NJIT New Jersey Institute of Technology

THE ELISHA YEGAL BAR-NESS
CENTER FOR WIRELESS COMMUNICATIONS
AND SIGNAL PROCESSING RESEARCH

The Elisha Yegal Bar-Ness

Center for Wireless Communications

and Signal Processing Research

Activity Report

for FY 12/13 to Present

Vision of the Center

Primary Goal:

Serve as focal point in the Department of Electrical and Computer Engineering for research on wireless, communications and signal processing.

Activities carried out by participants:

- Initiate and pursue research in the fields of wireless, communications and signal processing.
- Search, collectively as well as individually, for possible sources of financial research support for themselves and their affiliates (graduate students or visiting faculty).
- Establish contacts in the electronics industry in the Newark-metropolitan area and New Jersey as a whole, learn about their needs, and suggest methods of collaboration.
- Assume responsibility for teaching graduate courses in the fields of communications and signal processing, propose and plan new courses, and monitor graduate courses taught by adjunct faculty.
- Undertake initiatives to recruit highly qualified graduate students, research associates and visiting faculty members, and support the efforts of the department chairman to recruit new faculty.
- Suggest, design, prepare, and deliver short courses as part of the New Jersey Institute of Technology's continuing education program.
- Organize seminars on topics of interest to Center members, the Department of Electrical and Computer Engineering, and local industry.
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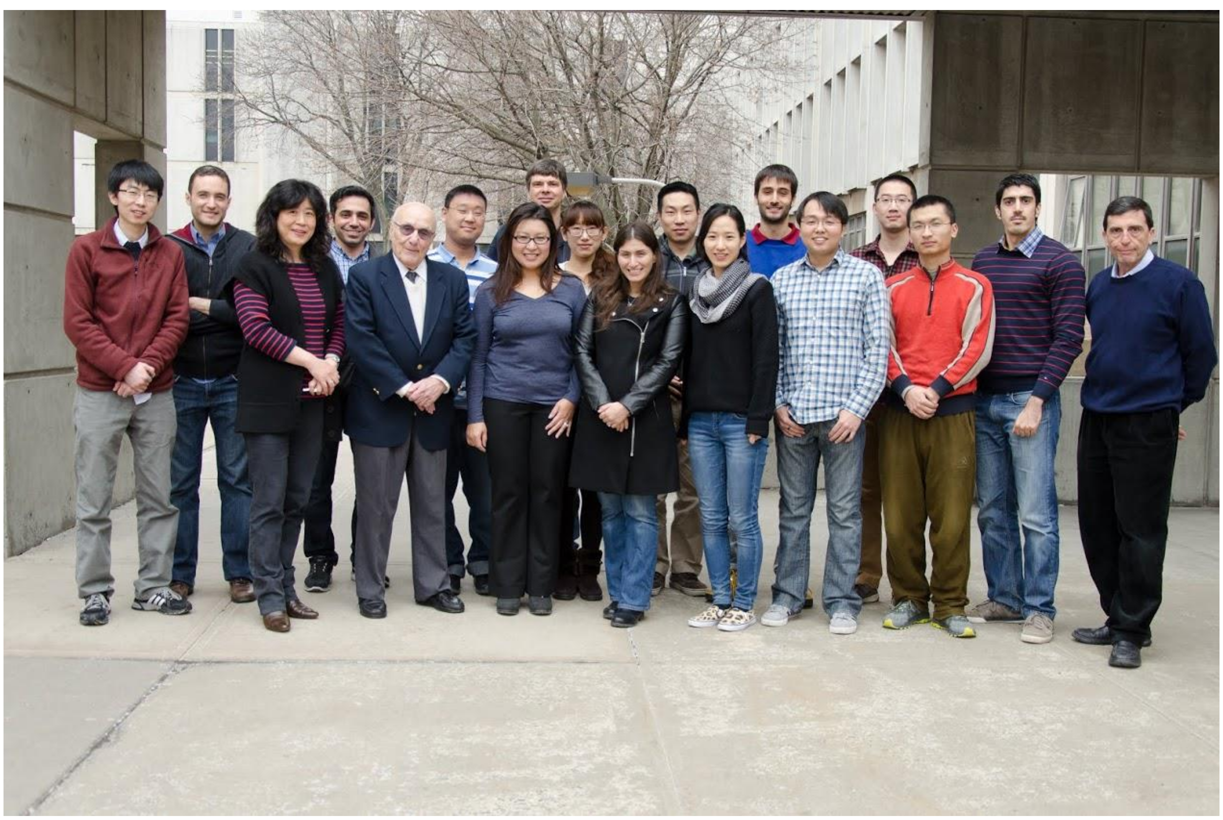


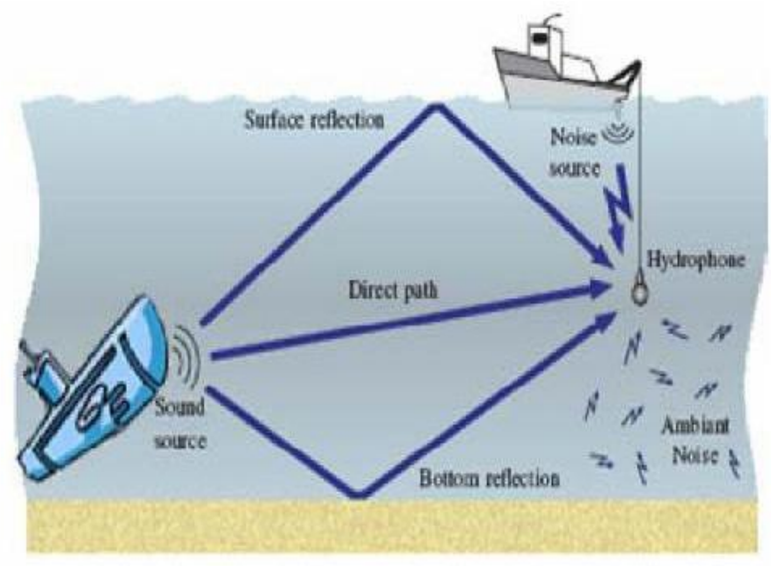
Research Interests of Center Faculty

Data Communication via the Vector Components of the Acoustic Field

Faculty: A. Abdi

Graduate student: E. Zhang

Sponsor: NSF



Over 75% of the earth's surface is covered with water that overlays many resources upon which our lives depend. High speed wireless underwater data communication between underwater sensors, deepwater moored instruments, autonomous underwater vehicles, and surface vessels is of crucial importance in many applications of national interest. However, the achievable data rates by the conventional technologies are much smaller than what is needed for effective communication and management. To have high speed communication links in underwater environments, the transformative concept of communication via the vector components of the acoustic field was proposed and developed by A. Abdi in a prior NSF supported project.

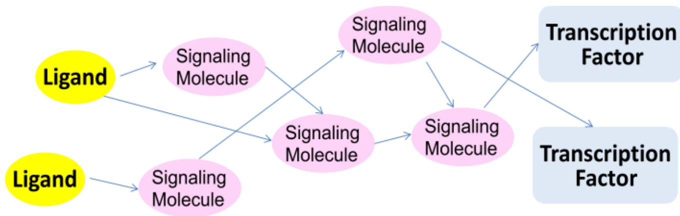
In this project, a prototype modem is going to be developed, based on the vector field concept. The key difference between the new modem and other existing modems is that it uses vector transducers, which are compact multichannel devices, to transmit several data streams via multiple particle velocity vector channels. This is while other modems use scalar transducers, which can modulate the data only on the scalar acoustic pressure.

The proposed concept to communicate via particle velocity vector channels is expected to have a major technological impact on underwater communication systems, which have solely used the acoustic pressure channel for decades. Development of a high speed vector acoustic modem will eventually allow the growth of many underwater systems and businesses whose operations have been constrained by low wireless data rates or very expensive undersea cables.

Systems Biology of Intracellular Communication in Molecular Networks

Faculty: A. Abdi

Graduate student: I. Habibi



(A) An intracellular molecular network where signaling molecules communicate input signals to some target proteins such as transcription factors.

Each cell in the human body includes many biomolecules, which communicate with each other via biochemical reactions, through intracellular signaling networks, to transmit signals from inputs such as ligands to outputs, say, transcription factors. There are massive amounts of qualitative data regarding different individual communication mechanisms among various types of molecules in different cellular pathways. However, a systematic theory that can quantify intracellular communication processes is not available.

