Analysis of Vocal chord Vibration Patterns During Speech Production
Platon Lukyanenko, Yiyang Xia, Dinesh Chhetri, Ginxi Guo, Soo Jin Park, Abeer Alwan

The larynx is a key component in speech production – the configuration of laryngeal muscles to a large degree determines sound production. It has been assumed that glottis (gap between vocal folds) opening/closing frequency or width correlates with pitch.

Video and Audio data from nine different artificially stimulated laryngeal muscle configurations was provided by Dr. Dinesh Chhetri from an experiment performed in 2009 at UCLA. We analyzed glottal width over time, as measured with the help of a kymogram through matlab, which suggested that while glottal width can be used to determine mode change, although actual width values correlate poorly with F0. An attempt at determining open/close frequency of the glottis using the same width data was also done with both a moving-sum-of-peaks and autocorrelation approach. The moving sum results correlated poorly with F0 values and were a bad predictor of modal change. Autocorrelation results did not correspond clearly with F0 but showed a difference after a mode change. A glottaltopogram program, created by Gang Chen at the Speech Processing and Audio Perception Lab, was used to analyze the pattern change in vocal fold movement. The result did not reveal any significant change before and after mode change.

The question of whether or not glottis open/close frequency is indicative of pitch should be examined more closely in the future.

Breathing Pattern Detection using ECG Data
Fernando T. Do Vale, Lucas F Wanner, Haksoo Choi, Wentao Ouyang, Mani B Srivastava

The evaluation of the respiratory system has an important role on the identification of many breathing disorders. Conventional methods of diagnosis are usually expensive and impractical, thus simplified breathing sensing techniques are necessary. Knowing that there is a close relationship between respiration and heart activity, ECG data can be used as an alternative way of detecting breathing patterns. Using ECG and RIP signals collected from the Zephyr BioHarness chest belt for three different people, we trained four classification models and compared the accuracies obtained through cross-validation. The results showed that the ECG can reflect the breathing pattern in some level, but there is still some uncertainty. With further improvements, we believe that ECG analysis could be a good replacement for dedicated breathing measuring equipment.

Data Analysis of Seismic and Environmental Effects on Watts Towers
Sergio Herrera, Robert Nigbor

The Watts Towers are a National Historic Landmark located in Los Angeles, California and consist of 17 interconnected structures. The Watts Towers were built between 1921 to 1954 by Simon Rodia. Overtime, there has been numerous cracks that have formed in the cement mortar. There have been efforts in repairing the towers but their deterioration has continued. As efforts led by the Los Angeles County Museum of Art (LACMA), to preserve the site, they founded necessary in better understanding the behavior of these towers. To do this, LACMA contacted the UCLA Department of Civil and Environmental Engineering, to help with the monitoring of the towers. UCLA engineers have performed experimental testing and studied how the environmental factors have affected the structural behavior of the towers. Several different monitoring devices have been installed throughout the structure in attempt to better understand the thermal, wind and seismic effects the structure experiences. Since its construction, earthquakes and windstorms have damaged the Watts Towers.
Developing a Low-cost, High-efficiency Syringe Pump using an Arduino Microcontroller
Kyrollos Yanny, Lisa Sobajian, Jacob Schmidt

Syringe pumps are common devices needed in most hospitals and laboratories to administer fluids at a precise rate to either a patient or a reaction chamber. Despite the simplicity of the functionality of syringe pumps and the continuous need of precise administering of fluids, syringe pumps’ prices are unjustifiably high. This unjustifiable high cost increases all syringe pump related healthcare services and prevents community colleges, high schools, and limited funded university laboratories from performing experiments including syringe pumps. Thus, focus in the Schmidt laboratory at UCLA was directed to designing a low cost, high-efficiency syringe pump that works as an infusion and withdrawal syringe pump, is easy to use and modify, and accommodates different syringe sizes and different functionalities. This was done using a stepper motor, a stepper motor driver, and an Arduino microcontroller. The proposed syringe pump costs about $130 and does the same functionality as the $3000-$4000 currently available syringe pumps with a percent accuracy of 97%. The percent accuracy can increase significantly if a correction factor is implemented in the software.

Effects of Fluorinated Microporous Active-Carbon in Capacitance of Electrochemical Double-Layer Capacitors
Jesus M. Lopez Baltazar, Huihui Zhou, Yunfeng Lu

Carbon based electrochemical capacitors, also named supercapacitors, together with fuel cells and batteries represent types of electrochemical energy storage devices. Compared with batteries and fuel cells, supercapacitors deliver their stored energy in a few seconds, offering higher power densities and long cycling life. However, supercapacitors based on the electrochemical double-layer capacitance (EDLCs) have lower energy density compared to batteries and fuel cells, which limits their application as energy storage devices. In this project, in order to improve the energy density of EDLCs, fluorination of the carbon-based electrodes was attempted to enhance the wettability between electrode materials and the electrolyte and to fully utilize the carbon surface area, thus enhancing the overall capacitance of carbon-based supercapacitors. Two types of commercialized active carbon (named as CAC and SAC, respectively), used as electrode materials, were fluorinated with HF by sonication at room temperature and prepared for electrochemical tests. Although similar electrochemical responses were obtained from CAC and fluorinated CAC (F-CAC-RT), the capacitance value for fluorinated SAC (F-SAC-RT) was found to be 121.42 Fg⁻¹, which is slightly higher than the capacitance value of 116.91 Fg⁻¹ found for SAC, showing a trend of improvement in the capacitance value of fluorinated carbon-based EDLCs. Fluorination of the carbon materials CAC and SAC still needs further experimentation to confirm the possibility of promising features in the application of portable electronic devices and electric vehicles.

