DESIGNING A MUSCLE STIMULATOR FOR PEDIATRIC SURGERY
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The purpose of this paper is to introduce a muscle stimulator for pediatric surgery with the maximum performance and the lowest cost. With this instrument, the signal used in the excitation of muscles must be at low frequency but also it must be a signal by which transition time and volume can be adjusted. The frequency of an oscillator circuit that can provide this signal is determined to be in the field of 1 to 200 Hz. The output voltage is high enough in excitation of muscle and at the same time it is below the level of human health damage. Besides, the transformers used at power circuit are performed within city network to isolate the harmful voltage. For the application of pediatric surgery, electrical muscle stimulation uses an outside electrical source that stimulates the nerves to send signals to patient’s muscles to expand and contract. Muscle stimulator can increase muscle observability and it may be used to help the doctors in order to see the patient’s muscle groups.

CAPSULE ENDOSCOPY
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The development of “capsule endoscopy” is one of the greatest achievements in the history of medical field. The new form of gastrointestinal endoscopy that was performed with a miniaturized, swallowable camera that was able to transmit color, high fidelity images of the gastro intestinal tract to a portable reading device. This paper highlighted the ability of the device to image the entire small bowel, a prospect that had been difficult with preexisting endoscope technology. The device known as M2A (mouth to anus) imaging system quickly generated widespread interest with in the gastrointestinal community as a means of investigating small bowel disease. The M2A (mouth-to-anus) capsule endoscopy (CE) system developed by Given Imaging, Ltd. has provided gastroenterologists with the ability to examine the small intestine as never before. The capsule contains a video imaging, self-illumination, and image transmission modules as well as a battery supply that lasts for up to 8 hours. The indwelling camera takes images at a rate of 2 frames per second and uses wireless radio transmission to send the images to a receiving recorder device that the patient wears around the waist. The current proposal for use of this technology is with patients who have digestive tract bleeding for which other testing hasn’t found a cause.

REMOTE SENSING OF HEART AND LUNG MOTION USING A MICROWAVE ANTENNA
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A theoretical microwave technique has been developed for detecting heartbeat and breathing signals of a human body near and far from the receiver and transmitter antennas. The basic principle of the system is to illuminate the body with a low-intensity microwave beam and to receive the backscattering microwave signal in order to extract the modulated heartbeat and breathing signals. This study has been realized on two human body models considering heart and lung to be a sphere at the core of concentrically and stratified layered body structures. The description of this technique is given with the results of the comparison of the two body models.

DATA ACQUISITION AND IMAGE RECONSTRUCTION ENVIRONMENT FOR METU MAGNETIC RESONANCE IMAGING SYSTEM
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Data acquisition and image reconstruction tasks of METU Magnetic Resonance (MR) Imaging System are used to be performed by a 15 year-old technology. This system is incapable of transmitting control signals simultaneously and has memory limitations. Control software is written mostly in assembly language, which is hard to modify, with very limited user interface functionality, and time consuming. In order to improve the system, a LabView® based data acquisition system consisting of a NI-6713 D/A card (to generate RF envelope, gradients, etc.) and a NI-6110E A/D card (to digitize echo signals) from National Instruments™ are integrated and a pulse sequence design and image reconstruction front-end is designed and implemented.

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*National Instruments Laboratory Virtual Instrument Engineering Workbench, a graphical development environment specialized in acquiring, analyzing and presenting data.
THE DIGITAL AMBULATORY ECG DEVICE USING FLASH MEMORY STORAGE UNIT

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Today, especially with production of high capacity flash memories, ambulatory electrocardiogram (ECG) devices, which have the capability of long time digital data recordings, have started to play more active roles to take clinically significant records. The memory capacity, volume and weight of ambulatory device are important for many aspects, specifically for the patients to use comfortably this kind of devices.

Conventional Holter cassette ECG recorders have difficulties both for clinical applications and patient usage due to storing data on the magnetic cassette tape and including an electro-mechanical part.

This study aims at reflecting up-to-date improvements in the fields of microcontrollers and non-volatile memory units to a digital ambulatory ECG monitor. The device has the advantage of digital recording and being compatible with the commercially available flash card readers and general-purpose software.