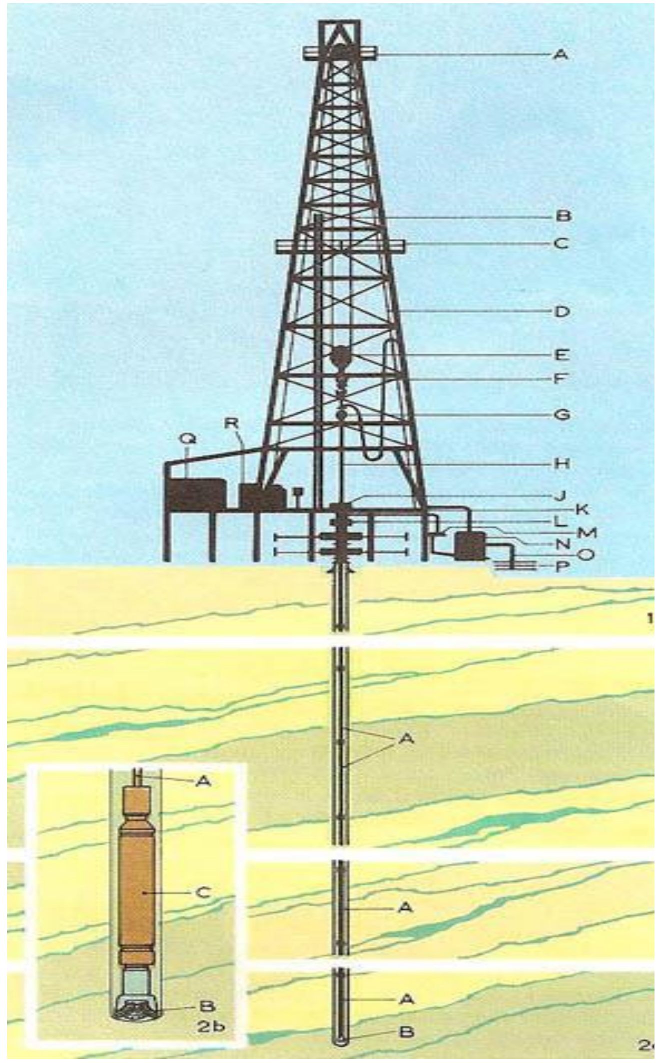
This research introduces an experimentally-verifiable quantitative and predictive theory for intracellular communication in complex molecular networks. It allows biologists to quantitatively model and analyze different types of molecular communication mechanisms and their impacts on cellular functions, using a generic set of concepts, metrics and methods. One important therapeutic application is identification of proper molecular targets at the drug discovery stage.

Borehole Communication and Telemetry via Drill Strings in Oil Fields

Faculty: A. Abdi

Graduate student: A. Alenezi

An onshore oil rig



Drill string underneath the oil rig

To extract oil from underground reservoirs, a well needs to be drilled using a long drill string. During the drilling process, real-time transmission of important data such as temperature, pressure, torque, drilling direction, etc., from downhole to the surface is of high importance. Such data allows the driller to closely monitor the process, change the drilling direction, adjust the penetration rate, etc., to minimize the failure chance of the costly operation and the machines.

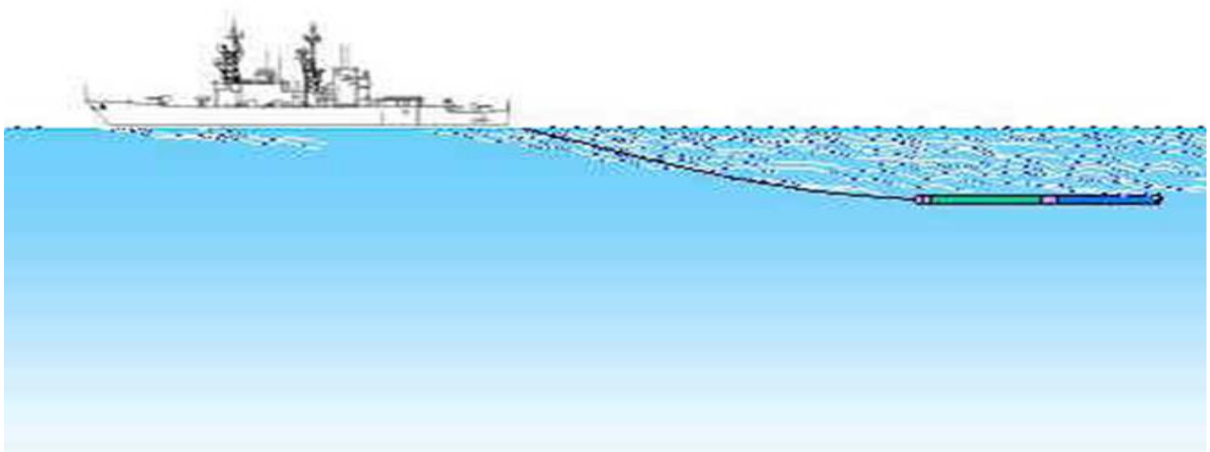
Since boreholes are typically very deep, several thousand feet or more, wired communication is very expensive and prone to failure. On the other hand, wireless electromagnetic-based and mud-based methods can provide only very low data rates, typically few bits per second. Acoustic transmission, however, offers higher data rates. In this research, new high rate communication schemes are going to be developed, by utilizing the physics of sound propagation.

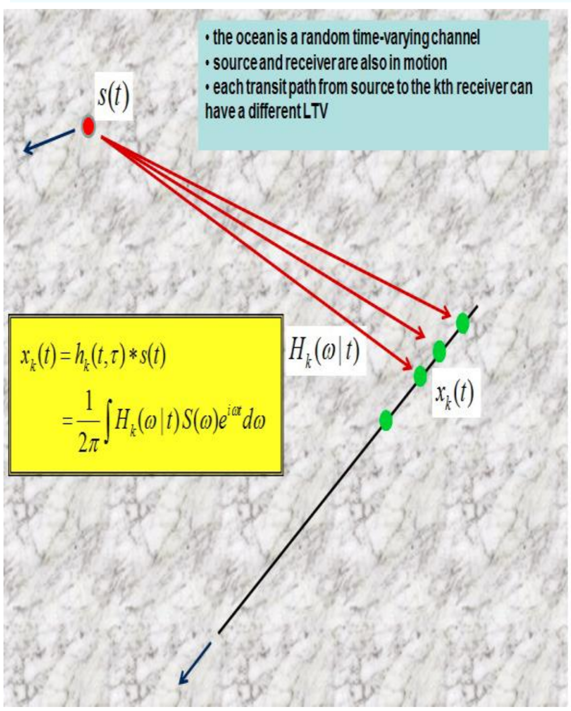
Passive Ranging using Distributed Arrays in Underwater Acoustic Environments subject to Spatial Coherence Loss

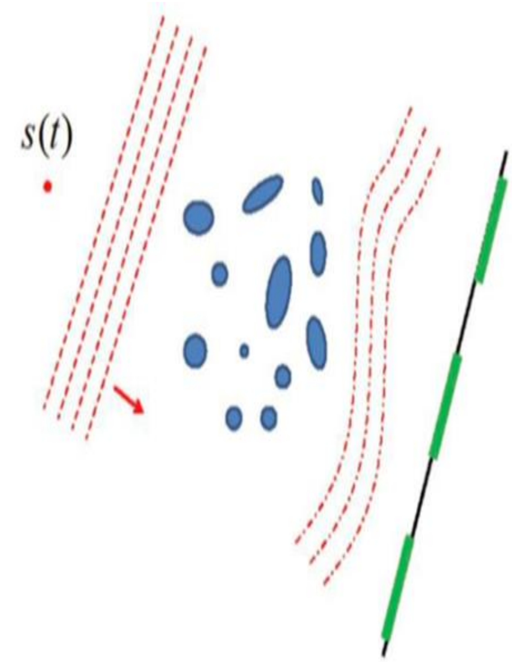
Faculty: Hongya Ge

Collaborators: Ivars P. Kirsteins (NUWC, Newport, RI)

Sponsor: US Office of Naval Research (ONR), NAYSEA and NUWC







Passive ranging in challenging underwater environments is an important problem in many naval applications, ranging from national defense to disaster recovery and environmental monitoring. Large aperture and/or moving aperture array systems has been designed and redesigned to enable the performance gain in passive methods to source detection, localization and tracking.

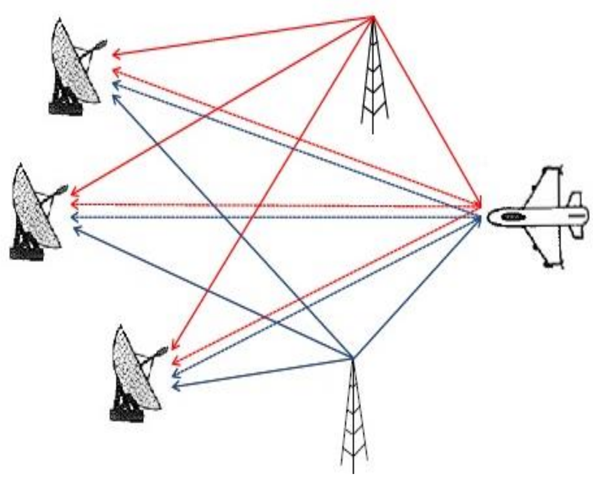
Through data-driven adaptive signal processing, our research explores statistical as well as tempo-spatial-spectral features of acoustic data collected by towed array systems comprised of multiple distributed volumetric array modules. The large amounts of space-time data are collected during different sea trials under the sponsorship of ONR, NAYSEA and NUWC. The goal is to design real-time solutions to passively localize (detection and estimation), classify and track distant emission sources undersea. Due to the turbulent nature and random media effects of underwater acoustic channels, an emission source's spherical or plane wavefronts are partially distorted when arriving at the receiving arrays of large/moving aperture. The relative motion between the source of interest and receiving arrays makes data and the associated parameters highly time varying (a typical high-dimension and sample poor scenario). All these will results in performance degradation to the wavefront curvature ranging systems equipped with very long aperture. We developed maximum likelihood multi-stage and multi-rank wavefront curvature passive ranging solutions to the problem of localizing and tracking distant source of interest.

