMaster, Dean, College of Sciences and Engineering, UTPA Lokenath Debnath, Chair, Math Dept, UTPA
8:45 – 9:40 am	Multisensory Data Exploitation Using Advanced Image Fusion and Adaptive Colorization Yufeng Zheng Dept. of Advanced Technologies, Alcorn State University, MS
9:40 – 10:35 am	Interesting projects on Data Fusion Genshe Chen CTO of DCM Research Resources LLC, Germantown, MD
10:35 – 11:05 am	Radar Imaging and Electromagnetic Sensing Junfei Li Dept of EE, Univ. of Texas-Pan American
11:05 – 11:35 am	Cross-range imaging of SAR and PDE analysis Guillermo Garza, Jaime Lopez, and Zhijun Qiao Dept of Math, Univ. of Texas-Pan American

12:00pm Lunch at Sun Palace

This workshop aims to seek for new collaborations between UTPA and external universities/companies. Both external speakers have had lot experience with DoD and other sources projects. Currently, both of them are funded the DoD programs. In addition to discussing research work, we will also focus on future common interests and together make effort to write joint proposals.

Multisensory Data Exploitation Using Advanced Image Fusion and Adaptive Colorization

Yufeng Zheng*

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ABSTRACT

Multisensory data usually present complimentary information such as visual-band imagery and infrared imagery. There is strong evidence that the fused multisensor imagery increases the reliability of interpretation, and the colorized multisensor imagery improves observer performance and reaction times. In this paper, we propose an optimized joint approach of image fusion and colorization in order to synthesize and enhance multisensor imagery such that the resulting imagery can be automatically analyzed by computers (for target recognition) and easily interpreted by human users (for visual analysis). The proposed joint approach provides two sets of synthesized images, a fused image in grayscale and a colorized image in color using a fusion procedure and a colorization procedure, respectively. The proposed image fusion procedure is based on the advanced discrete wavelet (*a*DWT) transform. The fused image quality (IQ) can be further optimized with respect to an IQ metric by implementing an iterative *a*DWT procedure. On the other hand, the daylight coloring technique renders the multisensor imagery with natural colors, which human users are use to observing in everyday life. We hereby propose to locally colorize the multisensor imagery segment by mapping the color statistics of the multisensor imagery to that of the daylight images, with which the colorized images resemble daylight pictures. This local coloring procedure also involves histogram analysis, image segmentation, and pattern recognition. The joint fusion and colorization approach can be performed automatically and adaptively regardless of the image contents. Experimental results with multisensor imagery showed that the fused image is informative and clear, and the colored image appears realistic and natural. We anticipate that this optimized joint approach for multisensor imagery will help improve target recognition and visual analysis.

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Short Bio of Dr. Yufeng Zheng

Yufeng Zheng received his Ph.D. degree in Digital Image Processing from the Tianjin University (Tianjin, China) in 1997. Dr. Zheng serves as a program director of the Computer Networking and Information Technology Program, and a director of the Pattern Recognition and Image Analysis Lab. He is the principle investigator (PI) of two federal grants and the Co-PI of several grants. So far Dr. Zheng holds two patents in glaucoma classification and face recognition, and has published two book chapters and 35 scientific papers. His research interests focus on image analysis, pattern recognition, visual process modeling, biometrics, and computer-aided diagnosis.

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Some Interesting projects on Data Fusion

Genshe Chen

CTO of DCM Research Resources LLC, Germantown, MD,

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ABSTRACT

In this talk, we will summarize some recent and interesting projects in data fusion. These projects include: 1) Game Theoretic Multi-Agent Modeling and Analysis Framework for Distributed Collaborative Systems with Aid of Data Mining and Data Fusion; 2) Awareness-based Compressed Data Collection and Dynamic Resource Management for Large-Scale Sensor Networks; 3) A Semantic Analysis Based Automatic Object Classification and Activity Perception System for Large-view Urban Environment; 4) Performance modeling and prediction for multi-sensor ATR and tracking. If we have time, we will talk about other projects as well. The emphasis of the presentation will be on concepts and results. Hence anyone who is interested in the various areas of data fusion is welcome to attend.

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Short Bio of Dr. Genshe Chen

Dr.Genshe Chen is the CTO of DCM Research Resources LLC, Germantown, MD, where he directs the research and development activities for the Government Services and Commercial Solutions. Prior to founding DCM Research Resources, he was the program manager in Networks, Systems and Control at Intelligent Automation, Inc., leading research and development efforts in target tracking, information fusion and cooperative control. He was a Postdoctoral Research Associate in the Department of Electrical and Computer Engineering of The Ohio State University from 2002 to 2004. He worked at the Institute of Flight Guidance and Control of the Technical University of Braunshweig (Germany) as an Alexander von Humboldt research fellow and at the Flight Division of National Aerospace Laboratory of Japan as a STA fellow from 1997 to 2001. He did postdoctoral work at the Beijing University of Aeronautics and Astronautics and Wright State University from 1994 to 1997. He has served as the Project Manager/ Principal Investigator/Technical lead for 20+ government projects such as maneuvering target detection and tracking, cooperative control for teamed unmanned aerial vehicles, a stochastic differential pursuit-evasion game with multiple players, multi-missile interception, asymmetric threat detection and prediction, space situation awareness, cyber defense, and space-time adaptive processing, etc. His technical expertise includes game theoretic estimation and control, threat prediction and information fusion, guidance and control of manned and unmanned vehicles, GPS/INS/image integrated navigation system, computational intelligence and data mining, hybrid system theory and Markov chain, signal processing and computer vision, pattern recognition, biometrics, Bayesian network and influence diagram, social network analysis, simulation and training, and GIS.

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Radar Imaging and Electromagnetic Sensing

Junfei Li
Dept of EE, Univ. of Texas-Pan American

ABSTRACT

Present some recent work on Radar Imaging and Electromagnetic Sensing.

Presenter: Junfei Li is a faculty in Dept of EE, UTPA

Cross-range imaging of SAR and PDE analysis

Guillermo Garza, Jaime Lopez, and Zhijun Qiao
Dept of Math, Univ. of Texas-Pan American

ABSTRACT

In this presentation, we present a deeper observation and clarification of the mathematics of cross range imaging of SAR data. We begin with an introduction to the cross-range SAR image scenario, and establish the relationship between the signal received by the radar antenna and the desired target function. We then evaluate the matched-filtered version of the target function by use of Fourier transforms. Sampling of the echoed signal is also discussed to introduce the concept of the radar system Pulse Repetition Frequency (PRF), and its affect on the digitized signal. A method of reducing the PRF via slow-time compression is also explained. Importantly, we present a detailed derivation of slow-time sample spacing, which corrects the previous formulation. A cross-range imaging algorithm and a comparison of the results are given based on our slow-time sample spacing. Finally, we discuss a mathematical model for SAR imaging - Maxwell's equations for SAR image reconstruction.

Presenters: Guillermo Garza and Jaime Lopez are UTPA graduate students.