ANALYSIS OF DOSE DISTRIBUTION IN GAMMA KNIFE TREATMENT NEAR TISSUE INHOMOGENETIES USING GEL DOSIMETRY

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Relative dosimetric uncertainties in Gamma Knife Radiosurgery particularly near the tissue inhomogeneties are investigated using phantoms made of new normoxic Polymer Gel. For calculating the dose distribution in the phantoms, T2 mapping of the exposed normoxic gel is calculated by using Spin Echo MR sequence for different TE values and exponential nonlinear least-squares fitting based on the Levenberg- Marquardt algorithm. The treatment planning system, GammaPlan, ignores the tissue inhomogeneties and assumes all tissue to be water equivalent.

Dose mapping calculated along the x-, y- and z-axes show that the dose distribution near tissue inhomogeneties is different from that predicted by GammaPlan.

EFFECT OF COCHLEAR IMPLANT ALGORITHMS ON FORMANT FREQUENCIES

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Cochlear Implant device implanted in Cochlea aims to mimic the functions of Cochlea in order to supply partial hearing. Cochlear Implant device is mainly formed by a microphone, signal processor, transmission system and electrodes implanted in the Cochlea. The main purpose of many developed Cochlear Devices is to minimize the difference between real and sensed speech. Different signal processing techniques, electrode combinations, insertion depths and channel numbers are investigated to fulfill this purpose. In this study, some vowels are processed with different channel numbers using ACE and CIS algorithms and formant frequencies of these processed vowels are compared with those of the originals.

CALCULATION OF TEMPERATURE RISE FORMED BY SEQUENTIAL CONTINUOUS WAVE DOPPLER ULTRASOUND

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By using both theoretical and experimental method it is possible to estimate the heating potential or thermal hazardous of Diagnostic Ultrasound. The temperature elevation on tissue that induced by Diagnostic Ultrasound Studies if calculated by the Bioheat Transfer Equation the initial condition related to the temperature rise induced by Diagnostic Ultrasound Studies was not taken into account in solution of the Bioheat Transfer Equation. In this study the initial condition is taken into account and the analytical solution of the BioHeat Equation is obtained by using Green’s functions. Using that solution it is possible to calculate temperature rise formed by sequential Continuous Wave Doppler. According to scanned (B-mode) and unscanned (Doppler) mode the numerical results have been obtained by simulation program. By means of animal experiment the thermal hazard effect of Diagnostic Ultrasound Studies on fetal tissue will be determined.
SYNCHRONIZATION PHENOMENA IN BRAIN RESPONSES TO EXTERNAL STIMULI

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The synchrony phenomenon between neural signals is of importance for the study of large scale interactions in the brain. The synchronization of instantaneous power and phase of time-varying energy of the brain responses (EEG signals) of healthy subjects to the auditory oddball paradigms recorded on Fz electrode site are studied using Wavelet Transform and statistical parameters. By this, it is aimed to gain a measure of the stability of the instantaneous power and phase of the time-varying EEG signal across single trials. The level of synchrony obtained by using surrogate data has demonstrated reliable power and phase locked brain responses that offer a common language and framework that can be used in the future research for understanding brain dynamics.

3D MEDICAL VISUALIZATION AND ANALYSIS TOOL FOR DETECTION OF PATHOLOGICAL FORMATIONS: INTEGRATION WITH PHOTOGRAHMETRIC TECHNIQUES

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In this project, we reconstruct 3D models of human body by using CT, MR slices and digital images and precisely find the locations of pathological formations such as tumours. For this purpose, within this project we developed a software, which we called as "Medical Image Processing and Analysis System (MIPAS)". In this paper, we introduce the abilities of MIPAS briefly and also give a sample application on finding location and visualization of a brain tumour. MIPAS uses volume and surface rendering techniques for 3D modelling of the tissues and provides both volume and surface models at the same time on the screen when required. It is possible to register CT and MR images by using both anatomical landmarks and artificial (external) markers. MIPAS also provides surface registration functions with both rigid body and non-rigid body transformation with the variants of ICP algorithm. For photo-realistic visualization of the external human body like face of the patient, it provides a photogrammetric module.