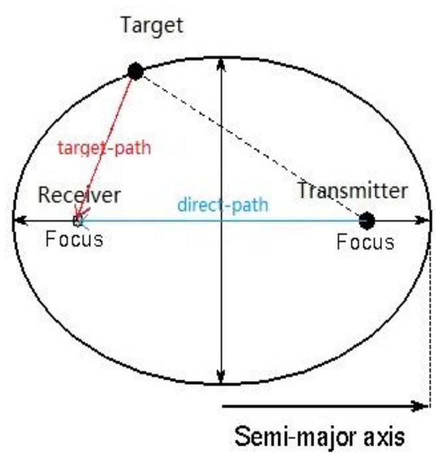
Passive MIMO-Radar for Target Detection

Faculty: Hongya Ge

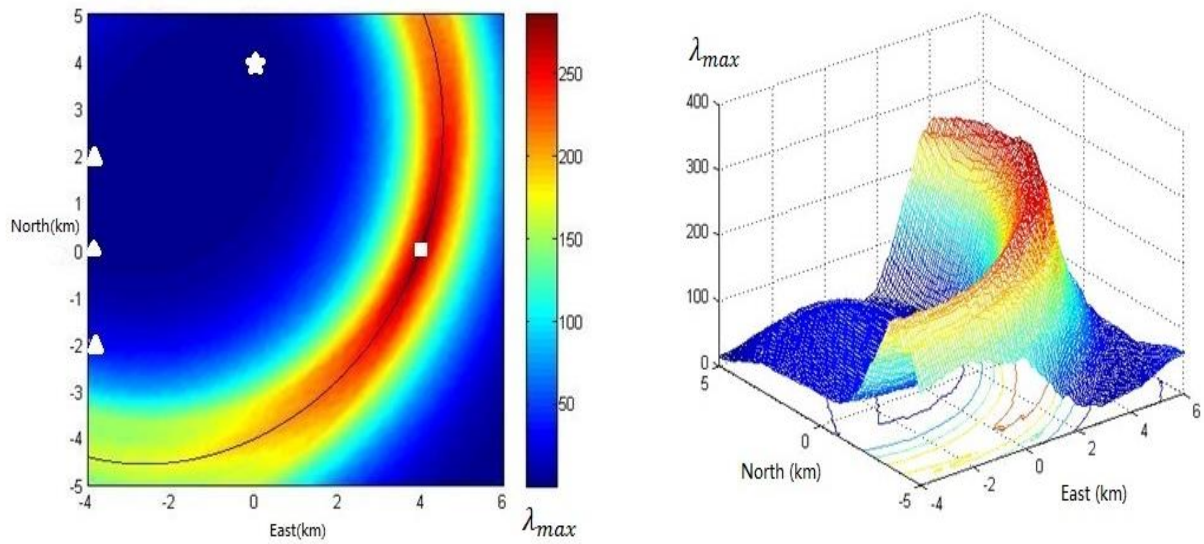
Graduate student: Enlong Hu

In passive MIMO-Radar system, the RF transmission from existing radio towers along with the reflected RF signals from a target are utilized by low-cost radar antennas. Such primary and secondary multi-channel data can be used to build low-cost MIMO radars for surveillance applications. We studied the performance gain in detection using multiple RF towers as well as reference channel data.

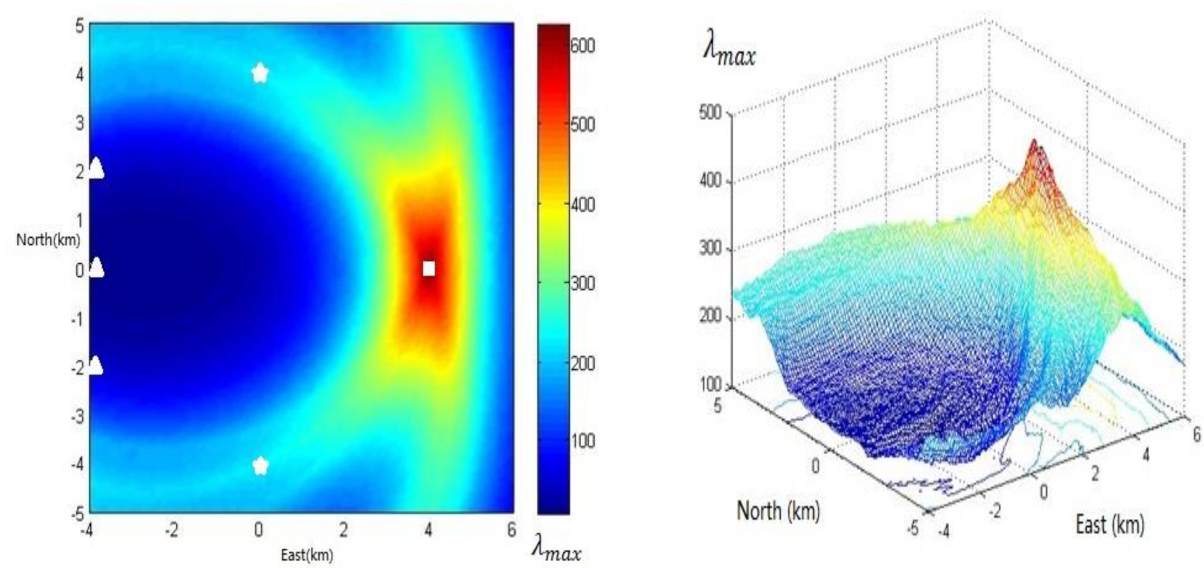




Results obtained by using the transmission from a single RF tower and the target reflection



Results obtained by the using transmissions from two RF towers and the target reflection



MIMO radar: compressive sensing techniques for localization

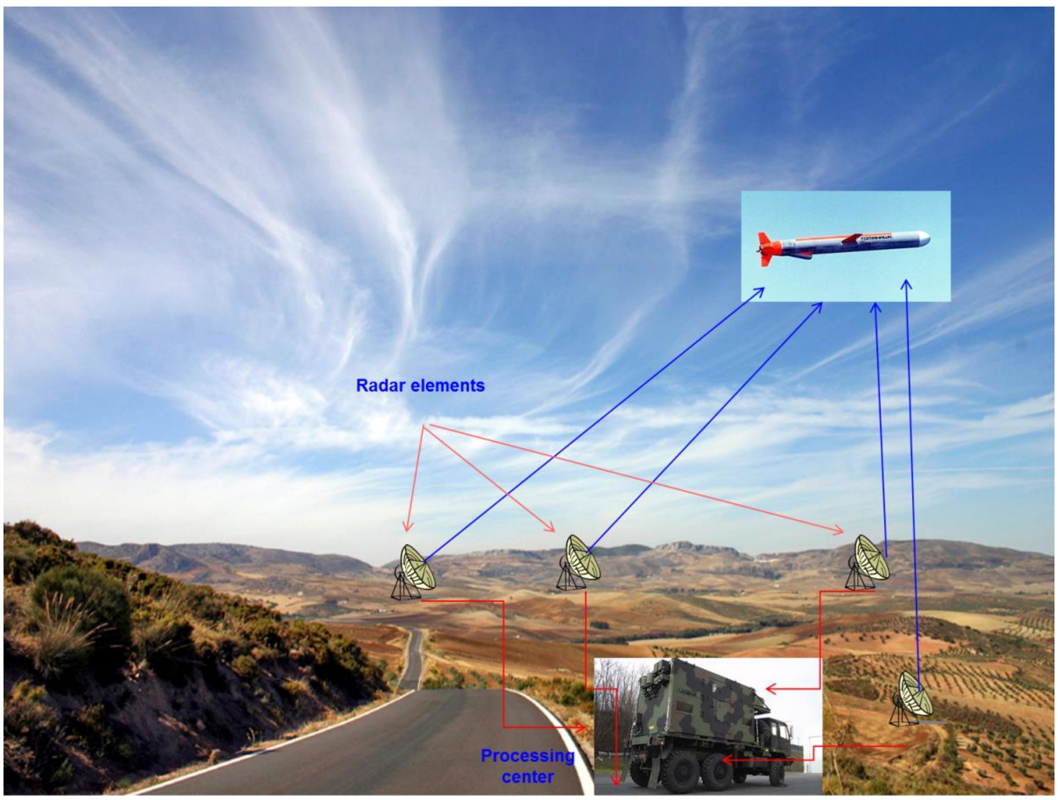
Faculty: Alexander Haimovich

Graduate students: Marco Rossi

Collaborators: Yonina Eldar (Technion)

Other collaborators on MIMO radar: Rick Blum (Lehigh), Qian He (Univ. of Science and Technology, China)

Sponsor: Air Force Office of Scientific Research



Multiple-input multiple-output (MIMO) radar is a sensing paradigm in which multiple transmitters and receivers have the ability to jointly plan transmissions and to process received signals in order to detect, localize and track targets. Compressive sensing is an emerging field in which performance of sensing systems is maintained even when observed signals are undersampled. Compressive sensing algorithms are designed to cope with ambiguities introduced by undersampling.

