INTEGRATION AND CONTROL OF A LIQUID NITROGEN DELIVERY SYSTEM

Qijun Huo (Mike Scarpulla), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

This project aims to design a self-control system of a sample cryostat. The heater in the sample will increase the temperature constantly. The liquid nitrogen will cool down the temperature of the sample. In order to maintain the sample temperature invariantly, the nitrogen flow rate should under a certain condition to keep the temperature decreasing rate constant. The motor valve acts like the liquid nitrogen pump to transfer the nitrogen. The control system uses a pressure sensor to detect the pressure of the nitrogen and the heater to control the pressure in the tank.

SYSTEM FOR REAL-TIME MEASUREMENT AND PERTURBATION OF RODENT 3D ARM MOVEMENTS

Jichen Zhang, Basel Habash, (Ross Walker), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

This project concentrates on testing of high-density arrays that take place in rodent brains. The neural recoding electrode arrays have improved immensely allowing us to get higher resolution neural mapping of the brain. The purpose of this project is to understand what part of the rat's brain would respond to an interruption that occurs while the rat is trying to receive his treat. Implementing a 3-Dimentional Control system and reading measurements with great accuracy is essential to this project.

PARAMETRIC ARRAY SPEAKER WITH PREDISTORTION

Trevor Hatch, John Loudenback (Ross Walker), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

A directional parametric array was designed and built to emit audio along a narrow beam by using ultrasonic modulation. Amplitude modulation with a 40kHz carrier wave was chosen as loudest and easiest method to implement. An audio signal demodulated via the non-linear interaction between ultrasound and air contains significant harmonic distortion, as predicted by Berktay's expression. The inversion of this expression was programmed into Labview to predistort the input signal. This predistortion removes the harmonic distortion from the demodulated audio. The parametric array was shown to emit highly directional sound that was free of harmonic distortion.

ARDUINO BASED LI-FI (LIGHT-FEDELITY) COMMUNICATION SYSTEM FOR HOME AUTOMATION

Minseop.Kim, Nasser A Aljasser, Simon M.Luo (Angela Rasmussen), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

Home automation systems were recently introduced in the early 20th century as the science behind locally and remotely controlling various home applications and smart devices over Wi-Fi. However Wi-Fi is limited to speeds of data transmissions and the use of radio frequencies. Li-Fi (Light Fidelity) is a new emerging technology that could overcome these obstacles, thus integrating Li-Fi into home automation could bring an advancement in technology. This project idea is to use an Arduino controlled LED driver to transmit information on the visible light spectrum to Arduino based receiver stations. These sets of receiver stations will only receive information based on high frequencies being transmitted. The LED Driver will transmit high powered Pulse-Width-Modulation (PWM) so humans won't be distracted by various pulses of light. The LED Driver will be controlled via ESP8266 Wi-Fi Module, Web-server/Smart-hub, and a Smart phone application. This paper discusses our project ideas and methods on integrating Wi-Fi and Li-Fi into home automation systems.

SKILLED NURSING CENTER ELECTRICAL DESIGN

Jareth Smith, Chen Li (Jon Davies), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

Commercial buildings are designed and approved by licensed professional engineers. In order to ensure safety, design requirements have been put in place by government authorities. Health care facilities have special requirements to ensure patient safety under all circumstances. Our project focused on designing a skilled nursing center to these strict guidelines and regulatory codes.

ELECTRIC VEHICLE SENSING AND POWER TRANSFER MEASUREMENT

Kanglin Fu, Kevin Tran, (Alex Orange), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

A charging system for an electric vehicle (EVs) consists of: a power control system using MOSFETS and a MOSFET driver, a power measurement system using a current sense amplifier and an Arduino board, a sensing circuit consisting of a peak detector, comparator, and amplifier, and a communication system which uses a Butterworth filter and Arduino to communicate between the charging station and EV. The charging method is wireless power transfer through primary and secondary magnetic coils. The system was tested with coils of differing turn values in an attempt to increase power efficiency.

