Eli Saber

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RESEARCH INTERESTS

- Image and Video Processing for Multimedia & Military Applications.
- Biomedical Engineering
- Image-Based Rendering for Motion Picture and Computer Vision.

EDUCATION

Ph.D., Electrical Engineering, University of Rochester, Rochester, New York *(March 1996).*
Concentration: Signal/Image/Video Processing, Pattern Recognition, Computer Vision, Communications.
Dissertation: Automatic image annotation and query-by-example using color, shape and texture information.

M.S., Electrical Engineering, University of Rochester, Rochester, New York *(May 1992)*
Concentration: Signal/Image/Video Processing, Pattern Recognition, Computer Vision, Communications.

B.S., Electrical and Computer Engineering, Summa Cum Laude, State University of New York at Buffalo, Buffalo, New York *(May 1988)*
Concentration: Computers, Microprocessors, Communications, Instrumentation.

A.S., Engineering Science, Mohawk Valley Community College, Utica, New York *(May 1986)*

ACADEMIC EXPERIENCE

Associate Professor, Dept. of Electrical Engineering, Rochester Institute of Technology. *(8/04-Present)*
- Responsible for teaching undergraduate & graduate courses in Digital Signal Processing, Digital Image Processing, Digital Video Processing, Pattern Recognition, Communications, Computer Vision.
- Currently advising 2 Master Students.
- Involved in 3 senior design projects.

Adjunct Faculty Member, Dept. of Electrical & Computer Engineering, University of Rochester. *(9/96-Present)*
- Taught and/or currently teaching undergraduate & graduate courses in Digital Signal Processing, Digital Image Processing, Pattern Recognition/Advanced Image Processing, Detection/Estimation Theory, and Analog & Digital Communications.
- Advised and graduated Ph.D. students in the area of “Image Understanding” and “Database Content Indexing”.
- Advised and graduated 1 MS student in the area of “Color Rendering” and “Printer Characterization”.
- Served as a committee member on several doctoral dissertations.
- Served on PhD qualifying examinations.
- Currently seeking funding from the National Science Foundation and other government agencies for a proposal on “Simultaneous object recognition & tracking from video by machine learning and Kalman Filtering”

- Sought and captured funding from the National Science Foundation for the development of an intelligent image database system. Proposal funded for 4 years under NSF Grant IIS – 9820721
- Sought and captured industrial funding from Xerox Corporation for Printer Color Characterization.

Adjunct Faculty Member, Dept. of Electrical Engineering, Rochester Institute of Technology. *(3/98-08/04)*
- Taught and/or currently teaching undergraduate and graduate courses in Pattern Recognition, Digital Video Processing, Analytic Techniques III, Image and Video Compression, and Communications.
- Advised a master student in the area of "Texture Classification" and currently advising a master student in the areas of "motion estimation" and "object Tracking".

INDUSTRIAL EXPERIENCE

Product Development Scientist & Manager, Print Engine Development Unit, Xerox Corporation. *(10/98-08/04)*
Major responsibilities include:
- Lead the Image Science, Analysis and Evaluation area (10-12 direct reports and $1.2 Million budget).
- Lead the development of color characterization algorithms for the iGen3 print engine.
- Lead the image quality integration of two color front end for the iGen3 Product.
- Lead the development of ROS and LED based imaging systems and image path architectures for upcoming highlight & full color products.
- Lead the development of xerographic hardware/algorithms & imaging systems for the DP92C highlight color product. (Product launched 9/30/99 and follow-on launched 4/20/00)
- Lead the research and development of image quality metrics for various product platforms and their dissemination throughout the Print Engine Development Unit and Xerox Corporation.
- Collaborate with the Department of Electrical & Computer Engineering (Univ. of Rochester) & the Center for Electronic Imaging Systems.

Advanced Development Scientist and Manager, Print Cartridge Delivery Unit, Xerox Corporation. *(2/97 – 9/98)*
Major responsibilities included:
- Establish the Advanced Design Laboratory (an imaging/xerographics lab) and provide technical and managerial leadership for the Electrical, Imaging and Xerographics Dept.
- Perform image processing and xerographic hardware/software design and development for low/mid volume color copiers and printers for current and future programs.
- Perform technology development, modeling, and product design for upcoming Xerox color products, specifically image on paper and image on belt products..
- Lead the development of the xerographic module for a color intermediate belt transfer product with direct technical and management responsibilities.
- Collaborate with the Department of Electrical & Computer Engineering (Univ. of Rochester) & the Center for Electronic Imaging Systems.