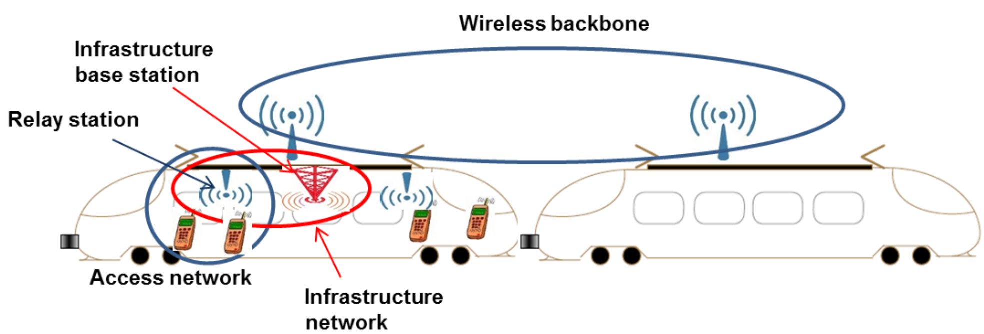
Large, random arrays are undersampled adaptive arrays that support improved angle-Doppler resolution and lower minimum detectable velocity (MDV), at the cost of higher sidelobes. Even though random arrays have been studied as early as the 1970's, new results reveal interesting links to the emerging field of compressive sensing. MIMO provides further improvements in angular resolution and MDV, while supporting waveform diversity and additional savings in the number of sensors. Compressive sensing algorithms are designed to cope with ambiguities introduced by undersampling. We develop methods involving MIMO radar and compressive sensing that enable to localize radar targets with high accuracy.

Wireless Communications for High Speed Rail: Train Topology Discovery

Faculty: MengChu Zhou, Osvaldo Simeone, Alexander Haimovich

Graduate students: Shahrouz Khalili, Yu Liu, N. Pelin Yalcin

Sponsor: CSR Zhuzhou Institute Co., Ltd.



Current standards for the implementation of train backbone networks are based on wired point-to-point links connecting the backbone nodes. The overall goal of this project is to develop a wireless implementation of the backbone network based on the WiFi standard IEEE 802.11n. A specific goal of the project is to apply the wireless network to the train topology discovery, a process known as inauguration.

Due to the high speed of the train, wireless links between backbone nodes are subject to highly time-varying channels. In addition, due to the high bandwidth of the signals, these channels are frequency selective. The traditional way to mitigate the distortion caused by the channel is to first estimate its effect by leveraging pilot symbols, and then use this estimate in order to detect the information streams. To this end, wide area networks, such as LTE, reserve a sufficient amount of time-frequency resource to support channel estimation and tracking. In contrast to wide area networks, local area networks such as IEEE 802.11n, prescribe a number of pilots that is significantly smaller than the total number of parameters to be estimated or tracked. The project is implemented in two phases. The goal of Phase 1 is to assess the performance of an 802.11n-based communication network in a high-speed train environment, and to devise algorithms that enable this network to support the train inauguration process. The inauguration process itself is the topic of the Phase 2 of the project.

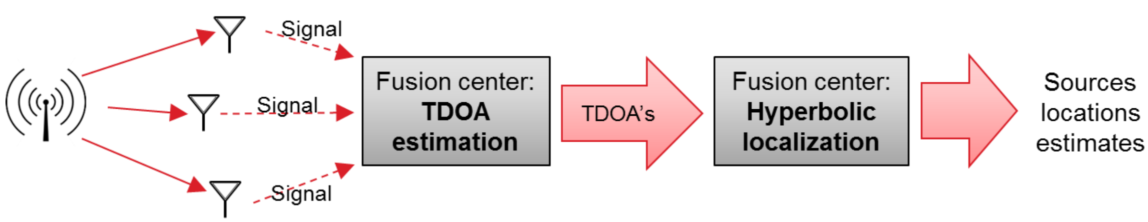
Precision Localization of RF Sources in Multipath Channels

Faculty: Alexander Haimovich

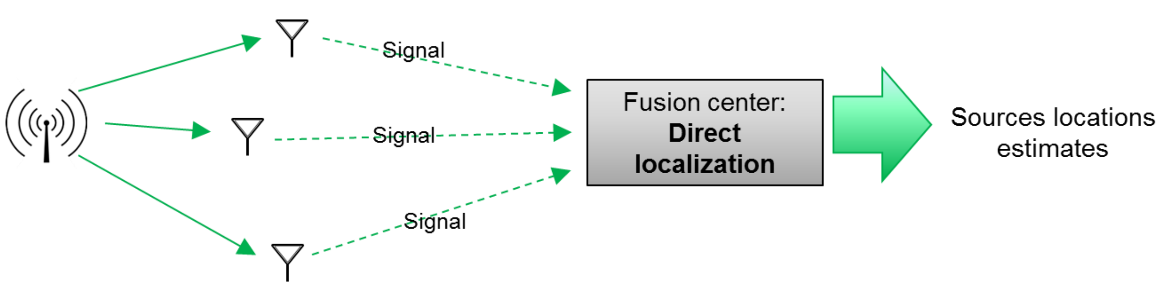
Graduate Students: Nil Garcia

Collaborators: Jason Dabin (US Navy), Martial Coulon (Univ. of Toulouse), Marco Lops (Univ. of Cassino)

Sponsor; SPAWAR, US Navy through ARO and Battelle



Indirect localization



Direct localization

The problem of localizing multiple emitters using widely spaced sensors is most commonly solved by estimating some parameters such as time of arrival (TOA), time difference of arrivals (TDOA) or received signal strengths (RSS). Subsequently, the emitters are located by multilateration. Such techniques estimate the intermediate parameters independently and therefore are suboptimal in comparison to direct localization techniques, in which emitter locations are estimated jointly. The literature on direct localization in the presence of frequency-selective multipath is scarce. To fill this gap, we propose a direct localization technique designed to work in the presence of flat or frequency-selective multipath, for known signals. A common approach in localization is to assume that the first arrival at each sensor corresponds to the line of sight (LOS) path, however, such approach can lead to large errors if the LOS path is blocked or confused with secondary lobes from other arrivals. Our approach divides the search area of the emitters in a grid of points. Since the number of emitters is sparse compared to the number of grid points, it leads naturally to a compressive sensing problem, which can be solved by sparse recovery techniques. Moreover, we show how such framework enables to distinguish between LOS and NLOS paths. Our technique has the advantage of direct localization techniques, i.e. superior accuracy, while being specially robust to strong NLOS signals, and to some extent, to sensors with blocked LOS. Subsequently, we will address the problem of localizing RF sources whose waveforms are unknown.

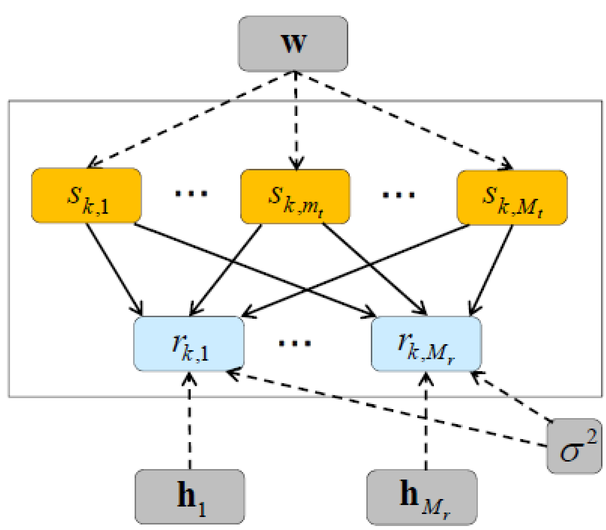
Modulation Classification of Signals in Multiple Antenna Systems

Faculty: Alexander Haimovich, Osvaldo Simeone

Graduate student: Yu Liu

Collaborators: Wei Su (US Army)

Sponsor: US Army



Recognition of the modulation format of unknown received signals is an important functionality of intelligent, or cognitive, radios for both military and civilian applications. Much of the literature on modulation classification addresses single-input single-output (SISO) systems. Modulation classification of multiple-input multiple-output (MIMO) signals is considerably more challenging than the SISO problem due to the observed data being an unknown mixture of unknown signals. In this case, the modulation classification has to be preceded by blind signal separation, a difficult problem in its own right. In this project we develop Markov Chain Monte Carlo methods for modulation classification of single and multiple antenna systems.