Human Activity Recognition Using Accelerometer and Gyroscope Sensors Attached on the Wrist
Jun Yu Jacinta Cai, Hector Flores, Bobak Mortazavi, Ebrahim Nemati, Kristina Vander Wall, Arash Naeim, Majid Sarafzadeh

Human activity recognition using wearable sensors placed on hips or other regions have become popular activity monitoring research tools. Activity recognition would be highly useful in modern healthcare system for tracking physical activities of the patients once they have been discharged from the hospital. In current systems, there is a lack of an efficient, inexpensive, and noninvasive activity monitoring system for the patients. As a result, wearable devices could substitute for other monitoring mediums. Past researchers have studied human activity recognition by strategically placing multiple sensors or using a single sensor placed on the hip, few studies were completed for placement solely on the wrist for various activities. By adopting modern technologies, we propose using a Samsung Galaxy Gear to demonstrate how the accelerometer and gyroscope sensors embedded in a smart watch can be used for activity recognition. To recognize movements and activities, the collected sensor data undergo a low-pass filter, a feature extraction and feature selection step, and finally, activity classification. Results are compiled in a 10-fold cross-validation setting based upon the training data, as well as a live android smart watch demo for real-time testing. The smart watch demo was implemented to present live updates on the recognition algorithms used to detect the human motions. Two implementations of support vector machine models were compared to examine the run-time efficiency during activity classification and prediction.
**MRI – Hydraulically Actuated System**  
Gabriela Lopez, Samuel Ross, Michael Chui, James Simonelli, Tsu-Chin Tsao

Magnetic Resonance Imaging (MRI) is used by the doctors to detect tumors or malformations as well as a tool for guidance in performing biopsies. Currently doctors perform biopsies by taking the patient out of the MRI bore, placing the biopsy needle inside the patient and using the MRI for real time imaging of the soft tissues to verify that the needle was accurately placed. However, this process can be lengthy and uncomfortable for the patient. Previous research includes devices actuated by motors in a master and a slave configuration using hydraulic or pneumatic transmission. However, the MRI environment is very restrictive in the materials allowed. Instead of using motors, we manually control a three degree of freedom hydraulic system, which was previously created at the Mechatronic and Controls Lab (UCLA), for biopsy needle positioning inside an MRI. We construct the device with MRI-compatible materials like polypropylene, Delrin and ABS plastic. In this research, we examine the input-output efficiency of the device when using different fluids in the transmission lines and the efficiency of the control mechanisms on operating the device.

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**Indoor Localization using BTLE Beacons**  
Niko Grupen, Samuel Munoz, Paul Martin, Mani Srivastava

We present an indoor localization system using Bluetooth low energy beacons that fuses trilateration with inertial sensor measurements to provide a detailed positional estimate of a smart device. We provide a mechanism for zone classification, in which a user can receive information relevant to a particular section of a room. Our approach is reliable and exploits the easy deploy. Results from indoor environments of various sizes indicate an average location error of 0.530m and classification accuracy of 88%. Due to the increasingly flexible and cost-effective nature of BTLE beaconing technology, we believe that our approach holds promise for real-world deployment.

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**Providing Location Context for Activity Classification Using Indoor Navigation**  
Jose Gonzalez, Mitch Rathbun, Hua-I Chang, Yan Wang, Greg Pottie

Several studies have been completed recently that emphasize the important role location context can play in activity classification. Including context can be especially beneficial when applied for medical purposes, such as the assessment of progress in rehabilitative therapy. Since it is necessary for the position of the subject being monitored to be determined with a high degree of accuracy, their location is usually introduced as ground truth by the user. However, recent advances in the indoor navigation field, such as the use of MEMS technology to create smaller and cheaper Inertial Measurement Units and the use of particle filters to aid with localization, allow for the tracking of a subject accurately without constant human interaction. Therefore, our project introduces a model to automatically generate context for an activity classifier, which will simultaneously increase the efficiency and accuracy of the classification process.

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**Sensor Calibration with Microsoft KINECT 2.0**  
Faraz Aghazadeh, John Goodlad, Derrick Chang, Greg Pottie

This project compares acceleration readings derived from the Kinect 2.0 and a medical quality inertial sensor and detecting miscalibration of the sensor on the forearm and generating a quaternion to correct of yaw and roll misplacement. This research project uses a double exponential filter to smooth the data that is coming in from the Kinect as well as the derived velocity and acceleration. Assuming the orientation that the sensor was started in was known, the KINECT 2.0 could be used to compare the quaternion of the joint of the sensor that was attached to the joint over a period of time and correct for yaw and roll miscalibration. The data collected yielded results within 3.3 m/s² and 1.5 m/s² mean squared error for the X and Y axes respectively ranging from -10m/s² to 10m/s². Z provided only limitedly useful data and is therefore not included. The correction quaternion was within 3% of ideal.
The theoretical aspect of increasing the bandwidth covers concepts and practices related to unidirectional plastic waveguide. It explains some of the terminology applicable to electromagnetism and telecommunications systems because it is necessary to understand the processes that go on behind waveguides. In addition, understanding this theoretical aspect will help me tremendously as I am looking to going into the specific field of communications within the electrical engineering field. I expect to learn a lot of new terminology and some of the basic fundamentals behind communications systems.