MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

2014 Graduate Research
Writing and Presentation
Workshop

GRWPW 2014

22-23 May 2014

Graduate Research Writing and Presentation Workshop (GRWPW 2014)
22-23 May 2014

Department of Electrical and Electronics Engineering
Middle East Technical University
Ankara, Turkey

Proceedings
Edited by Özgür Ergül

Message From the Chairperson

Dear Students, Research Assistants and Professors,

The Graduate Research Workshop (GRWPW-2014) has been organized for the first time in our Department of Electrical and Electronics Engineering on May 22-23, 2014.

The purpose of this workshop has been twofold: First of all, our graduate students will get the chance to talk about their thesis research in an academic platform to get feedback not only for the technical content of their presentations but also for their written and oral communication skills. Secondly, we all might get the chance to establish new and fruitful collaborations between different research groups by sharing our research interests with the rest of the department.

Research papers delivered in oral and poster presentation sessions of this event have revealed the breadth and depth of the graduate-level research studies conducted in our department. We have been all glad to witness many successful presentations of international conference quality.

My special thanks go to all who have made this workshop possible. I hope that GRWPW-2014 has become a successful onset of a traditional research activity in our department to further stimulate and support our students in their research studies during the upcoming years.

Best Regards,

Prof. Dr. Gönül Turhan-Sayan
Department Chair

Message From the GRWPW Committee

Dear METU EEE Members,

I have been given a chance to be directly involved in the organization of the first ever Graduate Research Writing and Presentation Workshop (GRWPW).

We received a total of 63 abstract submissions, which were evaluated by 19 professors who kindly agreed to help us. Following the reviews, 44 of these submissions were upgraded to full papers that are now included in this proceedings. The workshop included 26 oral presentations (distributed into 5 different tracks) and 18 poster presentations. Based on the evaluators' feedbacks, 4 oral and 3 poster presentations have been awarded. Even though we have been restricted to give awards only to a few top presentations, evaluators' feedbacks clearly indicate that most of the presentations were indeed of very high quality and beyond standards of an international conference.

I would like to thank all presenters and evaluators for contributing to this high-quality workshop. I hope this has been a kick-off for a traditional workshop series in our department with improving quality and higher impacts.

Kind Regards,

Asst. Prof. Dr. Özgür Ergül

MIDDLE EAST TECHNICAL UNIVERSITY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

2014 EEE Graduate Research Workshop
GRWPW 2014

GRWPW 2014 Committee

Gönül Turhan Sayan
Özgür Ergül
Fatih Kamışlı
METU IEEE Student Branch

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Zafer Ünver
Ali Özgür Yılmaz
Melek Yücel
METU IEEE Student Branch

GRWPW 2014 Awardees

Oral Presentations

1. Çağrı Çetintepe
2. Yağmur Demircan
3. Melih Günay
3. Yiğit Özcan

Poster Presentations

1. Elif Tuğçe Ceran
1. Fourough Gharbalchi
1. Mustafa Kangül

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

2014 EEE Graduate Research Workshop
GRWPW 2014 - PROGRAM on May 23, 2014 Friday

ORAL PRESENTATIONS (Morning Sessions)

TRACK SC (Control Systems & Robotics)

Time: 09:40-11:30
Room: D-134
Session Chairs: Yeşim Serinağaoğlu Doğrusöz, Kemal Leblebicioğlu, Emre Tuna

09:40-10:00	**Gökhan Koray Gültekin** *FPGA Based High Performance Optical Flow Hardware Design for Mobile Robotic Applications*
10:00-10:20	**Mehmet Mutlu** *A Real-Time Inertial Motion Blur Metric: Application to Frame Triggering Based Motion Blur Minimization*
10:20-10:40	**Gözde Şahin** *Multi-Dimensional Hough Transform Based on Unscented Transform as a Method of Track-Before-Detect*
10:40-10:50	**BREAK**
10:50-11:10	**Hasan İhsan Turhan** *A Novel Methodology for Target Classification Based on Dempster-Shafer Theory*
11:10-11:30	**Melih Günay** *Approximate Chernoff Fusion of Gaussian Mixtures Using Sigma-Points*

TRACK ST (Telecommunications & Electronics & Computer)

Time: 09:40-12:10
Room: D-135
Session Chairs: Serdar Kocaman, Engin Tuncer, Ali Özgür Yılmaz

09:40-10:00	**Hasan Uluşan** *A Fully-Integrated and Battery-Free Interface Electronics for Low Voltage Vibration-Based Electromagnetic Energy Harvesters*
10:00-10:20	**Ömer Melih Gül** *Achieving Nearly 100% Throughput Without Feedback in Energy Harvesting Communication Networks*
10:20-10:40	**Sajjad Baghaee** *Toward an Energy-Neutral Operation for Localization and Identifying a Target on a Magnetic WSN*

10:40-10:50 **BREAK**

10:50-11:10 **Utku Civelek**
A Software Tool for Vehicle Calibration, Diagnosis and Test via Controller Area Network

11:10-11:30 **Yiğit Özcan**
A Scalable HTTP Adaptive Streaming Solution with Server Feedback

11:30-11:50 **Yağmur Demircan**
Detection of Imatinib and Doxorubicin Resistance in K562 Leukemia Cells by 3D-Electrode Contactless Dielectrophoresis

11:50-12:10 **Baran Tan Bacinoglu**
Finite Horizon Energy-Efficient Scheduling with Energy Harvesting Transmitters over Fading Channels

ORAL PRESENTATIONS (Afternoon Sessions)

TRACK SE (Electromagnetics, Antennas, and Microwaves)

Time: 13:40-15:30
Room: D-131
Session Chairs: Lale Alatan, Özgür Ergül, Nilgün Günalp

13:40-14:00 **Emre Erdil**
Reconfigurable Nested Ring-Split Ring Transmitarray Unit Cell Employing the Element Rotation Method by Microfluidics

14:00-14:20 **Ömer Bayraktar**
Longitudinal Slot Array on Cylindrical Substrate Integrated Waveguide (CSIW)

14:20-14:30 **BREAK**

14:30-14:50 **Çağrı Çetintepe**
A 5-Bit DMTL Phase Shifter with Analog Tuning Features