We also develop a theoretical bound on the accuracy of classification over unknown MIMO channels. We assume that the number of transmit antennas and signal to noise ratio (SNR) are known, and that MIMO channels are flat fading and unknown to the receiver. To develop the theoretical bound on performance, our approach is to first derive the Cramer-Rao bound (CRB) of the estimates of the MIMO channels. We then develop a bound on the probability of correct classification (PCC) based on the CRB.

Source Compression with Spatially Coupled Codes

Faculty: Joerg Kliewer

Graduate Student: Ahmad Golmohammadi (NMSU)

Sponsor: NSF

Collaborators: David Mitchell (University of Notre Dame), Dan Costello (University of Notre Dame)

In the last ten to fifteen years, the area of channel coding has undergone a revolutionary change based on the combination of graph-based codes and iterative decoding algorithms. These coding methods, which include both turbo codes and LDPC codes, approach the capacity limits of channel coding performance promised by Shannon in his landmark 1948 paper. As a result, turbo and LDPC codes are replacing conventional error control techniques in numerous digital communication and storage applications, including deep-space digital transmission systems, next-generation digital wireless transmission, last-mile digital cable transmission, digital video broadcasting, high-density digital magnetic recording, and flash memories.

In a remarkable recent development, a new class of protograph-based LDPC convolutional codes, also referred to as *spatially coupled LDPC codes*, has been shown to possess an unique combination of desirable asymptotic properties – *capacity achieving* iterative decoding performance *plus* minimum distance growing linearly with block length. As a consequence, codes of practical lengths chosen from this class are the first to promise to achieve near-optimal performance at *both* low and high signal-to-noise ratios.

In this project we explore whether spatially coupled codes are also suitable for low-complexity source compression. In particular, we consider the duals of these codes, spatially coupled low density generator matrix (LDGM) codes. This is useful for example for applications as flash memory storage or low-complexity distributed video compression.

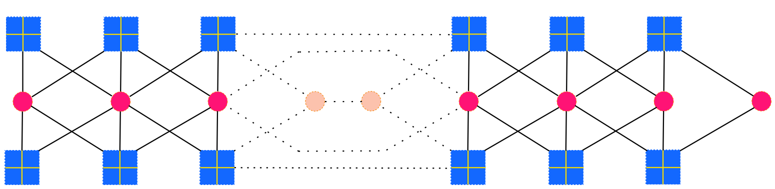


Figure: Protograph of a (3,6) spatially coupled LDGM ensemble

Measuring and Modeling Information Flow on the Brain-Response Channel

Faculty: Joerg Kliewer

Graduate Student: Ketan Mehta (NMSU)

Sponsor: NSF

Collaborators: Chuck Creusere (NMSU), Jim Kroeger (NMSU)

We use mutual information (MI) as a measure to quantify the subjective perception of audio quality by directly measuring the brainwave responses of human subjects using a high resolution electro-encephalogram (EEG). Specifically, we propose an information theoretic model to interpret the entire "transmission chain" comprising stimulus generation, brain processing by the human subject, and EEG measurements as a nonlinear, time-varying communication channel with memory. In the conducted experiments at NMSU, subjects were presented with audio whose quality varies between two quality levels. The recorded EEG measurements can be modeled as a multidimensional Gaussian mixture model (GMM). In order to make the computation of the MI feasible, we have derived a novel approximation technique for the differential entropy of the multidimensional GMM.

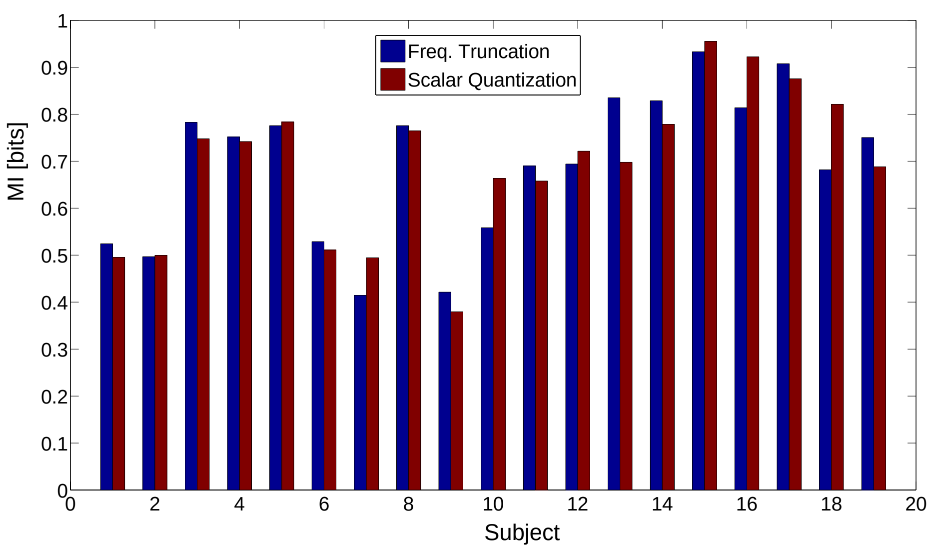


Figure: The median mutual information estimates for each of the 19 test subjects when presented with the same set of trial-sequences, across the two different distortion-types.

Future research focuses on blind classification of audio based on EEG measurements by modeling the brain-response channel with a hidden Markov model which can be trained by using the obtained MI results.

Cloud Radio Access Networks

Faculty: Osvaldo Simeone

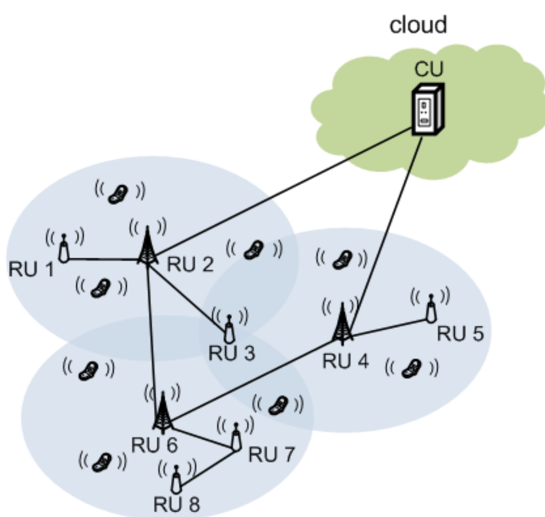
Post-Doc: Seok-Hwan Park

Visiting Student: Jinkyu Kang (KAIST)

Collaborators: Shlomo Shamai (Technion), Onur Sahin (InterDigital), Joonhyuk Kang

(KAIST)

Support: InterDigital, Vienna Science and Technology Fund



Next-generation wireless cellular systems are expected to undergo a radical paradigm shift, which is akin to the revolution brought forth by clouding computing in computer networks. As cloud computing prescribes the physical separation of user-centric data input/output and remote computing, cloud radio access networks (C-RANs) separate distributed and localized radio transmission/reception units from centralized information processing nodes.

In a basic C-RAN, radio units (RUs), such as macro-, pico- and home-base stations, provide the wireless interface between the operator's network and the mobile devices. However, unlike in conventional cellular systems, the RUs do not implement the information processing functionalities needed to encode and decode information on the wireless channel. Instead, information processing is carried out remotely within the "cloud" of the operator's network. This migration of computing to the cloud is enabled by a network of backhaul links that connect the radio units both among themselves and to control units (CUs) within the cloud.

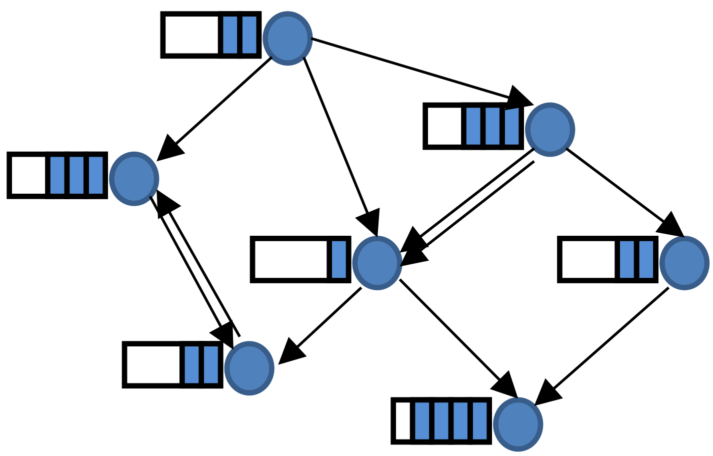
The centralization of information processing afforded by C-RANs enables effective interference management at the geographical scale covered by the distributed radio units. This in turn promises to be a key component of the solution to the so called “spectrum crunch” problem. However, the main roadblock to the realization of the mentioned promises of C-RANs hinges on the effective integration of the wireless interface provided by the radio units with the backhaul network that links the radio units and information processing nodes within the cloud. The goal of this research is to investigate advanced integration strategies based on network information theoretic principles.