Research and Development Scientist, Production Systems Group, Xerox Corporation. *(1/96-1/97)*
Major responsibilities included:
- Lead the design and development of color characterization/management and image quality algorithms and specifications for digital front ends destined to drive high quality, high speed color print engines.
- Integrate color management & image processing algorithms into the Raster Image Processing module.
- Participate in the design and development of a high speed raster image processing architecture.
- Benchmark developed algorithms against existing products & systems both internally and externally.
- Collaborate with the Department of Electrical & Computer Engineering of the University of Rochester and the Center for Electronic Imaging Systems.

Research and Development Engineer, Corporate Research & Technology, Xerox Corporation *(8/93-12/95)* & Department of Electrical & Computer Engineering, University of Rochester. *(1/95-12/95)*
Major responsibilities included:

- Design and develop query by image content and query by example image annotation algorithms utilizing color, shape, texture and motion cues. System is able to perform query by keywords, color, shape, texture, and/or a combination of the above cues.
- Design and develop intelligent image segmentation algorithms. These algorithms are currently utilized in the query by image content and query by example systems described above.
- Design and develop face detection and facial feature extraction approaches.
- Design and develop color characterization/calibration and image quality algorithms for Digital Front Ends aimed at driving high speed / high quality print engines.

(Note: Image annotation/content analysis research was done in conjunction with the Department of Electrical & Computer Engineering and Center for Electronic Imaging Systems leading to the Ph.D.)

Electronic, Computer and Instrumentation Engineer, New Toner/Developer Facility Engineering, Xerox Corporation. *(6/88-7/93)*
Major responsibilities included:

- Provide design, development, installation, startup, and training for multiple toner production facilities.
- Provide development and implementation of control system database, software and displays for several systems.
- Evaluate vendor supplied electrical specifications and drawings.
- Manage and coordinate the efforts of technicians, electrical support, construction crew, and industrial workforce during the design, construction, startup, and implementation phases.
- Supervise and complete a number of upgrade projects for toner & photoreceptor production including software development, preparation of electrical design, procurement of necessary equipment and parts, supervision of technicians, contractors and industrial workforce, and scheduling of construction.

During this time, I gained extensive experience in the following systems: Fisher distributive control, unit operation controller, Provue console, Acrison material handling, Werner and Pfleiderer extrusion, Alpine air grinding, Majac/Micropul centrifugal classifiers, dry/wet material screening, Waeschle and others bulk powder storage and pneumatic convey, Ingersoll Rand and Joy compressed air equipment, Statistical process control.

PEER-REVIEWED JOURNAL PUBLICATIONS

- M. Vrhel, E. Saber, and H. J. Trussell, “An Overview of Color Image Technologies”, to appear in IEEE Signal Processing Magazine, January 2005.
- H. J. Trussell, E. Saber and M.Vrhel, “The ABC’s of Color & Color Image Processing”, to appear in IEEE Signal Processing Magazine, January 2005.
- Y. Xu, E. Saber, and A. M. Tekalp, “Dynamic Learning from Multiple Examples for Semantic Object Segmentation and Search”, to appear in the Journal of Graphical Modeling and Image Understanding.
- Y. Xu, E. Saber, and A. M. Tekalp, “Shape Matching of Partially Occluded Objects for Object Based Image Labeling”, under review for publication in the Journal of Pattern Recognition.
- Y. Xu, P. Duygulu, E. Saber, A. M. Tekalp, and F. T. Yarman-Vural, “Object-Based Image Labeling through Learning by Example and Multi-Level Segmentation”, Pattern Recognition, vol. 36 (6), pp. 1407-1423, June 2003.
- Y. Xu, E. Saber, and A. M. Tekalp, “Hierarchical Content Description and Matching for Efficient Color and Shape-Based Object Retrieval by Learning from User Search-Patterns and Profiles”, IEEE Transactions on Image Processing, Vol. 12, No. 6, June 2003.
- M. Celik, G. Sharma, A. M. Tekalp, E. Saber, “Lossless Generalized-LSB Data Embedding”, IEEE Trans. on Image Processing, July 2002.
- M. Celik, G. Sharma, E. Saber, and A. M. Tekalp, “Hierarchical watermarking for secure image authentication with localization”, IEEE Trans. on Image Processing, vol. 11, no. 6, June 2002.