14:50-15:10 **Özge Topuz Alemdaroğlu**
Human Motion Classification Using Micro Doppler Features

15:10-15:30 **Öznur Türkmen-Kücüksarı**
Design of Novel Multi-Band Metamaterials: Nested U-Ring Resonators

TRACK SS (Signal Processing)

Time: 13:40-15:10
Room: D-134
Session Chairs: Ece Güran Schmidt, İlkay Ulusoy, Zafer Ünver

13:40-14:00 **Cem Tarhan**
Realtime Superresolution Using FPGA

14:00-14:20 **Ahmet M. Elbir**
Angle and Position Estimation for Far-Field Sources with Near-Field Multipaths

14:20-14:30 **BREAK**

14:30-14:50 **Özlem Tuğfe Demir**
Optimum Discrete Single Group Multicast Beamforming

14:50-15:10 **Beril Beşbınar**
A Framework to Detect Inshore Ships from Panchromatic and Multispectral High Resolution Satellite Images

TRACK SB (Biomedical Engineering)

Time: 13:40-15:30
Room: D-135
Session Chairs: Gözde Bozdağı Akar, Mustafa Kuzuoğlu, Gönül Turhan Sayan

13:40-14:00 **Ceren Bora Orçun**
Localization of Atrial Fibrillation Sources by Solving the Inverse Problem of Electrocardiography

14:00-14:20 **Cihan Göksu**
Imaging Current Density Distribution by Using Magnetic Resonance Imaging at 3 Tesla

14:20-14:30 **BREAK**

14:30-14:50 **Hasan Hüseyin Eroğlu**
Image Reconstruction Approaches for Induced Current Magnetic Resonance Electrical Impedance Tomography

14:50-15:10 **Mehdi Sadighi**
J-Based Magnetic Resonance Conductivity Tensor Imaging (MRCTI) at 3 Tesla

15:10-15:30 **Mürsel Karadaş**
Simulation Analysis of Lorentz Field Electrical Impedance Tomography

POSTER PRESENTATIONS

Time: 10:00-12:00 & 14:00-15:30

Evaluators: Özlem Aydın Çivi, Nevzat Güneri Gençer, Fatih Kamışlı

1. Elif Tugce Ceran
Wireless Access Point on the Move: 0/1 Knapsack with Dynamic Capacity

2. Pınar Şen
A Low-Complexity Graph-Based LMMSE Receiver Designed for Colored Noise Induced by FTN-Signaling

3. Samet Gelincik
Channel Estimation Refinement with Channel Tracking with Interleaver Design

4. Mahdi Shakiba-Herfeh
Optimization of Feedback in a MISO Downlink with Energy Harvesting Users

5. Erdal Epçaçan
Beamforming Optimization For a Particular Uniform Linear Array Equipped with Triplets

6. Ömer Çayır
Radar Resource Management Techniques for Multi-Function Phased Array Radars

Evaluators: **Aydın Alatan, Umut Orguner, Melek Yücel**

7. Ömürcan Kumtepe
Logo Classification with Bag of Words Approach

8. Savaş Özkan
Visual Group Mask Pattern for Video Copy Detection

9. Emin Zerman
A No-Reference Video Quality Assessment Metric based on Video Characteristics and Network Parameters

10. Tuğser Kutlu
Ghost Removal in High Dynamic Range Images

11. A. İlden Ak
Landing Autopilot Design for an Unmanned Aerial Vehicle

12. Caner Ipek
Intelligent Traffic Signal Control Systems: A Comparative Study

13. Gökhan Özdoğan
System Identification and Modeling of Gyro-Stabilized IR/EO Gimbal System in Frequency Domain

Evaluators: **Gözde Bozdağı Akar, Mustafa Kuzuoğlu, Gönül Turhan Sayan**

14. Mustafa Kangül
Development of a Complete Resonant Mass Sensing System for Rare Cell Detection Application

15. Gizem Bedir
Solution of Forward Problem of Electrocardiography using COMSOL Multiphysics Environmen

16. Mirmehdi Seyedebrahimi
Simulation of Cardiac Electrical Activity in a Patient Specific Heart Geometry

17. Fourough Gharbalchi
Lead-set Reduction in the Solution of Inverse Electrocardiography Problem

18. Görkem Kandemir
A Robotic Arm Control By EMG Signal

FPGA Based High Performance Optical Flow Hardware Design for Mobile Robotic Applications

Gökhan Koray Gültekin (gultekin@eee.metu.edu.tr)
Supervisor: Afşar Saranlı

Optical Flow (OF) information is used in higher level vision tasks in a variety of computer vision applications. However, its use in resource constrained applications such as small-scale mobile robotic platforms is limited because of the high computational complexity involved. In this work, we present the design and implementation of a high performance FPGA hardware with a small footprint and low power consumption that computes OF at a speed exceeding real-time performance. A well known OF algorithm by Horn and Schunck is selected for this baseline implementation. To achieve maximum possible execution speed, a parallel, pipelined architecture design is utilized. A detailed multiple-criteria performance analysis of the proposed hardware is presented with respect to computation speed, resource usage, power consumption and accuracy compared to a PC based floating-point implementation. The implemented hardware computes OF vector field on 256 256 pixels images in 3.89 ms i.e. 257 fps. The FPGA hardware implementation achieves an accuracy of 1.319 average angular error rate with 0.509 standard deviation and maximum of 0.024 pixels endpoint error as compared with the floating point PC implementation. Overall, the proposed implementation achieves a superior performance in terms of speed, power consumption and compactness while there is minimal loss of accuracy.

A Real-Time Inertial Motion Blur Metric: Application to Frame Triggering Based Motion Blur Minimization

Mehmet Mutlu (memutlu@metu.edu.tr)
Supervisor: Afşar Saranlı and Uluç Saranlı

Mobile robots suffer from sensory data corruption due to body oscillations and disturbances. In particular, information loss on images captured with onboard cameras can be very high, and such loss may become irreversible or computationally costly to undo. In this paper, we propose a novel method to minimize average motion blur captured by such mobile visual sensors. To this end, we derive a motion blur metric (MMBM) that can be computed in real-time by using only inertial sensor measurements and validate it through comparisons with optic flow computations. The applicability of MMBM is illustrated through a motion blur minimizing system implemented on the SensoRHex hexapod robot by externally triggering an onboard camera based on MMBM values computed in real-time while the robot is walking straight on a flat surface. The resulting motion blur is compared to motion blur levels obtained with a regular, fixed frame-rate image acquisition schedule by both qualitative inspection and using a blind blur metric on captured images. MMBM based motion blur minimization system not only reduces average motion blur, but also avoids frames with extreme motion blur before an image gets corrupted by appropriately delaying the triggering of frame acquisition.