BATTERY PACK EQUALIZATION BASED ON BATTERY MANAGEMENT SYSTEM

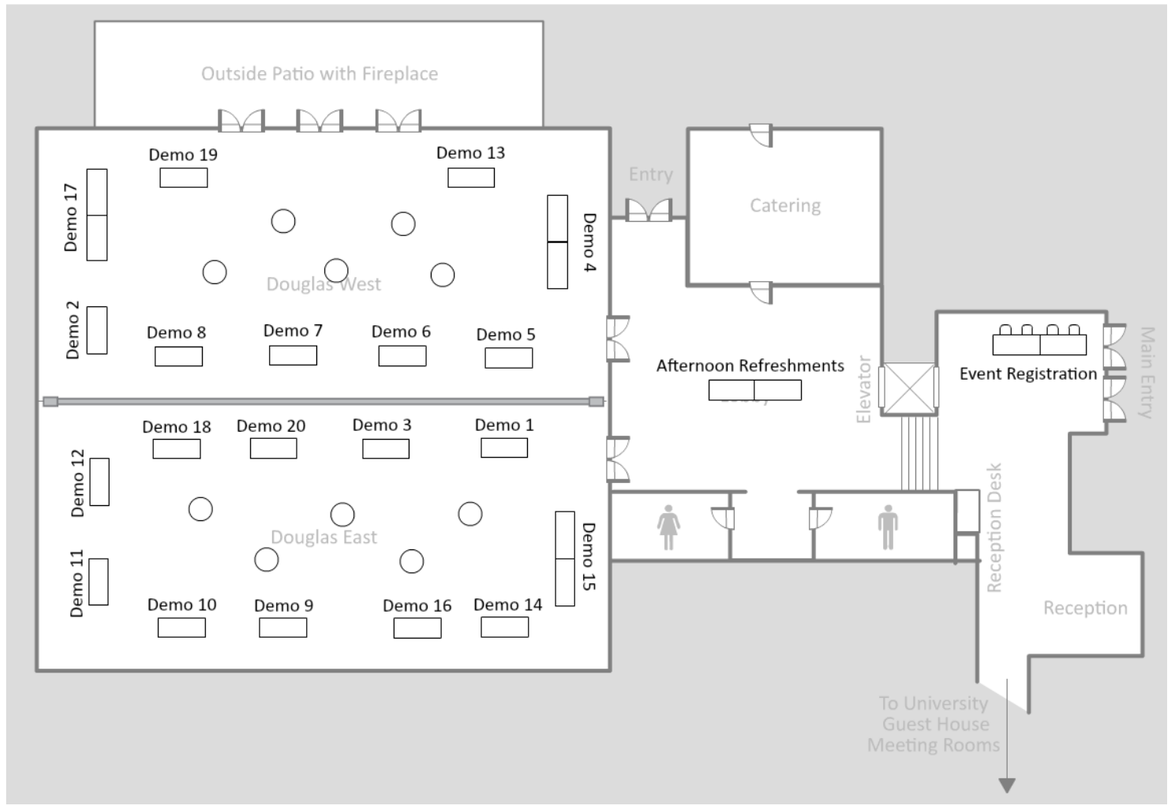
Ke Xu, ZiShuo Li (Angela Rasmussen, Jon Davies, Alex Orange), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