EFFECTS OF BIOELECTROMAGNETIC DATA FUSION IN HEAD TISSUE RESISTIVITY ESTIMATION IN VIVO

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In vivo resistivity estimation is possible by using bioelectromagnetic data (potential and magnetic field) and an inverse problem solver. In this study, we aim to investigate estimation performances of statistically constrained minimum mean square error estimator (MIMSEE) by using three different data schemes: only MEG data, only EEG data and raw fused combined MEG – EEG data. The MIMSEE is used because at an earlier study it was shown to be the most accurate one compared to Least Square Error Estimator (LSEE) and Bayesian Maximum A Posteriori (MAP) estimators. The measured data are obtained from a source localization experiment involving one subject of which the median nerve has been stimulated. Using three data sets scalp, skull and brain resistivities are estimated and the error rates are calculated. The calculated error rates are %20.28 with EEG data, %7.08 with MEG data and %12.5 with the combined EEG - MEG data for brain region. Since the variation in MEG measurements are the least sensitive to geometry and resistivity disturbances, the estimations seem to be the least erroneous.

BIOMEDICAL IMAGE FUSION WITH SELECTION OPERATION IN THE LAPLACIAN PYRAMID DOMAIN

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The purpose of this study is to provide more effective imaging by using selection operation in the Laplacian pyramid domain for MRI (Magnetic Resonance Imaging) based images, which contains anatomical and morphological information about body tissues in the medical imaging. In this way, the sub-pixel information from multiple images of the same scene can be combined to provide both more detailed and increased resolution beyond that provided by a single image itself. It is anticipated that, this study will help the physician towards a more realistic and effective assessment of disease.
Conformal Transformation on the Analysis of Forward Problems in Electrical Impedance Tomography

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Electrical Impedance Tomography (EIT) shows the conductivity distribution through the cross-section of a body part. It is reported that the image reconstruction is distorted considerably when the boundary shape is considered to be more elliptical than circular in thorax model. Elliptic geometry model, which constructs more general structure, reduces the amount of problems and ensures more accurate results about perceiving inhomogeneities. In this study, the forward problem of EIT is analyzed under elliptical and circular frameworks by using analytical and finite element method. The Analytical Solution defined for Elliptic Geometry is improved by applying Conformal Transformation to the forward problem.

2-D and 3-D Simulation of Brain Structure Deformations by Tumor Pathology Using MRI Images

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Developments in surgical planning applications in brain surgery have revealed the need for modeling the brain using physical approaches, i.e. soft tissues, viscoelasticity, etc. This has given rise to the term ‘deformable objects’, which refers to organs with a morphology, a physical and a mechanical behaviour of their own.

In this paper, we propose a simulation model, based upon physical laws, to simulate the brain deformation caused by regular and irregular shaped tumor pathologies using the reconstructed surface data taken from MR (magnetic resonance) scans. We also use the 2-D MR images to estimate the physical nature of the different brain structures. The 2-D model is then modified to simulate the deformation in 3-D. A physics based model of the brain is used that is able to simulate the evolution of different nature pathological intra-cranial tumors.

Performance Analysis of Two Magnetic Resonance-Electrical Impedance Tomography (MR-EIT) Reconstruction Algorithms to Image Anisotropic Conductivity

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It has been shown that conductivity distribution inside a conductor object can be imaged using Magnetic Resonance - Electrical Impedance Tomography (MR-EIT). All MR-EIT algorithms developed to date assumes isotropic conductivity, however it is known that electrical conductivity of most biological tissues are anisotropic. In this study, performances of two MR-EIT algorithms, proposed by Zhang [1] and Eyüboğlu et al [2] are investigated in reconstructing anisotropic conductivity. The two algorithms are tested by using simulated data, obtained from numerical models.

A Simple Non-Invasive Blood Pressure Monitoring and Heart Rate Measurement System

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Blood pressure is detected by measuring light intensity passed through tip of finger. Source of the light is simply a LED and located under the tip of the finger. The analog signal is amplified and converted to digital form by a 12 bit analog digital converter. The digital signal is transferred to a PC through the printer port. The monitoring and measurement is done under Linux operating system. A simple driver is developed for the measurement device to be recognized by Linux. Monitoring program is developed by using Gnu C/C++ and QT library. Besides monitoring diastolic and systolic blood pressures are measured and heart rate is extracted from the blood pressure signal. The blood pressure monitoring system is simple and can be mobile by using a notebook instead of a PC. It is also cost-effective when compared with commercial non-invasive continuous blood pressure monitoring devices.
Commercial biosignal amplifiers are costly and they are in general integral parts of medical devices. And they are usually not suitable for biomedical researches. For this reason, simple and low-cost biomedical amplifiers for ECG and EEG were designed. The designed amplifiers have standard features and can compete with commercial amplifiers. For ECG, pass band is from 0.5 to 100 Hz and the gain is 2200. Standard lead connections such as bipolar, unipolar limb leads can be easily used for measurements. For EEG, pass band is from 1.5 to 37 Hz and the gain is 25000. The device has also dual channels inputs and monopolar, bipolar and hjort measurements can also be performed. The amplified signals can be easily transferred to a PC by a DAQ card and processed by the computer.