Multi-Dimensional Hough Transform Based on Unscented Transform as a Method of Track-Before-Detect

Gözde Şahin (gozde.sahin@metu.edu.tr)
Supervisor: Mübeccel Demirekler

Track-Before-Detect (TBD) is the problem where target state estimation and detection occur simultaneously, and is a suitable method for the detection of low-SNR targets in unthresholded sensor data. As used in TBD, Hough Transform aims to detect a target moving on a straight line. In this study, a new Multi-Dimensional Hough Transform (MHT) technique based on Unscented

Transform is proposed for the detection of low-SNR targets in radar data. MHT is a TBD method that fuses Hough Transform results obtained on (x-t), (y-t) and (xy) domains in order to detect a target moving with a constant velocity. The proposed study models Hough Transform results in (x-t) and (y-t) domains by Gaussians and transforms these Gaussians to (x-y) domain by using Unscented Transform and uses the results to confirm that the candidate target trajectory exists in all three domains. This improves the computational efficiency significantly without degrading performance. Moreover, the algorithm is modified to make use of the echo amplitudes of the radar data and the prior knowledge of targets maximum speed. Lastly, a score-based track confirmation algorithm is proposed to increase the performance under heavy clutter and eliminate possible false trajectories presented by the Hough Transform.

A Novel Methodology for Target Classification Based on Dempster-Shafer Theory

Hasan İhsan Turhan (hasan.turhan@metu.edu.tr)
Supervisor: Mübeccel Demirekler

In this paper, classification of air vehicles according to their types is studied. Demspter-Shafer Theory is utilized for this purpose. A novel algorithm is developed for the mass assignment problem. Tracker data (pdf) is used for obtaining the probability masses by comparing it with the prior information (pdf). Prior information is modeled as the probability density function of the features used for classification. The prior is selected as a Gaussian mixture while the tracker data models the same feature vector as a non-parametric density. This new methodology is tested on real data.

Approximate Chernoff Fusion of Gaussian Mixtures Using Sigma-Points

Melih Günay (e119749@metu.edu.tr)
Supervisor: Mübeccel Demirekler and Umut Orguner

Covariance intersection (CI) is a method used for consistent track fusion with unknown correlations. The well-known generalization of CI to probability density functions is known as Chernoff fusion. In this paper, we propose an approximate approach for the Chernoff fusion of Gaussian mixtures based on a sigma-point approximation of the underlying densities. The resulting general density fusion rule yields a closed form cost function and an analytical fused density for Gaussian mixtures. The proposed method is applied to a simple but illustrative density fusion problem and compared to exact numerical Chernoff fusion.

A Fully-Integrated and Battery-Free Interface Electronics for Low Voltage Vibration-Based Electromagnetic Energy Harvesters

Hasan Uluşan (hulusan@metu.edu.tr)
Supervisor: Haluk Külah and Ali Muhtaroğlu

This study presents a fully-integrated and battery-free interface electronics for converting the low-voltage AC signals generated by electromagnetic (EM) energy harvesters to a reliable DC voltage. The circuit is composed of an AC/DC converter stage which rectifies the harvested AC signal and a DC/DC converter stage to boost the rectified voltage. The rectifier stage utilizes an improved AC/DC doubler structure with active diodes to minimize the forward bias voltage drop and enhance the rectification efficiency. The comparators in the active diodes are powered internally by a passive AC/DC doubler with diode connected transistors. At the DC/DC converter stage, a low voltage charge pump circuit with an on-chip ring oscillator is utilized. The circuit is

designed and implemented by using TSMC 90 nm CMOS technology. Measurement results show that maximum efficiency of the rectifier stage is 67%, while providing 0.61 V to 40 μA load, and it is able to operate down to 100 mV input peak voltages which is the lowest operation voltage among the fully-integrated and self-powered interface circuits, to the best of our knowledge. The full interface circuit can maintain more than 1 V DC voltage at 1 MΩ load resistance for input peak voltages higher than 0.4 V and the circuit is capable of delivering 2.48 V to a 4.4 MΩ load, when interfaced to an in-house EM harvester, subjected to vibrations at 10 Hz, 2.5 mm peak-to-peak displacement with 0.5 g acceleration.

Achieving Nearly 100% Throughput Without Feedback in Energy Harvesting Communication Networks

Ömer Melih Gül (omgul@metu.edu.tr)
Supervisor: Elif Uysal Bıyıkoğlu

A single-hop network where a fusion center (FC) collects data from a set of energy harvesting nodes is considered. If a node that is scheduled has data and sufficient energy, it makes a successful transmission. Otherwise, the channel allocated to the node remains idle. The goal is to make efficient use of channel resources in order to either (1) use all the energy that is harvested by nodes, or (2) stabilize all data buffers. In the absence of feedback from nodes about buffers or battery states, or prior knowledge of the statistics of energy harvest and data arrival processes, this is a Restless Multi-Armed Bandit (RMAB) problem. Despite the hardness of RMAB problems in general, a simple randomized policy achieves near optimality for this problem under a broad class of arrival processes for unlimited battery capacity. Moreover, there is almost no loss of optimality under a reasonable-sized finite battery assumption.

Toward an Energy-Neutral Operation for Localization and Identifying a Target on a Magnetic WSN

Sajjad Baghaee (sajjad@baghaee.com)
Supervisor: Elif Uysal Bıyıkoğlu and Sevgi Zübeyde Gürbüz

This study focused on using magnetic sensors for localization and identification of targets with a wireless sensor network (WSN). A wireless sensor network with MICAz motes was set up. The MTS310, which is equipped with a 2-axis magnetic sensor was used as a data acquisition board. This work aims at understanding the sensing limitations of magnetic sensors by considering small-scale targets moving within a 30 cm radius. Target detection, identification and sequential localization were accomplished using the Orthogonal Matching Pursuit (OMP) algorithm method. Target identification was done on the boundaries of sensing regions. An online ILS system was implemented and continuous movements of the ferromagnetic objects (iron bar and a car) were monitored in LAB and car parking lot. For designing and energy-efficient, intelligent magnetic sensor networks, power drawn by Motes for microcontroller operation, data transmission, listening/reception and LED activation are measured.