- M. Xia, E. Saber, G. Sharma, and A. M. Tekalp, "End-to-End Color Calibration by Total Least Squares Regression", IEEE Transactions on Image Processing, Vol. 8, No. 5, May 1999.
- E. Saber and A. M. Tekalp, "Facial Pattern Detection and Eye Localization using Color, Shape and Symmetry-Based Cost Functions", Pattern Recognition letters, Vol. 19, 1998.
- E. Saber and A. M. Tekalp, "Integration of Color, Shape and Texture for Automatic Image Classification, Annotation and Retrieval", Journal of Electronic Imaging, Vol. 7, No. 3, July 1998.
- E. Saber and A. M. Tekalp "Region-Based Affine Shape Matching for Automatic Image Annotation and Query-by-Example", Journal of Visual Communication and Image Representation, March 1997.
- E. Saber, A. M. Tekalp, and G. Bozdagi, "Fusion of Color and Edge Information for Improved Segmentation and Edge Linking,", Image and Vision Computing, Vol. 15, 1997.
- E. Saber, A. M. Tekalp, R. Eschbach and K. Knox, "Automatic Image Annotation using Color Classification", Graphical Models and Image Processing, Volume 58, Number 2, March 1996.

CONFERENCE & WORKSHOP PUBLICATIONS

- Y. Xu, E. Saber, and A. M. Tekalp, "Semantic Object Segmentation by Dynamic Learning From Multiple Examples", International Conf. on Acoustics, Speech, and Signal Proc., May 2004, Montreal, Canada.
- M. Celik, G. Sharma, A. M. Tekalp, E. Saber, "Lossless Authentication Watermark", SPIE/IS&T: EI 2003, San Jose, CA, USA.
- M. Celik, G. Sharma, A. M. Tekalp, E. Saber, "Reversible Data Hiding", International Conf. on Image Processing 2002, Rochester, NY, USA.
- M. Celik, G. Sharma, E. Saber, and A. M. Tekalp, "A Hierarchical Image Authentication Watermark with Improved Localization & Security", International Conf. on Image Processing 2001, Thessaloniki, Greece.
- M. Celik, E. Saber, G. Sharma, A. M. Tekalp, "Geometry-Invariant Watermarking", SPIE/IS&T: Electronic Imaging, San Jose, 2001.
- Y. Xu, E. Saber, and A. M. Tekalp, "Contour based Shape matching of Partially Occluded Objects for Image Labeling using Hierarchical Content Description", SPIE:IS&T : Electronic Imaging 2001, San Jose, CA.
- Y. Xu, E. Saber, and A. M. Tekalp, "Image Retrieval through Shape Matching of Partially Occluded Objects using Hierarchical Content Description", International Conf. on Image Processing, Vancouver, Canada, 2000.
- P. Duygulu, Y. Xu, E. Saber, A. M. Tekalp, and F. T. Yarman-Vural, "Object Based Image Retrieval for Multi-Level Segmentation", International Conf. on Acoustic, Speech, and Signal Processing, Istanbul, Turkey, 2000.
- Y. Xu, E. Saber, and A. M. Tekalp, "Object-Based Image Retrieval through Learning from User Search Patterns and Profiles", SPIE/IS&T Electronic Imaging, January 2000, San Jose, California.
- Y. Xu, E. Saber, and A. M. Tekalp, "Learning-based Hierarchical Content Description for Object Formation and Retrieval", IEEE Image Processing Workshop, Rochester, NY, September 1999.
- Y. Xu, E. Saber, and A. M. Tekalp, "Object Formation and Retrieval using a Learning-Based Hierarchical Content Description", International Conf. on Image Processing, 1999, Kobe, Japan.
- Y. Xu, E. Saber, and A. M. Tekalp, "Hierarchical Content Description and Object Formation by Learning", Computer Vision and Pattern Recognition Workshop, Fort Collins, Colorado, 1999.
- M. Xia, E. Saber, G. Sharma, and A. M. Tekalp, "Total Least Squares Regression in Neugebauer Model Parameter Estimation for Dot-on-Dot Halftone Screens", Non Impact Printing, October 1998.
- M. Xia, E. Saber, G. Sharma, and A. M. Tekalp, "Total Least Square Technique in Color Printer Characterization", International Conference on Image Processing, Chicago, 1998.
- M. Xia, E. Saber, G. Sharma, and A. M. Tekalp, "Adaptive Content Dependent Color Rendering of Images and Documents", SPIE/IS&T: Electronic Imaging, San Jose, 1998.
- M. Xia, E. Saber, G. Sharma, and A. M. Tekalp, "Total least squares regression in color printer calibration", IEEE Image Processing Workshop, Rochester, NY, September 1997.
- E. Saber and A. M. Tekalp, "Image Annotation and Retrieval by Integrating Color, Shape and Texture", International Conference on Image Processing, September 1996, Lausanne, Switzerland.
- E. Saber and A. M. Tekalp, "Region-Based Image Annotation using Color and Texture Cues", European Signal Processing Conference, September 1996, Trieste, Italy.