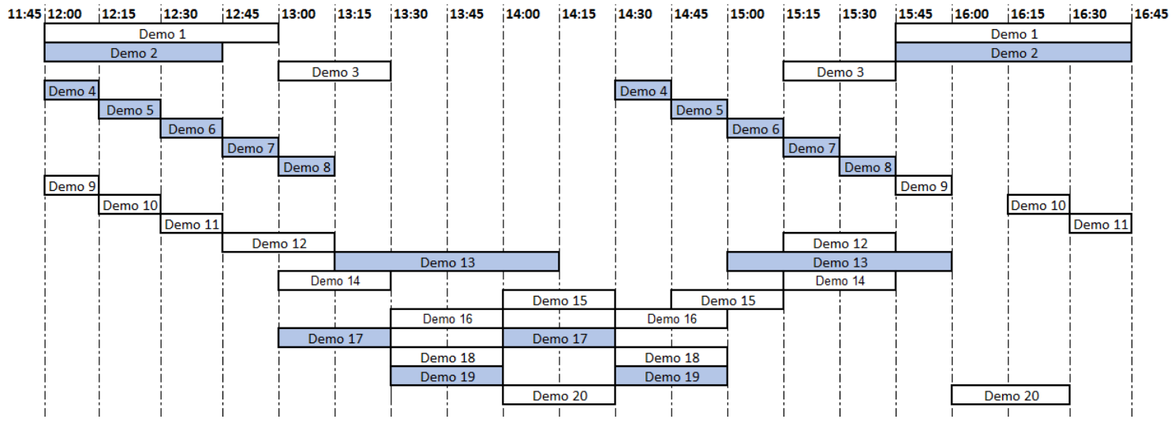
We are planning to design a equalization system which is based on Battery Management System(BMS). As for the development of hardware, more and more electrical devices need more power to drive for more functions. Therefore, we need large capacity battery and efficiency battery management system to let electrical devices have more working time. As we know, let multiple batteries in series is a good way to increase voltage and power for load, The problem is we need to let all the batteries keep in same voltage in order to decrease the energy loss, thus the equalization of multiple batteries is very important which can let BMS become more efficiency. For example, in series battery packs are most popular applied in Electrical Car, Laptop and drone, because those electrical devices need large voltage to drive them. Therefore, we want to design a equalization system which can balance discharging and charging for the drone's BMS to improve drone's flying time and battery life.

2017 Electrical and Computer Engineering Technical Open House

Senior Project Expo Abstracts and Map

University Guest House
April 20, 2017





*Above timeline is in 15-minute increments, which may not be 100% accurate. Please refer to inserted schedule for exact demo times.

ANALOG INTERFERENCE CANCELLATION (AIC) FOR SIMULTANEOUS TRANSMIT AND RECEIVE

Fang He, Yang Qian, Spencer Orgill, Thomas Buhler, Zijian Wang (Jeffrey Walling), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

The goal of this project is to study and develop an analog interference cancellation circuit which can be controlled by a digital adaptive algorithm. This cancellation circuit is in order to mitigate or cancel the cosite interference. The cosite interference of this project means in-band interference which is generated by a transmitter and a closest receiver in a same PCB (printed circuit board) board. This project wants to allow the transmit and receive signal to operate at the same time and frequency, but to use interference cancellation circuit to mitigate or cancel the known transmit signal from the receive path. So in our project, the cosite interference is about -10dB, we hope we can cancel it by our interference cancellation circuit which is controlled by an Arduino board.

INTERFERENCE OF POWER LINE HARMONICS WITH PIVOT IRRIGATION SYSTEMS

Brian Barkey, Krysta Rasmussen, Camille St. Louis, Frank Tsai (Masood Parvania), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

The purpose of this research is to create screening criteria, in order to identify methods of reducing harmonic effects of power lines on pivoting irrigation systems. The criteria and solutions explored were the location of farms on a feeder, the distance between pivoting systems and power lines, the type of VFD used at farms, and shielding on pivoting antenna. From the research, a VBA Excel program was created to allow data collected from farms to create a plan customized for reducing the effects of harmonics on pivoting systems.

5-AXIS HIGH RESOLUTION 3D SCANNER

Nathan S. Godfrey, Devin T. Renshaw, Kevin T. Whipps (Kam Leang, Pierre-Emmanuel Gaillardon, Jon Davies), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

An autonomous high-resolution 3D scanning and sensing device capable of measuring objects up to one cubic meter in size. Object sensing is performed using a combination of two displacement sensors to create a 3D point cloud of the scanned object with sub-millimeter accuracy. Autonomous control of the scanner is achieved by using G-Code generated with an algorithm developed in C. Necessary safety features, including limit switches and other electrical safeguards, have been integrated into the design.