A Software Tool for Vehicle Calibration, Diagnosis and Test via Controller Area Network

Utku Civelek (civelek@metu.edu.tr)
Supervisor: Ece Güran Schmidt

Controller Area Networks (CAN's) in vehicles need highly sophisticated software tools to be designed and tested in development and production phases. These tools consume a lot of

computer resources and usually have complex user interfaces. Therefore, they are not feasible for vehicle service stations where low-performance computers are used and the workers not very familiar with software are employed. In this article, we develop a measurement, calibration, test and diagnosis program -diaCAN- that is suitable for service stations. diaCAN can transmit and receive messages over 3 CAN bus channels. It can display and plot the data received from the bus, import network message and Electronic Control Unit (ECU) configurations, and record bus traffic with standard file formats. Moreover, diaCAN can calibrate ECU values, acquire fault records and test vehicle components with CAN Calibration Protocol functions. All of these capabilities are verified and evaluated on a test bed with real CAN bus and ECUs.

A Scalable HTTP Adaptive Streaming Solution with Server Feedback

Yiğit Özcan (yozcan@metu.edu.tr)
Supervisor: Ece Güran Schmidt

HTTP Adaptive Streaming (HAS) has become a popular video streaming solution since it both benefits from the ubiquitous HTTP protocol and TCP's firewall and network address translation traversal capabilities. HAS aims to provide high Quality of Experience (QoE) to the users under limited and varying bandwidth by rate adaptation algorithms which allow the clients to choose the most appropriate video quality. In this paper, we propose HTTP Adaptive Streaming with Server Feedback (HAS-SF) which enables the clients to adapt their rates according to the total number of users, average video rate and the average available bandwidth information provided by the server. These values are computed as moving averages by the server with a small amount of state information that is sent from the clients. The server feedback information computation is simple and not client specific which makes HAS-SF a scalable solution. Our experiments show that HAS-SF achieves significantly better fairness and less rate switches than the well-known Microsoft Smooth Streaming (MSS) while efficiently utilizing the available bandwidth.

Detection of Imatinib and Doxorubicin Resistance in K562 Leukemia Cells by 3D-Electrode Contactless Dielectrophoresis

Yağmur Demircan (dyagmur@metu.edu.tr)
Supervisor: Haluk Külah

This study presents the trapping of imatinib and doxorubicin resistant K562 (human chronic myelogenic leukemia, K562/ima and K562/dox, respectively) cells by 3D-electrode contactless dielectrophoresis (DEP). 3D electrodes are isolated from the solution by means of a thin parylene layer, eliminating Joule heating, electrolysis, and cell damaging. 3D electrodes (extruded along the microchannel in z-axis) provide uniform distribution of DEP force along z-axis, enhancing the separation performance, considerably. It is verified that the system is capable of trapping K562/ima and K562/dox cells at a concentration of 6.25x10e5 cells/ml and 10 microliter/min flow rate by applying 9 Vpp. No trapping occurs for sensitive K562 cells at the same experimental conditions.

Finite Horizon Energy-Efficient Scheduling with Energy Harvesting Transmitters over Fading Channels

Baran Tan Bacinoglu (barantan@metu.edu.tr)
Supervisor: Elif Uysal Bıyıkoğlu

In this paper, energy-efficient transmission schemes achieving maximal throughput in a finite time interval are studied in a problem setting including energy harvests, data arrivals and channel

variation. The goal is to express the optimal offline policy in a way that facilitates a good online solution. The objective of the problem combines throughput maximisation and energy efficiency goals, and is left reasonably general. The family of throughput maximising energy efficient offline schedules (TM-EE-OFF) is defined as solutions to the problem in its full generality, and these policies are expressed in terms of explicitly stated water levels. This characterisation of TM-EE-OFF policies allows per-slot computation of transmit power and rate decisions in an online manner. The online algorithm obtained this way exhibits performance close to the offline optimal, in practically meaningful short problem horizons.

Reconfigurable Nested Ring-Split Ring Transmitarray Unit Cell Employing the Element Rotation Method by Microfluidics

Emre Erdil (eerdil@gmail.com)
Supervisor: Özlem Aydın Çivi and Kaan Topallı

A continuously tunable, circularly polarized X-band microfluidic transmitarray unit cell employing the element rotation method is designed and fabricated. The unit cell comprises a double layer nested ring-split ring structure realized as microfluidic channels embedded in Polydimethylsiloxane (PDMS) using soft lithography techniques. Conductive regions of the rings are formed by injecting a liquid metal (an alloy of Ga, In, and Tin), whereas the split region is air. Movement of the liquid metal together with the split around the ring provides 360° linear phase shift range in the transmitted field through the unit cell. A circularly polarized unit cell is designed to operate at 8.8 GHz, satisfying the necessary conditions for linear phase shifting, provided by the element rotation method. Unit cell prototypes are fabricated and the proposed concept is verified by the measurements using waveguide simulator method, within the frequency range of 8-10 GHz. The simulation and measurement results shows satisfactory agreement, illustrating the viability of the approach to be used in reconfigurable antennas and antenna arrays.

Longitudinal Slot Array on Cylindrical Substrate Integrated Waveguide (CSIW)

Ömer Bayraktar (bomer@metu.edu.tr)
Supervisor: Özlem Aydın Çivi

A traveling wave longitudinal slot array on the broad wall of cylindrical substrate integrated waveguide (CSIW) is examined in terms of pattern synthesis problem. The designs are carried out at 25 GHz using resonant and non-resonant slot elements. Pencil beam pattern is achieved using resonant slot elements while both pencil beam pattern and low SLL is obtained using non-resonant slot elements. The design difficulties of both of the methods are discussed.