- E. Saber and A. M. Tekalp, “Detection of Faces and Eyes using Color, Shape and Symmetry-Based Cost Functions”, International Conference on Pattern Recognition, August 1996, Vienna, Austria.
- E. Saber, A. M. Tekalp, and G. Bozdagi, “Fusion of Color and Edge Information for Improved Segmentation and Edge Linking”, International Conf. on Acoustics, Speech, and Signal Proc., May 1996, Atlanta, Georgia.
- E. Saber and A. M. Tekalp, “Image Query-by-Example using Region-Based Affine Shape Matching”, SPIE/IS&T Electronic Imaging, Volume 2666, January 1996, San Jose, California.
- E. Saber, A. M. Tekalp, R. Eschbach and K. Knox, “Annotation Of Natural Scenes Using Adaptive Color Segmentation”, SPIE/IS&T Electronic Imaging, February 1995, San Jose, California.

INVITED SEMINARS AND TALKS

- “VOOGLE: Tools for Labeling & Manipulating Objects in Images using Low-Level & “Semantic” Level Information”, invited talk, Dept. of Elec. Engineering, Rochester Institute of Technology, May. 2004.
- “Digital Libraries: Tools for Labeling & Manipulating Objects in Images Using Low-Level & “Semantic” Level Information”, invited talk, Dept. of Elec. And Computer Engineering, Cornell University, Nov. 2002.
- “Total least squares regression in color printer calibration”, invited talk, IEEE Image Processing Workshop, Rochester, NY, September 1997.

PATENTS

- E. Saber & R. Loce, “Corner Sharpening in a Super Resolution Anti-Aliasing Image Path”, in process.
- LK Mestha, E. Saber, S. Bolte, and S. Updegraff, “Systems And Methods For Obtaining A Spatial Color Profile, And Calibrating A Marking System”, in process for patent application.
- LK Mestha, E. Saber, “Systems and methods for sensing marking substrate area coverage using a spectrophotometer, US Application# 09 985419 filed on November 2nd, 2001.
- E. Saber, D. Damji, A. Leon, and P. Perez, “Remanufacturing system for replaceable modules in a digital printing apparatus”, U. S. Patent 6173128.

PROPOSALS

- A. M. Tekalp & E. Saber, “Event Modeling, Representation, and Indexing for Large Video Databases, to be submitted to the National Science Foundation.
- A. M. Tekalp and E. Saber, “Simultaneous object recognition and tracking from video by machine learning and Kalman filtering”, to be submitted to the National Science Foundation.
- A. M. Tekalp and E. Saber, “An intelligent visual database system: Hierarchical content description and matching using integrated similarity metrics”, funded for four years by the National Science Foundation under NSF Grant IIS – 9820721.

HONORS AND AWARDS

- Winner of an M.S./Ph.D. scholarship for graduate study from Xerox Corporation.
- Winner of the quality recognition award from Xerox Corporation for outstanding performance.
- Core member of a toner/developer facility engineering project team recognized as ``The 1991 and 1993 team of the year" by the Delaware Valley Chapter of the Project Management Institute.
- Elected to the Electrical Engineering Honor Society, Eta Kappa Nu.
- Winner of Gibran Khalil Gibran Scholarship for outstanding academic achievements.
- Valedictorian of the Electrical and Computer Engineering Department at the University of Buffalo.
- Recipient of several prizes and awards from the University of Buffalo and the Mohawk Valley Comm. College for excellent academic achievements; and from Xerox Corporation for outstanding performance.