Electrophysiological recordings are considered a reliable method of assessing a person’s alertness. Sleep medicine is asked to offer objective methods to measure daytime alertness, tiredness and sleepiness. In this study, EEG signals recorded from 30 subjects were processed by PC-computer using classical and model-based methods. The classical method (fast Fourier transform) and three model-based methods (Burg autoregressive, moving average, least-squares modified Yule–Walker autoregressive moving average methods) were selected for processing EEG signals to discriminate the alertness level of subject. Power spectra of EEG signals were obtained by using these spectrum analysis techniques. These EEG spectra were then used to compare the applied methods in terms of their frequency resolution and the effects in determination of vigilance state of subject. It is found that, FFT and MA methods have low spectral resolution, these two methods are not appropriate for the analysis of the awake-sleep correlation. Burg AR and least-squares modified Yule–Walker ARMA methods’ performance characteristics have been found extremely valuable for the determination of vigilance state of healthy subject, because of their clear spectra.
MICROCONTROLLER BASED NERVE CONDUCTION VELOCITY MEASUREMENT SYSTEM

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In this study, a microcontroller based system to measure nerve conduction velocity has been developed. The measurement system consists of a multiple channel electrical stimulator and a multi-channel bio potential amplifier unit controlled by a microcontroller unit via a PC. The electrical stimulator is used to stimulate multiple sites along a nerve from the skin surface. Resultant EMG signals are amplified by the biopotential amplifier, digitized and then recorded by the PC. The distances between different stimulation sites and the response time of the EMG is utilized to determine the conduction velocity of the corresponding nerve.

THE ECG ASSISTANT

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This project includes the design of an expert system (ES) which is able to distinguish various arrhythmia types. For this idea, first the Electrocardiography (ECG) signals were captured by an Holter Device. The ECG signals consist of a variety of arrhythmia such as bradycardia, ventricular tachycardia, atrial fibrillation and atrial flatter. Then, the important features were determined with the consultation of an ECG expert from the American Hospital, Istanbul. The knowledgebase of the ES was then constructed by the knowledge engineer who transformed the features to rules and facts. As the expertise of the human expert is transferred to the ES, the program was correctly able to distinguish the type of the arrhythmia without the need for the human expert.

VISUALIZATION OF THE SPREADING CORTICAL DEPRESSION (SCD) WAVEFRONT ON THE HUMAN BRAIN SURFACE

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Spreading Cortical Depression (SCD) is a wave of electrochemical changes at a slow rate that depresses the electrical activity of neurons when it spreads across the cerebral cortex. Many studies have been performed to explore the mechanism of SCD and the relationship of SCD to pathological brain functions. A possible link between SCD and migraine is a hypothesis often found in literature. In order to describe SCD data obtained in animal and possibly human studies by means of source localization, we propose a source model consisting of propagating current dipoles equally spaced along the wavefront. Starting from a point initiation, the wavefront dipoles spread with a given velocity along the cortical surface. By using realistic human surface data from one subject, various SCD activities from different starting points on the brain, have successfully been visualized by using the software developed under windows visual C++ platform. Here, we present the results of numerical simulations, while the comparison with experimental results is planned in the next stage.