A 5-Bit DMTL Phase Shifter with Analog Tuning Features

Çağrı Çetintepe (ccagri@metu.edu.tr)
Supervisor: Şimşek Demir and Tayfun Akın

A Radio Frequency MicroElectroMechanical (RF MEM) Distributed MEMS Transmission Line (DMTL) is designed for a 5-bit digital phase shifter application. Return loss, insertion loss, insertion phase coverage and phase increments of the DMTL phase shifter are optimized for a design frequency of 35 GHz. Electromechanical characteristics of the MEM bridges as well as the DC bias configuration are exploited to allow analog tuning of phase shifter performance. The 5-bit DMTL phase shifter is fabricated using the METU RF MEMS technology at METU-MEMS Center Fabrication Facilities. Fabricated phase shifters exhibit broadband true-time-delay (TTD) performance over 10-40 GHz frequency band with a tailored millimeter-wave performance at 35 GHz. Measurements for

representative bit states demonstrate good phase shift accuracy at 35 GHz with an average value of 11.5 ◦/cell and associated worst case return and insertion losses of 10 dB and 3 dB, respectively, for DC bias voltages ranging between 7.5 V and 13 V.

Human Motion Classification Using Micro Doppler Features

Özge Topuz Alemdaroğlu (otopuz@aselsan.com.tr)
Supervisor: Çağatay Candan and Sencer Koç

This study aims to experimentally investigate the feasibility of discriminating human motions with the help of micro Doppler features by using radar. In the first phase of the work, the synthetic data is generated through the human walking simulator by V. Chen and different time-frequency transformations are applied on the data and the results of the simulator are compared with field experiments. In the following phase, several field experiments which are in the scope of the simulator are conducted and the experimental data for running, crawling, creeping and walking with the aspect angles of 0°, 30°, 60° are collected. Signal processing steps and micro Doppler processing steps are applied to the collected data and spectrograms are obtained. Lastly, six features, which are torso frequency, bandwidth of the signal, offset of the signal, bandwidth without micro Dopplers, the standard deviation of the signal strength, the period of the arms or legs motions are extracted from the spectrograms and the efficiency of the features in motion classification is compared.

Design of Novel Multi-Band Metamaterials: Nested U-Ring Resonators

Öznur Türkmen-Kücüksarı (oturkmen@metu.edu.tr)
Supervisor: Gönül Turhan Sayan

In this paper, a novel metamaterial topology, called M-band nested U-ring resonator (M-NURR), is proposed to provide multiple band operation with an electrically small and geometrically simple unit cell design. The M-NURR unit cell has M-nested and unconnected U-shaped metal rings printed on a dielectric substrate where each ring is primarily associated with a distinct LC type resonance frequency where L and C stand for inductance and capacitance, respectively. Therefore this MNURR topology has the novel property that each of these resonance frequencies can be controlled almost independently by adjusting the arm length of the associated U-ring. In this study, three different M-NURR structures (for M =1, 2, 3) are designed, fabricated and characterised both numerically and experimentally with very good agreement. The suggested subwavelength M-NURR metamaterial topology is anticipated to be useful in the design of miniaturised multi-band mobile communication devices as it makes the fine tuning of operation frequencies possible by a simple parametric adjustment.

Realtime Superresolution Using FPGA

Cem Tarhan (cemtarhan@aselsan.com.tr)
Supervisor: Gözde Bozdağı Akar

A demand in real-time applications for superresolution increases as the surveillance and low resolution camera usage is spread for cost optimization. In this work two real-time superresolution algorithms have been proposed. The first algorithm (NDUID) is composed of non-dyadic upsampling cascade for smooth interpolation and an edge enhancement layer that uses a non-blind deconvolution. Second algorithm (EDAT) consists of a Total Variation (TV) decomposition of an image and edge adaptive interpolation. TV decomposition is used to separate noisy texture component from structure component. The structure component is then interpolated

with a fast edge adaptive interpolation and the edges are enhanced using a shock filter. The result is obtained by mixing bicubic upsampled texture component and structure component. The EDAT is implemented on a Spartan 3A DSP FPGA to demonstrate the results on a real application. Experimental results show that implemented algorithm is capable of outputting 640x480 resolution with up to 52 fps and numerical results show that results exceed quality of simple methods such as bicubic.

Angle and Position Estimation for Far-Field Sources with Near-Field Multipaths

Ahmet M. Elbir (elbir@metu.edu.tr)
Supervisor: Engin Tuncer

Multipath signals are main source of error for parameter estimation in direction finding applications. In this paper, a new method is proposed for the estimation of direction-of-arrivals (DOA) of far-field source and localization of its nearfield multipath reflections in two steps. In the first step, far-field source DOA is estimated using a calibration technique. In order to localize the near-field multipaths, a near-to-far field transformation is presented. The proposed method is evaluated using both ideal and close-to-real world data sets. It is shown that far and near-field source parameters are effectively estimated.

Optimum Discrete Single Group Multicast Beamforming

Özlem Tuğfe Demir (deozlem@metu.edu.tr)
Supervisor: Engin Tuncer

In this paper, transmit beamformer design for single group multicast scenario is considered. The problem is solved in discrete form where the beamformer phase and amplitude values are selected from finite discrete sets. Original optimization problem is converted to a linear form by introducing new variables. The solution of the equivalent optimization problem is always feasible as long as the total power is above a certain value. The problem in its linear form is guaranteed to return optimum solution. Proposed approach is very effective and the number of bits can be increased to obtain close to optimum continuous phase and amplitude beamformers.