Joint Wireless Energy and Information Transfer

Faculty: Osvaldo Simeone

Graduate Student: Ali Fouladgar

Collaborators: Elza Erkip (NYU Poly)



A conventional assumption made in the design of communication systems is that the energy used to transfer information between a sender and a recipient cannot be reused for future communication tasks. There are, however, notable exceptions such as communication systems based on wireless energy transfer, including passive Radio Frequency IDentification (RFID) and some classes of body area networks. In these systems, the wireless signals are leveraged as bearers of both information and energy.

The goal of this research is to provide the theoretical foundations, in the context of communication and information theory, for the study of the interaction between energy and information delivery in wireless communication systems. The focus of the research is the investigation of joint wireless information and energy transfer in key modern communication networks, such as for machine-to-machine communication and for cyber-physical systems.

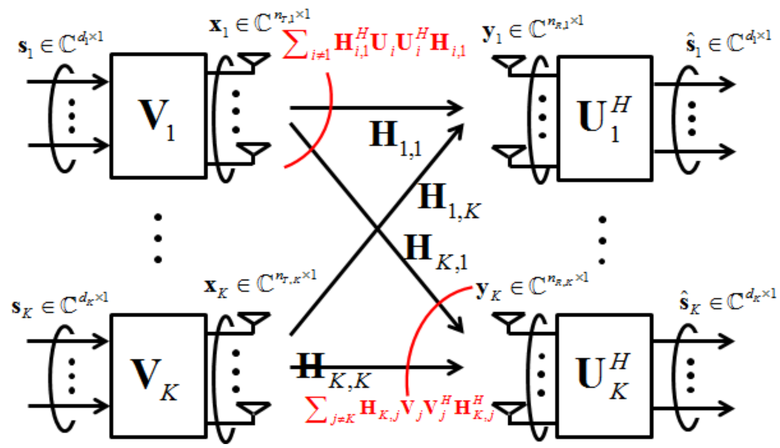
Robust Interference Alignment

Faculty: Osvaldo Simeone

Post-Doc: Tariq Elkourdi

Graduate Student: Ali Fouladgar

Sponsor: InterDigital



Interference alignment (IA) is a novel paradigm for the design of wireless networks that provides a radically different approach to interference management. Thanks to this paradigm shift, IA allows the capacity of wireless networks to be increased to levels that were previously thought to be theoretically out of reach. The key principle behind IA is the alignment of interference signals in a small subset of the "signal dimensions" occupied by the received signals at each interfered user. This alignment leaves a larger portion of the signal space available for the reception of information-bearing signals, hence increasing the capacity of the system.

In order to bridge the gap between theory and practice, this research aims at developing IA-based linear and non-linear transceivers that are robust to imperfections in the available channel state information and can be implemented in a decentralized fashion.

Center PhD Students and Visiting Post-Docs:

First	Last	Advisor
Chen	Chen	Abdi
Iman	Habibi	Abdi
Ali	Alenezi	Abdi
Erjian	Zhang	Abdi
Yuewen	Wang	Akansu
Manan	Patel	Bar-Ness
Eyal	Katz	Bar-Ness
Nan	Wu	Bar-Ness
Erjian (Eric)	Zhang	Bar-Ness
Enlong	Hu	Ge
Nil	Garcia	Haimovich
Haley	Kim	Haimovich
Marco	Rossi	Haimovich
Pelin	Salem	Haimovich
Liu	Yu	Haimovich
Farshid	Mokhtarinezhad	Kliewer
Behzad	Ahmadi	Simeone
Mohamad	Elkourdi	Simeone
Ali Mohammad	Fouladgar	Simeone
Eunhye (Grace)	Heo	Simeone
Seongah	Jeong	Simeone
Jinkyu	Kang	Simeone
Shahrouz	Khalili	Simeone
Seok Hwan	Park	Simeone

Center Masters and Undergraduate students working on projects:

Si	Yang	Abdi
Chih-yu	Chen	Abdi
Wei	Jiang	Abdi
Chizhong	Wang	Abdi
Mukesh Babu	Sundara Babu	Abdi
Diego	Agudelo	Abdi
Khoa	Dao	Abdi
Kleber	Solano	Abdi
Temilade	Afolabi	Abdi
Theo	Abavana	Abdi
Srinath	Yellepeddi	Abdi
Nasir	Younus	Abdi
Neel	Patel	Abdi
Niko	Ciccollela	Abdi

Matthew	Ross	Abdi
Jonathan	Davila	Abdi
Kristopher	Perovic	Abdi
Annan	Dong	Haimovich

Center Faculty and Staff:

Ali	Abdi	Faculty
Ali	Akansu	Faculty
Yeheskel	Bar-Ness	Retired Faculty
Hongya	Ge	Faculty
Alexander	Haimovich	Faculty
Joerg	Kliewer	Faculty (since Jan. 2014)
Osvaldo	Simeone	Faculty
Angela	Retino	Staff

List of Projects and Funding

Abdi, Ali (PI), Ehrlich, Michael (Co-PI), "Data Communication via the Vector Components of the Acoustic Field," Sponsored by NSF (Directorate for Engineering, Federal, $50,000.00.(May 2013 - October 2014).

Ge, Hongya (PI), “Passive Ranging using Distributed Arrays in Underwater Acoustic Environment subject to Spatial Coherence Loss”, Sponsored by US Office of Naval Research (ONR), Jan. 1st, 2012—Sep. 30th, 2013, $80,000.00

Haimovich, Alexander M. (PI), Simeone, Osvaldo (Co-PI), "Modulation Recognition Algorithms IAW," Sponsored by US Army/Aspen Consulting, Private, $64,497.00. (February 2013 - Present).

Haimovich, Alexander (PI) “Modulation Recognition Algorithms IAW,” US Army/US Navy/Battelle Memorial Institute, 7/1/13-6/24/14, $149,981.

Haimovich, Alexander (PI) “Compressive Sensing for Target Localization with MIMO Radar and Passive Methods,” AFOSR, 8/1/12-7/31/15, $454,499 (first two years are funded a total of $298,846 - year 1 is funded $147,439, year 2 is funded $151,407).

Haimovich, Alexander (PI), “Research and Development of Technologies for Perimeter Security Systems 6.1 – Compressive Sensing for STAP Radar” US Army, CEREDC through Picatinny Arsenal, 09/20/10 – 1/05/2013, $29,999.

Haimovich, Alexander M. (PI), "Signal Processing Algorithms for Very Accurate Geolocation in the Presence of Multipath," Sponsored by U.S. Army (subcontract with Princeton), Federal, $275,596.00. (May 1, 2010 - October 25, 2012).

Kliewer, Joerg (PI), “Collaborative Research: Coordination and Cooperation in Networked Multi-Agent Systems," Sponsored by U.S. National Science Foundation, Federal, $246,157. (Sept. 2014- Aug. 2017). Awarded to New Mexico State University, transferred to NJIT.

Kliewer, Joerg (PI), ”Collaborative Research: Spatially Coupled Sparse Codes on Graphs – Theory, Practice, and Extensions," Sponsored by U.S. National Science Foundation, Federal, $153,989. (July 2012-June 2015). Awarded to New Mexico State University, transferred to NJIT.

Kliewer, Joerg (PI), “Collaborative Research: New Approaches to the Design of Jount-Source Channel Codes," Sponsored by U.S. National Science Foundation, Federal, $177,193. (Sep. 2011-Aug. 2015). Awarded to New Mexico State University, transferred to NJIT.

Simeone, Osvaldo (PI), "Delay-Tolerant Robust Coding for Green Networking," Sponsored by InterDigital LLC, Private, $87,096.00. (December 2012 - December 2013).

Simeone, Osvaldo (PI), "Delay-Tolerant Robust Coding for Green Networking with Backhaul Constraints," Sponsored by InterDigital, Private, $87,386.00. (December 2011 - December 2012).

Simeone, Osvaldo (Co-PI), "TINCOIN," Sponsored by Vienna Science and Technology Fund, Other, $50,000.00. (November 2012 – Present).