IN VIVO ESTIMATION OF HEAD TISSUE RESISTIVITIES BY USING NONINVASIVE BIOELECTROMAGNETIC MEASUREMENTS

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Knowledge of tissue resistivities is needed to construct reliable volume conductor models of the human body and the head in solving forward and inverse bioelectric and biomagnetic field problems. In this study, three different estimation algorithms are run to estimate the resistivity distribution by using EEG and MEG data. The EEG-MEG data set has been obtained from a source localization experiment involving one subject of which the median nerve has been stimulated. The estimation algorithms used are as follows; conventional Least-Squared Error Algorithm (LSEE), Bayesian Maximum A Posteriori (MAP) Algorithm and statistically constrained Minimum Mean Squared Error Estimator (MIMEE). They intake a priori information on body geometry (realistic boundary element model obtained from 256 T1 weighted MRI images), and statistical properties of the following parameters; regional resistivities, linearization error and instrumentation noise. Scalp, skull and brain resistivities are estimated separately by using these algorithms and estimation variances are calculated.
DETECTION OF DELAYED POTENTIALS (DP) RELATED TO PHYSICAL NATURE OF MYOCARDIAL INFARCT
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This paper investigates the effect of possible variations of physical characteristics in myocardial infarcts on the parametric variations in ventricular late potential analysis from a signal processing point of view. The work aims to set up a framework for their relationship to the ability of the prevalence of VLPs using the common analysis methods and the wavelet transform (WT) analysis. The possible effects of physical Size, Position, Orientation and Type (SPOT) of the infarct are incorporated in the signal model used in the analysis. The data used included different signals modeling the behavior of late potentials based on duration, frequency, amplitude and position. The three widely accepted criteria; QRS duration, root-mean-square and duration of the signal at the end of QRS were used in the investigation as well as an alternative approach using wavelet transform (WT) analysis. Delayed potential (DP) is introduced as a new and more general description of the VLP phenomena. Results of the cross effects of these methods and their resultant parameters were presented in this work.

COMPARISON OF TRANSFORM TECHNIQUES FOR EEG SIGNAL COMPRESSION
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Transmission of biomedical signals through communication channels is being used increasingly in clinical practice. The technique of the electroencephalographic (EEG) signal transmission requires dealing with large volumes of information. In the EEG, various channels are recorded during several hours, resulting in a great demand of storage capacity or channel bandwidth. This work is concerned with the lossy compression of EEG signals using Fast Fourier Transform (FFT), Discrete Cosine Transform (DCT), and Wavelet transform (WT) based techniques with potential applications to transmission and storage of medical data. First, the EEG signal is segmented and then decomposed through the transform techniques. Then the decomposition coefficients are thresholded and those having absolute values below the threshold are deleted. The remaining coefficients are appropriately quantized and coded using a run-length coding scheme. These algorithms are tested by measuring measuring the compression rate (CR) and the the distortion in signal segments. By means of subband decomposition, wavelet transform showed a high robustness, allowing a reasonably low distortion after a compression-decompression process.

DYNAMIC ECG TEMPLATE CONSTRUCTION BASED ON WAVELET TRANSFORM
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This paper presents an improved method for patient-dependent template generation that takes into account the possible variation from patient-to-patient and beat-to-beat variations for the same patient. In addition to template generation, the method presented here allows for good reduction of data size without loss of information. The method shows good performance even for noisy signals since it isolates noise in a separate wavelet transform (WT) level. We introduce a method that extracts templates from patient data rather than using a general golden template and use this template in the coding process. This approach uses a method we developed specifically in this work to compute what we called dynamic averaging. Dynamic averaging allows for real time computation of the average of beats as they are recorded or received. A template of a user-defined size is generated for each patient and extracted from her/his own data.

BODY TEMPERATURE MONITORING BY COMPUTER-CONTROLLED BIOTELEMETRY IN SMALL MAMMALS
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Biotelemetry technique in measuring physiological parameters such as body temperature or heart rate has become widespread in especially biological and pharmacological studies because of some advantages. These advantages include collecting data continuously and for extended periods, avoiding hyperthermic effect induced by handling, restraining and measuring rectal temperature. In a biotelemetric system, implantable transmitters using for core body temperature send out temperature-dependent pulses. These pulses of transmitters are received by radio receivers and then send through a datapor to an interface card in a computer. The data are recorded and processed by a software program. In this study, temperature sensitive transmitters were implanted intraperitonally to Djungarian hamsters (Phodopus sungorus) to analyze whether metabolic rate reduction is a consequence of decrease in core body temperature in daily torpor. Temperature telemetry method (surgery, encapsulation of transmitters, calibration, data collection etc.) used for this purpose was evaluated as a biomonitoring system.