A Framework to Detect Inshore Ships from Panchromatic and Multispectral High Resolution Satellite Images

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In this paper, a two-step framework to detect inshore ships is proposed. In the first stage of the framework, a sea mask with fine details is generated in two steps. Using the low-resolution altitude data thresholded by zero-meter height, sea and land subspaces are created. For multispectral images, water index histograms for both sea and land are learned using these subspaces and thresholds are generated using percentiles and improved by median absolute deviations. The rough mask generated by thresholding the whole water index image and is refined by graph cut algorithm in the second step. The graph is generated using all the pixel intensity values and cost functions are determined using the sea and land models learned from the initial mask by Kernel Density Estimation. Solution of the graph by the max-flow algorithm gives a very detailed sea mask. For the panchromatic images, texture found by Local Binary Patterns calculated at sub-windows of the image is modelled by Gaussian Mixture Models using the subspaces. Sea and land texture models are used to determine the cost functions of graph

generated by using the windows and the initial mask is again obtained by max-flow algorithm. Refinement is made by thresholding the geodesic distance of intensity values to the initial sea mask for the panchromatic images. In the second stage, line segments are found near the sea mask by Line Segment Detection (LSD) Algorithm. Segments very close to sea-land mask boundary are chosen to be seeds and Djkstra algorithm is used to find all the line segments which are thought to be on the borders of the man-made docks. The connected components separated by the lines, which are found by merging previously found segments, are described by Angular Radial Transform. The connected components are then labelled to be ship or non-ship using Support Vector Machine which is trained using gorundtruth masks. The tests conducted on a high-variety satellite image dataset showed that this novel algorithm gives robust and promising results.

Localization of Atrial Fibrillation Sources by Solving the Inverse Problem of Electrocardiography

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Among the heart diseases, atrial fibrillation (AF) is one of the most frequently encountered arrhythmias. Although it is not considered as life threatening, if left untreated, it may lead to a degradation of the quality of life, stroke, or even death of a patient. Unfortunately, detection and characterization of atrial fibrillation is not straightforward since the major part of the signal recorded from the body surface contains the ventricular cardiac activity. The techniques to investigate the functionality of the heart can be listed as: electrocardiogram (ECG), body surface potential mapping (BSPM), catheter based mapping. The major aim of this study is to understand the cardiac electrical activity and the functionality of the heart during atrial fibrillation. For that purpose, solving the inverse problem of electrocardiography to localize the initiation points of atrial fibrillation and to model the propagation of the arrhythmia through the heart surface is the aim of this work. Finally, the last part of this work will focus on clinical evaluation of the method on patients with atrial fibrillation.

Imaging Current Density Distribution by Using Magnetic Resonance Imaging at 3 Tesla

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Knowledge of current density distribution can be used in various biomedical applications. Magnetic Resonance Current Density Imaging (MRCDI) is an imaging modality, which reconstructs the current density distribution inside an object by using Magnetic Resonance Imaging (MRI). In this study, a programmable current source, with maximum current injection capability of 224.7mA under 1kΩ resistive load, is utilized to perform MRCDI experiments. The experiments are performed with 2D uniform phantom, filled with saline solution. Current induced magnetic flux density distributions are measured, and current density distribution is reconstructed. The experiment is simulated, and the experimental results are compared with the simulation results. The accuracy of the experiment is demonstrated by comparing total current, which is calculated from the reconstructed current density images, with the total injected current.

Image Reconstruction Approaches for Induced Current Magnetic Resonance Electrical Impedance Tomography

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Induced Current Magnetic Resonance Electrical Impedance Tomography (ICMREIT) is an electrical conductivity imaging method which is based on inducing eddy current through a conductor by exciting a coil structure. The induced eddy current creates a secondary magnetic field distribution which could be measured with MR phase imaging methods. By using the magnetic field measurements, images of electrical conductivity could be reconstructed. In this study, forward problem of ICMREIT is introduced and solved by using Finite Element Method. Afterwards, secondary magnetic field measurement method is described briefly. Consequently, sensitivity matrix and Ohm's Law based image reconstruction algorithms are introduced. The algorithms are used to reconstruct conductivity images by using the simulated measurements and the performance of the reconstruction algorithms is evaluated.

J-Based Magnetic Resonance Conductivity Tensor Imaging (MRCTI) at 3 Tesla

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In this study, current density (J) - based Magnetic Resonance Conductivity Tensor Imaging (MRCTI) reconstruction algorithms namely, the Anisotropic Equipotential Projection (AEPP), the Anisotropic J-Substitution (AJS) and the Anisotropic Hybrid J-Substitution (AHJS) algorithms are implemented to reconstruct conductivity tensor images of a physical phantom using a 3T magnetic resonance imaging system. 10mA current pulses are injected in synchrony with a conventional spin-echo pulse sequence. Furthermore, a new J-based hybrid algorithm namely, the Anisotropic Hybrid Equipotential Projection (AHEPP) is proposed. In addition, reconstruction performances of the four algorithms are evaluated.

Simulation Analysis of Lorentz Field Electrical Impedance Tomography

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Lorentz Field Electrical Impedance Tomography (LFEIT) is a newly proposed technique for imaging the conductivity of the tissues by measuring the electromagnetic induction under the ultrasound pressure field. In this paper, the theoretical and initial simulation studies of the LFEIT are reported. To introduce a current distribution inside a conductive body a phased array ultrasound probe which can steer pressure field in different angles is used. The velocity current occurs, due the movement of the conductive particles under a static magnetic field. To sense this current, a receiver coil configuration that surrounds the volume conductor is proposed. The sensitivity of the receiver for a given excitation is evaluated by using the basis vectors provided by Singular Value Decomposition (SVD).

Wireless Access Point on the Move: 0/1 Knapsack with Dynamic Capacity

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This problem has been inspired by recent industry efforts toward providing Internet service in areas of the world devoid of regular telecommunications infrastructure via flying or floating platforms in the lower stratosphere. According to the abstraction in the paper, the Access Point on the Move (APOM) which is powered through energy harvesting (solar, wind, etc.) must use its energy carefully to provide service to users that demand service from it while it moves over an area. Within the problem setup, users appear in a sequential manner and the APOM must decide whether or not to provide service to each appearing user. The objective of the APOM is to maximize a total value (such as the total data rate provided to the encountered users). The problem is formulated as a 0/1 dynamic knapsack problem with incremental capacity (here, capacity corresponds to stored energy, and incremental capacity corresponds to available energy growing with energy harvests), where the items (i.e. users) arrive one by one, in an online manner. We propose several online heuristics, including one which has an optimal competitive ratio under a certain condition, and study their competitive ratios with respect to the optimal offline solution.