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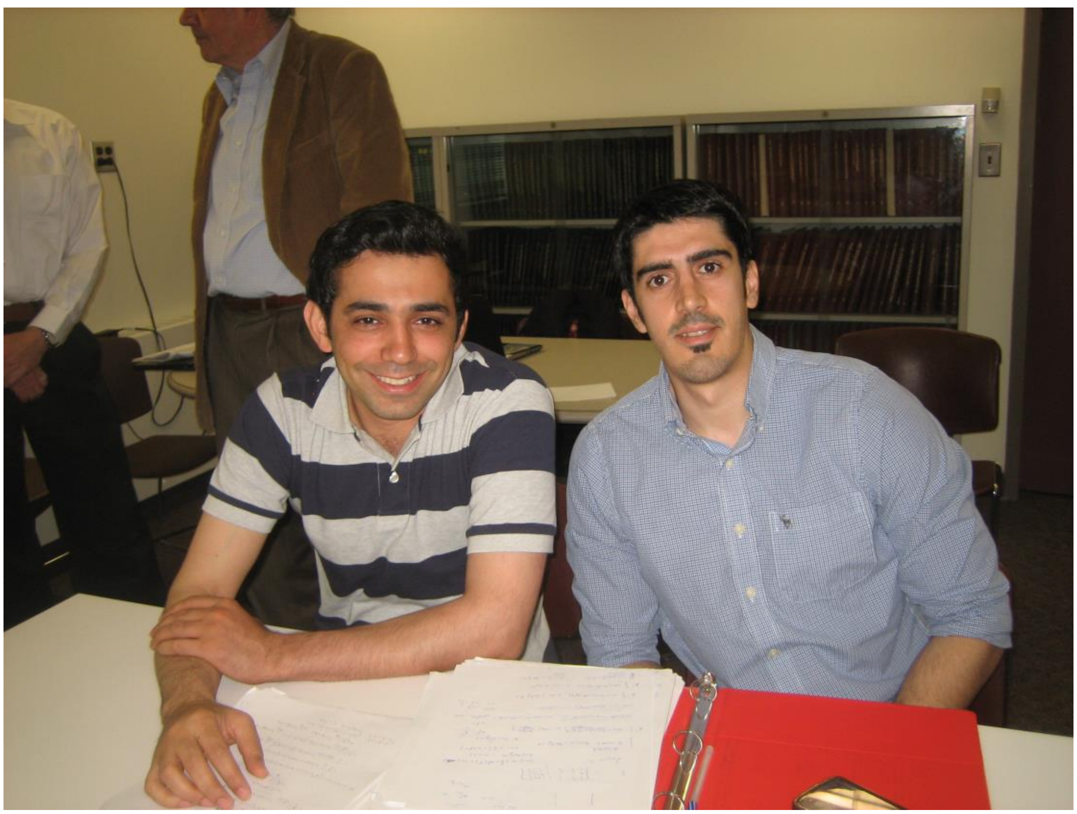

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A.N. Akansu, S.R. Kulkarni, D. Malioutov and I. Pollak, Editors, Financial Signal Processing and Machine Learning, Wiley, 2015.

M.U. Torun, O. Yilmaz and A.N. Akansu, Explicit Eigen Analysis of Discrete Auto Regressive Process for Finance Applications, a chapter in Financial Signal Processing and Machine Learning, Wiley, 2015.

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M.U. Torun and A.N. Akansu, An Efficient Method to Derive Explicit KLT Kernel for First-Order Autoregressive Discrete Process, IEEE Trans. on Signal Processing, vol. 61, no. 15, pp. 3944-3953, Aug. 2013.

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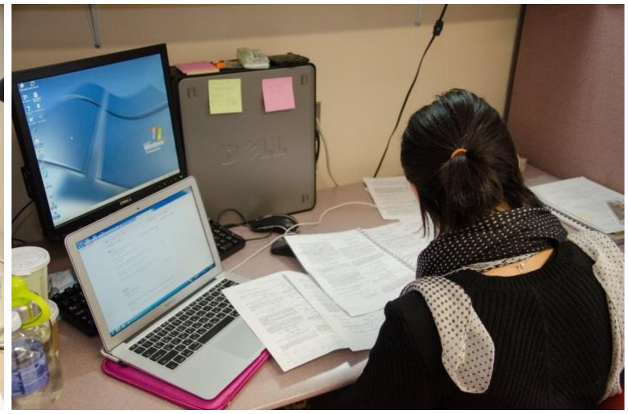

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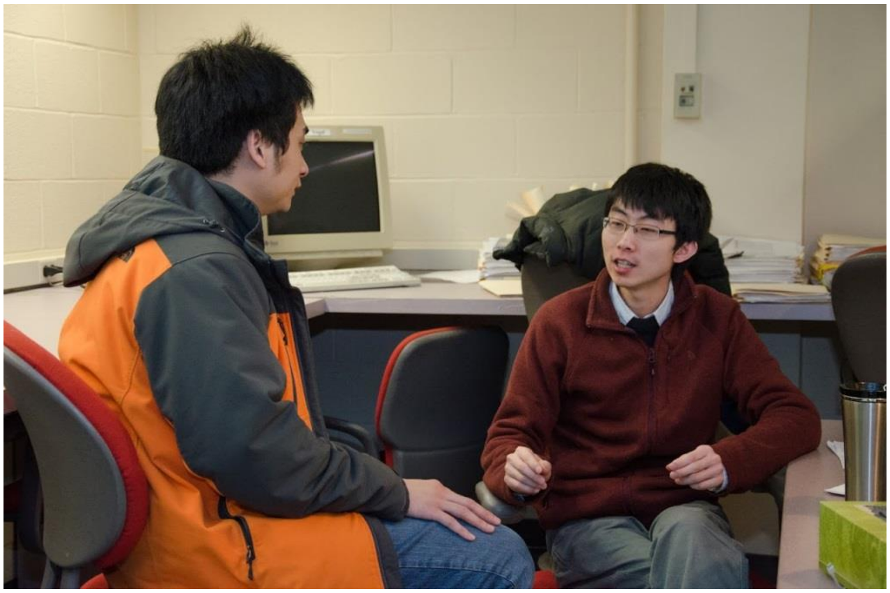

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V.M. Chiriac, Q. He, A.M. Haimovich, R.S. Blum, “Ziv-Zakai bound for joint parameter estimation in MIMO radar systems” submitted to IEEE Transactions on Signal Processing.

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O. Yilmaz, M.U. Torun and A.N. Akansu, A Fast Derivation of Karhunen-Loève Transform Kernel for First-Order Autoregressive Discrete Process, Proc. Big Data Analytics Workshop at SIGMETRICS, June 2013.

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C. Chen and A. Abdi, “Underwater communication in acoustic particle velocity channels via vector transducers,” in Proc. Conf. on Underwater Communications: Channel Modelling and Validation, Sestri Levante, Italy, Sept. 2012, pp. 1-8.

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Y. Sun andA.N. Akansu, Automatic Inference of Mental States from Spontaneous Facial Expressions, IEEE ICASSP 2014, under review.

O. Yilmaz and A.N. Akansu, Sparse Approximation to Transform Matrix with Zero-Zone pdf-Optimized Quantizer, IEEE ICASSP 2014, under review.

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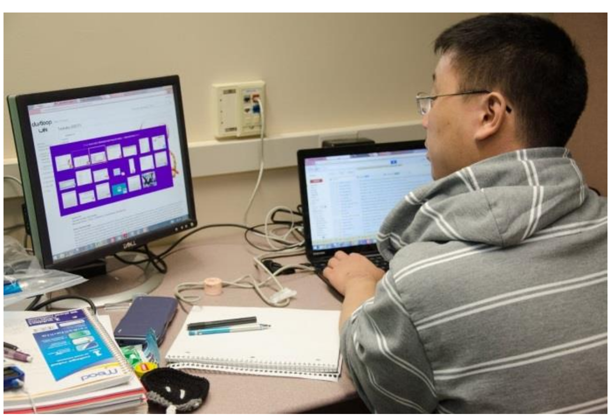
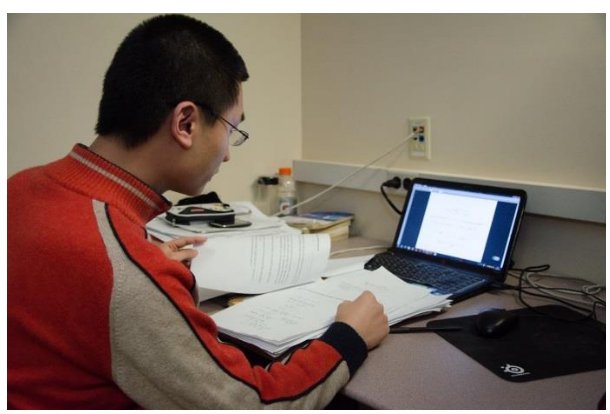




2014 invited papers

H. Kim, A.M. Haimovich, “Sparse arrays, MIMO and compressive sensing: confluent trends for future GMTI radar” submitted to Asilomar 2014

Nil Garcia, Martial Coulon, Marco Lops, Alexander M. Haimovich, “Direct Localization of Emitters Using Widely Spaced Sensors in Multipath Environments" submitted to Asilomar 2014.