PROFESSIONAL ACTIVITIES

- Senior Member of the Institute of Electrical & Electronic Engineers.
- Member of the IEEE Signal Processing & Communications Societies.
- Member of the Imaging Science & Technology Society.
- Finance Chair for the International Conference on Image Processing 2002 to be held in Rochester, NY.
- Color Image Processing Area Editor for the Journal of Electronic Imaging.
- Guest Editor for the "Color Image Processing" issue of the Signal Processing Magazine.
- Associate Editor for the IEEE Transactions on Image Processing for image/video processing and segmentation.
- Associate Editor for the IEEE Signal Processing Magazine for DSP Applications Forum.
- Member of IEEE Technical Committee on Industry DSP Technology in 2003 & 2004 & Chair for 2005/2006.
- Technical program committee member for ICIP 2003, ICIP 2002, ICIP 2001, ICIP 2002, and prior ICIPs.
- Technical program committee member for ICASSP 2003, ICASSP 2002, and prior ICASSPs.
- Session chair in ICIP 2002.
- Chairman, vice-chairman, treasurer, and secretary of the IEEE Rochester Chapter of the signal processing society in 1998, 1997, 1996 and 1995 respectively.
- Reviewer for the IEEE Trans. on Image Processing, IEEE Trans. on Pattern Analysis and Machine Intelligence, Graphical Models and Image Processing, IEEE Trans. on Signal Processing, IEEE Signal Processing Letters, Color Research and Applications, Graphical Modeling and Image Understanding, Image and Vision Computing, Optical Engineering, Journal of Imaging Science and Technology, and the Journal of Electronic Imaging.
- Technical committee for Western New York Imaging Workshop in 1997 and 1999 and general chair in 1998.
- Co-Chair of the Xerox Electronic Image and Video Processing Technology Council.
- Vice-president of the student association at the State University of New York at Buffalo. *(5/87-5/88)*

References Available Upon Request

Research Interest Statement for Eli Saber

My research interests span multiple areas in the field of signal, image, video processing and communications, where I have, over the last few years, secured funding from government agencies and industry and have been actively publishing in conferences and refereed journals. I intend to continue to grow my research in each of these areas pursuing appropriate funds from the National Science Foundation, various government agencies (Army, Darpa, Navy, etc.), the National Institute of Health, and Industry. To this effect, I plan to implement the research plan I have outlined below in a phased manner by beginning with my existing strengths and extending them to cover new areas.

Image and Video Processing for Multimedia & Military Applications

With the advent of powerful computers, relatively inexpensive imaging systems, digital storage devices and broadband networks, it is becoming easier and cheaper than ever to generate, store and transmit digital multimedia content, including audio, image and video. Large digital multimedia collections are becoming increasingly popular at the commercial, consumer and military level. Digital still and video cameras, satellites, and surveillance imaging systems continuously capture digital images/video from all over the world for consumer, military and homeland security applications. Their content has to be appropriately analyzed and managed in a practical manner to render timely action. Analysis by human observers is quite laborious and time consuming, if not infeasible, given the large volume of data. Efficient and suitable handling of these collections requires analysis, management and indexing of large amounts of visual information in an "automated" fashion for timely searching, browsing, matching and retrieving. Therefore, the development of effective, intelligent (automatic) machine analysis and learning tools will play a significant role in the management of the explosive multimedia content that will continue to be generated on a daily basis for years to come.

Generally speaking, multimedia content can be broadly classified as professionally produced content, such as movies, TV shows; raw content, such as consumer pictures and home videos; and real-time content, such as surveillance videos. In our work, we have developed novel techniques and algorithms - that span the spectrum from consumer to military applications - which are capable of: 1) segmenting and analyzing images based on their content, 2) searching, retrieving and tracking objects based on their color, shape and motion features in the absence and presence of occlusions, and 3) dynamically "learning" from previous searches in order to improve the outcome and minimize the inherent error. The segmentation and analysis algorithms provide a foundation for intelligent content accessing and object recognition. The shape and color techniques possess the capability to match and manage objects independent of translations, rotations, scale variations, occlusions and are robust to noise and boundary variations. More recently, we are working on developing robust tracking algorithms that build on the shape and color tools and employ Kalman filtering techniques to identify and track objects and humans in image and video scenes.