A Low-Complexity Graph-Based LMMSE Receiver Designed for Colored Noise Induced by FTN-Signaling

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We propose a low complexity graph-based linear minimum mean square error (LMMSE) equalizer which considers both the intersymbol interference (ISI) and the effect of non-white noise inherent in Faster-than-Nyquist (FTN) signaling. In order to incorporate the statistics of noise signal into the factor graph over which the LMMSE algorithm is implemented, we suggest a method that models it as an autoregressive (AR) process. Furthermore, we develop a new mechanism for exchange of information between the proposed equalizer and the channel decoder through turbo iterations. Based on these improvements, we show that the proposed low complexity receiver structure performs close to the optimal decoder operating in ISI-free ideal scenario without FTN signaling through simulations.

Channel Estimation Refinement with Channel Tracking with Interleaver Design

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Rapid variation of channel coefficients is one of the most important problems in wireless communication. In high frequency, channel coefficients change more easily due to smaller wavelength. To provide and keep on communication in desired quality, channel coefficients should be estimated continuously. This can be made by using pilot symbols between data blocks which are known by the transmitter and receiver. All the channel coefficients between pilot symbols can be estimated by interpolation but this method has a disadvantage that in the middle of two pilot symbols the channel coefficient estimation are worse than that near pilot symbols. To solve this problem we propose the method that using surrounding symbols of pilots and Least Mean Square(LMS) tracking we estimate the channel coefficients up to some point around two sides of pilot symbols and by interpolation we can estimate coefficients more accurately. Also by suitable

interleaver we have increased the performance of the receiver.

Optimization of Feedback in a MISO Downlink with Energy Harvesting Users

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We study the optimization of the number of bits allocated by energy harvesting users for sending feedback to a common multiple-antenna access point (AP). The nodes need to distribute their feedback transmissions judiciously across time (and channel states) in order to maximize certain throughput goals. While the MISO channel capacity from the AP to a user is a strictly increasing function of the number of feedback bits sent by the user to the AP for providing channel state information, the energy consumption for sending this feedback is (assumed to be) directly proportional to the number of feedback bits. Considering long term throughput, the nodes need to adapt the number of bits of feedback to their energy harvesting profiles.

Beamforming Optimization For a Particular Uniform Linear Array Equipped with Triplets

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Underwater towed uniform linear arrays (ULA) are used in many underwater systems nowadays. ULAs are mostly used for direction of arrival estimation (DOA), detection and classification of any target existing in the medium. However there are some basic problems with ULAs, one of the main problems is left-right ambiguity in DOA. Triplets (three omnidirectional sensors placed on the corner of an equilateral triangle) are used to solve this particular problem instead of a single omnidirectional sensor. The underlying aim in using these triplets is to get directional sensor from three omnidirectional sensors by applying appropriate weights to the output of the sensors and summing them, which is called as triplet beamforming. In our particular case there exist a constant source at end-fire direction and since the beam-width of the array response is large at end-fire, it becomes difficult to detect any target around end-fire direction. In addition to this problem, acoustic signals propagate through multipath in underwater; leading to fictitious targets. Moreover the radius of the circle surrounding the triangle is small and no more sensors are allowed to be used. Therefore directivity of a single triplet is small and suppression of signals coming from undesired elevation angles is not as desired level. In this work it is aimed to solve these particular problems under these particular physical constraints. In this purpose firstly the beam-width of the ULA is tried to be minimized at end-fire directions and then multipath problem will be handled.

Radar Resource Management Techniques for Multi-Function Phased Array Radars

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Multi-function radars (MFRs) are capable of executing several tasks by jointly optimizing limited time and energy resources. The allocation of radar time resources is usually referred to as scheduling in radar resource management (RRM) literature. In this paper, two scheduling algorithms, namely multi-type adaptive time-balance scheduler (MTATBS) and knapsack scheduler (KS), are studied.

Logo Classification with Bag of Words Approach

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Logos are the important features that describe and visualize a specific brand. They represent the brand and provide the recognition of it for the target group. Therefore, the logo should be unique and special to the brand. In this research work, a logo classification and detection system is proposed to check the uniqueness of a logo inside a big logo database. System takes the logo image as input and determines its category according to its visual content so as to refine the search and decrease the computational cost. Then it ranks the logo images in the related category by scoring the similarity to the query logo image. In order to represent logo images, bag-of-words approach is used where each image is defined as a histogram of features calculated by dense SIFT method. Although representations of visual content of logo images have a big semantic gap, this system gives promising results and gives insight about future research.

Visual Group Mask Pattern for Video Copy Detection

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Need for automatic video copy detection is increased with the recent technical developments. Even image-based techniques with bag-of-word kind of representations seem as a best solution because of robustness and speed, they discards convenient geometric relation which exists among interest points. In this work, we propose a novel geometric reasoning which computes a binary signature leveraging existence and nonexistence of interest points in the neighborhood area. The experimental results on TRECVID 2009 content-based video copy detection dataset show that combination of our method with recently proposed quantization-based indexing and weak geometric consistency schemes outperforms classical representations.

A No-Reference Video Quality Assessment Metric based on Video Characteristics and Network Parameters

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In the last decade, the internet streaming video has gained a lot of importance and drawn much attention from both public and industrial companies. This attention created a need to measure the supplied (or acquired) service quality, in this case video quality. Although there are different Video Quality Assessment (VQA) algorithms, most of them are either Full-Reference (FR) or Reduced-Reference (RR). In today's conditions, it is not feasible to supply the reference (or raw) data for just quality assessment. Hence, No-Reference (NR) VQA metrics are easier to use in different platforms including mobile and embedded platforms. In this study, an NR VQA metric has been proposed based on characteristics of a video and network parameters. The proposed metric has been evaluated on EPFL-PoliMI video quality database which includes videos with different contents and different packet loss ratios. The results show that the proposed metric has been proven to be accurate and robust under different network and video characteristics conditions of EPFL-PoliMI database.

Ghost Removal in High Dynamic Range Images

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High dynamic range (HDR) image generation techniques are becoming more favored in numerous applications. The construction of the HDRI is the fusion of multiple images which are taken with different exposures. For fusion, various methods can be found in literature. In this paper, exposure fusion technique is analyzed. During the fusion process, displacements of the image cause ghost artifacts in the final HDR image. In order to avoid this, ghost removal techniques are stated. In this paper, two of them will be analyzed. In addition, improvement of one of the techniques is presented. Aim of this paper is to state exposure fusion technique, to make comparison of the reviewed ghost removal techniques, and to propose an improvement of one of the ghost removal techniques.