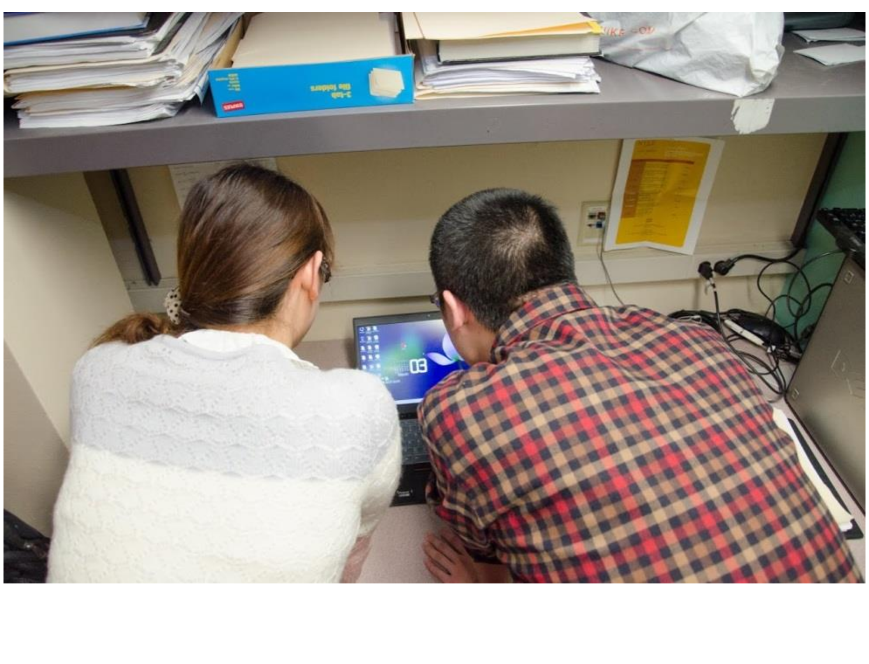
Invited Talks and Tutorials:

A.N. Akansu and I. Pollak (Purdue), Tutorial, High Frequency Trading and Signal Processing Models for the Microstructure of Financial Markets, IEEE ICASSP 2013.

I. P. Kirsteins, and H. Ge, “Rank Reduction: A Journey from Principal Components to Conjugate Directions for Sparsity Exploitation,” Presented in Oct 2013 at the IEEE Underwater Acoustic Signal Processing (UASP) Workshop.

A. Abdi, Invited Talk, Draper Lab (MIT Instrumentation Lab): “Particle Velocity Communication: Where Communication Meets the Channel Physics,” March 14, 2012, Cambridge, MA.

A. Abdi, Invited Talk, Naval Undersea Warfare Center (NUWC): “Underwater Acoustic Communication in Particle Velocity Channels: Transceiver Design and Channel Modeling,” March 29, 2012, Newport, RI.



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H. Ge, and I. P. Kirsteins, "Passive Ranging using Distributed Arrays in Underwater Acoustic Environment subject to Spatial Coherence Loss," to be presented in the 167th Meetings of Acoustical Society of America (ASA). May 2014.

J. Kang, O. Simeone, J. Kang, S. Shamai (Shitz), "Joint Signal and Channel State Information Compression for Uplink Network MIMO Systems," in Proc. IEEE GlobalSIP 2013, Austin, TX, Dec. 3-5, 2013.

S. Jeong, O. Simeone, A. Haimovich, J. Kang, "Beamforming Design for Joint Localization and Data Transmission in Distributed Antenna Systems," in Proc. IEEE GlobalSIP 2013, Austin, TX, Dec. 3-5, 2013.

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R. Karasik, O. Simeone and S. Shamai (Shitz), "Robust Uplink Communications over Fading Channels with Variable Backhaul Connectivity," in Proc. IEEE International Symposium on Information Theory (ISIT 2013), Istanbul, Turkey, July 7-12, 2013.

K. F. Trillingsgaard, O. Simeone, P. Popovski and T. Larsen, "Blahut-Arimoto Algorithm and Code Design for Action-Dependent Source Coding Problems," in Proc. IEEE International Symposium on Information Theory (ISIT 2013), Istanbul, Turkey, July 7-12, 2013.

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M. Li, O. Simeone and A. Yener, "The State-Dependent Degraded Broadcast Diamond Channel," in Proc. Australian Communications Theory Workshop, Adelaide, Australia, Jan. 2013.

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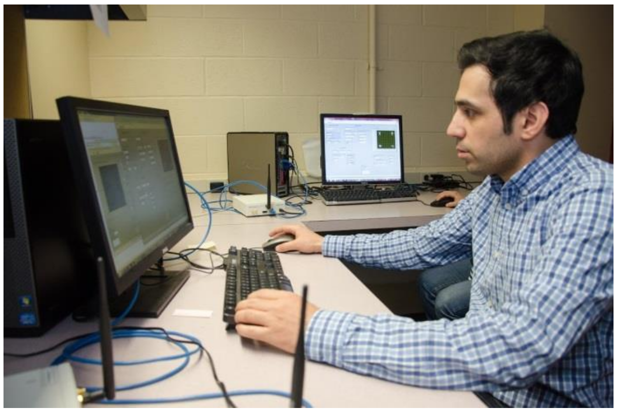
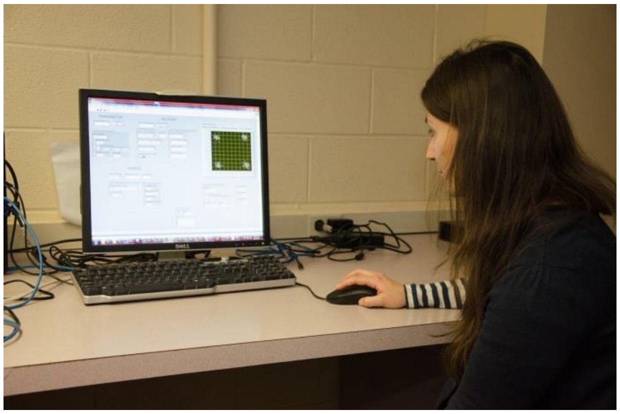
C. Koller, M. Haenggi, J. Kliewer, D. J. Costello, Jr.: "Joint channel/network coding for star networks,"Proc. IEEE Int. Symp. on Information Theory (ISIT 2013), pages 3080-3084, Istanbul, Turkey, July 2013.

C. Brito, J. Kliewer: "On polarization for the linear operator channel," Proc. IEEE Information Theory Workshop (ITW 2013), Sevilla, Spain, Sep. 2013.

News

Development of a Software Defined Radio undergraduate laboratory including purchasing lab equipment, developing experiments, and writing a lab manual. This is an ongoing collaboration with Prof. Haimovich and Prof. Simeone, ECE, 2012 – present.





NJIT's Elisha Yegal Bar-Ness Center for Wireless Communications and Signal Processing Research recently showcased the research of eight doctoral students. The students' work was featured in presentations and posters displayed in the area. The annual event aims to give doctoral students and their professors from the center a chance to exchange information from a year's worth of work. 4/22/13

Two new patents to improve orthogonal space time codes and decode data transmissions of space time spreading were recently awarded to NJIT Distinguished Professor Yeheskel Bar-Ness, executive director of the Elisha Yegal Bar-Ness Center for Wireless Communications and Signal Processing Research. Co-inventors with Bar-Ness on the patents were NJIT alums Amir Laufer and Kodzovi Acolatse. 3/6/13

A pioneer in the field of signal processing in adaptive arrays and multiple sensor radar, NJIT Professor Alexander Haimovich has been named an IEEE Fellow. His work has contributed greatly to the advancement and application of electrical engineering and technology. 1/23/13

Patents

US Patent # 8.275.019 0f Sep.25, 2012"SCFDE Space Time Spreading (STS) Schemes in Multiuser DS CDMA Wireless Communications" NJIT case # 08-080, filing date June 16, 2009 serial # (12/485,814) with K. Acolatse

US Patent # 8.355426 of Jan 15 2013 " Decoding Data Transmitted Space-Time Spreading in a Wireless Communication System Implementation and Performance Analysis of Space Time Spreading DS-CDMA System" NJIT case # 09-005, filing date April 27 2009 serial # (12/430,788) with K. Acolatse

US Patent # 8.379.746 of Feb.19 2013 " Method and apparatus for Improving Transmission with Orthogonal Space Time codes", NJIT case # 08-083 filling date, Feb.2, 2009 serial # (12/365,800 on Feb 04 2009).with Amir Laufer

H. Zhang and A. Abdi, Mobile Speed and Doppler Frequency Estimation Using Cyclostationarity, No. 8,209,150, June 2012, Patent is issued and licensed.

Awards

Nan Wu – Phonetel Fellow - Bar-Ness Endowed Scholarship (2013)

Dr. Bar-Ness received the 2013 NCE Research Award, NJIT (2013)

Dr. Ali Abdi received commendation from NSF I-Corps Program for the superb performance May 2013.