Signal Quality Assessment for Communications and Display Applications

The field of signal processing deals by and large with signals – be it audio, images or video - that are meant for human viewing and consumption. Examples of this are many including television, wireless communication, video conferencing or streaming over the internet, satellite and surveillance imagery among others. In general, a signal goes through many stages of processing before it is presented to a given subject, where each stage may introduce distortions that could reduce the quality of the final output. For instance, images and videos are acquired by camera devices thereby introducing distortions due to sensor noise, optics, color calibration, exposure control, camera motion etc. After acquisition, the image or video may be further processed by lossy compression algorithms to effectively reduce the bandwidth requirements for storage and/or transmission. However, lossy compression algorithms and transmission bit errors generally introduce distortions due, in part, to quantization and channel effects. Finally, the display device used to render the final output may introduce some of its own distortion, such as low reproduction resolution, bad calibration etc. The amount of distortion that each of these stages could add depends mostly on economics and/or physical limitations of the devices.

In this area of research, we are interested in being able to: 1) measure the quality of a given signal, 2) gauge the distortion that has been added to it during different stages, and 3) embed quality measurement techniques into the very algorithms that process the signals, so that their output quality may be maximized for a given set of resources. For instance, soliciting opinions of human observers for each and every one of the vast images and videos that are “out there” is not feasible, cost efficient or practical. Hence, our goal in objective signal quality assessment (as opposed to subjective quality assessment by human observers) is to develop quantitative measures that can automatically predict perceived quality in good agreement with subjective scores from human subjects. Generally speaking, an objective signal quality metric can play an important role in a broad range of applications, such as communications, audio, image acquisition, compression, displaying, printing, restoration, enhancement, analysis and watermarking. It can be used to: 1) dynamically monitor and adjust signal quality, 2) optimize algorithms and parameter settings of signal processing systems, and 3) benchmark signal processing systems and algorithms. In short, objective quality measurement seeks to determine the quality of signals algorithmically.

Image-Based Rendering for Motion Picture and Computer Vision

Image-based rendering (IBR) is an active research area where signal/image/video processing, color science, computer graphics, and computer vision meet together to provide realistic renderings of virtual images from captured ones using a variety of approaches such as lightfield, lumigraph, concentric mosaics, etc. Potential applications of this technology are many ranging from motion picture to robotic vision. Recently, IBR

has been utilized in effectively rendering various scenes of the "Matrix" movie. However, much less work has been reported in the capturing and recognition aspect where illumination changes, color constancy issues, object recognition, and rendering quality are effectively addressed and handled.

In our research, we propose to develop and apply image based rendering algorithms for motion picture and robotic vision applications, where image capture, color constancy, scene rendering, and content synthesis manipulation issues need to be appropriately and effectively handled to mimic reality. Consider, for instance, the scenario where a given actor is required to perform a difficult and perhaps dangerous martial art sequence. We propose to model the actor's body using finite elements with appropriate movement constraints (i.e. elbow only bend in certain directions, necks do turn 360 degrees, etc.) and then synthetically generate the sequence using novel computer animation and image rendering algorithms to ensure realism in a given setting. More so, we propose to apply IBR methods to robot vision to enable navigation throughout our physical world. To this effect, mounted camera(s) in a vehicle acquire images of the physical world, which are utilized to generate realistic renderings of the scene. These renderings coupled with object/pattern recognition algorithms enable the vehicle to navigate the scene without human interaction avoiding obstacles and driving around physical constraints. The applications of this are many ranging from consumer (e.g. a blind person can now travel using his own vehicle or rely on the proposed system to navigate in his/her daily life) to military (unmanned vehicles provide significant strategic advantages while eliminating loss of life). To drive towards these goals, we will utilize the foundation skills described in the "Image & Video Processing Area" and our industrial color science/rendering knowledge and build new novel image rendering and 3 dimensional object recognition algorithms.

Radar and Multi-Spectral Signal Processing for Commercial and Military Applications

Radar and array signal processing technology has been advancing steadily over the last few years and its impact is being observed in many facets of our daily life. Recent advances and future directions in radar signal processing are being explored on various fronts for military, defense, aviation, and commercial applications. Networks of small, densely distributed wireless sensor nodes are being envisioned and developed for a variety of applications involving monitoring and manipulations of the physical world in a tether less fashion. Typically, each node can sense in multiple modalities but has limited communication and computation capabilities. In this area of research, we are interested in developing digital and statistical signal processing techniques that utilize networks of sensors to infer information about objects via reflections of electromagnetic waves. Current topics of interest include detection, location, registration, and recognition of objects in radar imagery, space-time adaptive processing, and target tracking. To drive towards these goals, we will leverage our vast knowledge in the areas of object recognition & tracking and image analysis and understanding to develop new novel techniques for both commercial and military applications.