Landing Autopilot Design for an Unmanned Aerial Vehicle

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This paper describes the landing autopilot design for the UAV (Unmanned Aerial Vehicle), Pioneer RQ2. Firstly, dynamics of the aircraft is introduced and the Simulink model of the Pioneer RQ2 is presented. Then trim and linearization procedures are explained. Finally, designed PID Controllers and responses are shown and mentioned about the future works.

Intelligent Traffic Signal Control Systems: A Comparative Study

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In this study, rule base algorithms are developed to control the green signal duration in isolated intersections. The algorithms decide the green signal duration according to the flow rates and the queue lengths of all directions. Aim is to increase the performance of the intersection. In the construction and utilization of rule bases, fuzzy logic is used. For the simulations MATLAB is preferred.

System Identification and Modeling of Gyro-Stabilized IR/EO Gimbal System in Frequency Domain

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In this study, four-axes gyro stabilized electro optic gimbal system is modeled through experimental investigation in frequency domain and the results of this investigation are presented. The dynamic behavior of a mechanical system is obtained from input and output signals, strictly speaking, nonparametric measurements. Detecting and measuring the nonlinear distortions allow a better understanding and gives an intuitive insight of the error sources on frequency response function (FRF) measurements. Linear dynamic time invariant system is modeled by its parametric transfer function with plenty of different estimation techniques and their efficiencies, convergence properties, bias errors are compared and discussed. It turns out that, the nonparametric noise model allows the estimator to weight the cost function and reach statistically better results.

Development of a Complete Resonant Mass Sensing System for Rare Cell Detection Application

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In this paper design of complete mass sensing system which includes laterally resonating MEMS structure and read-out electronics for closed loop operation is presented for biochemical applications such as rare cell detection. The read-out electronics eliminates the drawbacks of crosstalk effect with a capacitive transimpedance amplifier. Overall simulations show that system is able to oscillate in closed loop mode with stray capacitance of 100 fF.

Solution of Forward Problem of Electrocardiography using COMSOL Multiphysics Environment

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Computation of the body surface potentials from equivalent heart sources is called the forward problem of electrocardiography (ECG). In this study, our aim is to solve the forward problem of ECG by modeling heart's electrical activity in terms of three dimensional transmembrane potential distributions, and then to find torso potential distribution which occurs due to these transmembrane potentials within the heart. Towards the end, Poisson equation based on 'bidomain' model is solved. In this model, current density distribution which occurs as a result of variations in the transmembrane potentials are defined and extracellular potential distribution formed by these current density distributions is calculated. This calculation is done by using finite element method (FEM), which is a numerical solution method. In order to do this calculation, we use "COMSOL Multiphysics" program which provides easy mesh generation and numerical computation. In this paper, solution of Poisson equation and thereby forward problem of ECG are introduced. Here, heart and torso are modeled by two concentric spheres.

Simulation of Cardiac Electrical Activity in a Patient Specific Heart Geometry

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Mathematical modeling of heart's electrical activity is useful for understanding the details of heart's function, and developing methods for diagnosis and treatment of various heart diseases. In this work, we modelled the electrical activity of the heart in the three dimensional ventricular geometry based on transmembrane potential distributions. Our model is intended to be patient specific using magnetic resonance imaging and diffusion tensor imaging techniques. We also used Aliev-Panfilov model to describe electrical activity of the heart at tissue level, which focuses on the potential wavefront propagation. It is also possible to include the anisotropy of the heart muscle. The model simulates two kind of arrhythmias namely ectopic initiation of heart beats in normal ventricular tissue and partially ischemic tissue.

Lead-set Reduction in the Solution of Inverse Electrocardiography Problem

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In inverse electrocardiography (ECG) one seeks to reconstruct the bioelectric sources, on the heart surface, from remote measurement using electrodeson attached to the body surface. Obtaining the body surface potential map (BSPM) in order to non-invasively estimate electrical activity of the heart is one of the main issues in the context of inverse electrocardiography. Number of studies undertaken to reduce the number of attached electrodes to the surface of the torso. It is appreciated that together with the reducing the number of leads on the torso, the inverse problem turn to have more unknowns than equations, namely, it becomes under-determined. In this study, in addition to Row Deletion method to reduce the number of leads, sequential selection method, which is data-mining based approach is used. Then a well-known Tikhonov regularization algorithms is implemented to solve the resultant underdetermined system using L-curve, Generalized Cross-Validation (GCV), and maximum Correlation Coefficient regularization parameter selection algorithms and results will be compared quantitatively and qualitatively.

A Robotic Arm Control By EMG Signal

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In this study, an electromyogram (EMG) based human machine interface system is designed and implemented. The system acquires EMG signals and processes them to generate commands to control a robotic arm. It is composed of three main parts: The Robotic Arm and its driver, Main Controller Software, and Analog and Digital Circuitry. Operator is linked to the system via 8 EMG channels from his/her specified muscles. The operator muscles are chosen as conjugates and the muscles Triceps Brachii (Long Head), Biceps Brachii, Flexor Carpi Ulnaris, and Flexor Carpi Radialis are used as system inputs. The raw EMG data is acquired from these muscles and amplified by analog circuitry, and then it is digitized in digital circuitry. Once the digital raw EMG data is obtained, it is fed to the Main Controller Software running on a PC. This controller software is responsible to extract necessary information from the raw EMG data in order to control the Robotic arm with full functionality. The Robotic arm is composed of 5 servos and mechanical components. Therefore, its driver is simply a servo driver which receives position inputs. In accordance with the extracted information from the raw EMG data, position commands are sent to the driver to control the robotic arm. The Robotic Arm itself and its driver are not designed in the scope of this study. In literature, the general solution to control of an independent device via bio-signals is based on constructing a mapping from set of N different gestures to a predefined set of N different device input. This mapping methodology prevents operator to direct the arm to all points in 3D space within mechanical limits. As a result, in robotic arm control problem, the whole system becomes useless for functional purposes from operator's point of view. However, in this study, information extracted from each muscle conjugate of the operator is used to drive a specific servo on the robotic arm. This methodology allows the operator to direct grabber of the arm to any point in 3D space with his visual feedback. Therefore, operator is capable of using the robotic arm for functional purposes.