ELECTRIC AIRCRAFT PROPULSION VIA DOUBLY FED INDUCTION GENERATORS

Logan G. Affleck (Marc Bodson), Department of Electrical and Computer Engineering, University of Utah, SLC, UT, 84112

Doubly fed induction generators (DFIGs) should be the aero-travel industry's primary hardware to successfully achieve electric aircraft propulsion. DFIGs are more viable than other AC machines because: the rotor windings are individually accessible allowing for greater control, the power electronics burden is greatly reduced, and the speed can vary as a function of power rather than being tied to synchronous speed. By utilizing hardware and software models constructed over the project's duration, various aspects of electric aircraft propulsion via DFIGs were recreated in a laboratory setting. The culminating recreation was successfully emulating two propellers thrusting differentially with the use of two doubly fed induction machines and PI speed controllers.

ELECTRON BEAM CHARACTERIZATION OF CADMIUM TELLURIDE SOLAR CELLS

Dean A. Collett, (Heayoung P. Yoon), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

Thin-film CdTe solar cells are a commercially successful photovoltaic technology today. However, at the maximum efficiency of 22 %, the fabricated efficiency is still well below the theoretical maximum value of 30 %. It has been suggested the microstructural properties impact on the overall performance. In this work, we use electron beam microscopy techniques to understand the microstructural properties at the level of atomic scale and correlate the local properties with the device efficiencies.

DEVELOPMENT AND CHARACTERIZATION OF TATTOOED ANTENNAS

Jordan Gluch (Cynthia Furse), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

Implantable devices such as pacemakers require a communication system to monitor device health and acquire data. The antennas for these systems are quickly running out of space due to shrinking battery sizes. This research changes the design of implantable antennas by tattooing conductive nanoparticles in the skin and adjacent fat layer at the body surface, allowing the antenna to use as much surface area as needed, and reducing the transmission lost in the body tissues. Various antennas and coils were simulated, built and tested as part of the feed pickup portion of the system, which is inductively coupled to the implanted antenna. The measured data closely matches the simulated, giving feasibility to an overall working system.

MOBILE ATX POWER SUPPLY UNIT

Alfred Neufeld (Arn Stolp, John Davies), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

Power Supply Units (PSU's) are the foundation on which computers are built. All the digital logic circuits as well as other peripherals all require power in order to operate correctly. In the age of ever shrinking technology, power supplies must begin to follow suit. There are minimal options when it comes to acquiring a PSU that is compatible with a standard car battery. This project details the methodology and implementation of such a design. The following systems were designed using ATX Power Supply Design Guide v2.4 as the base requirements for the system. The project's scope was to design and prototype all the required circuity, from the DC regulator controller to the high current output stage , as well as the digital logic control and functionality required by the ATX specification.

PROGRAMMABLE LOGIC CONTROLLER MIGRATION

Laramie K. White (Angela Rasmussen), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

Programmable logic controllers (PLC) control the industrial world. As PLC performance and technology improves legacy hardware needs to be replaced. There are many challenges and options that arise in migrating legacy hardware to updated hardware. These challenges and options include but are not limited to need of the plant, cost, and future plans for the site.

PROGRAMMABLE LOGIC CONTROLLER TRAINING AND TESTING PLATFORM

Thayne R. Larsen (Angela Rasmussen), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

A PLC training and testing platform prototype implementing manual switches to mimic user and sensor inputs, and lights to represent output actions. The platform also incorporates external sensors and a DC motor in a machine model. Two programs, one for the manual input and visual output and one for the machine model are demonstrated.

FDTD SIMULATION OF TERRAIN EFFECTS ON NUCLEAR ELECTROMAGNETIC PULSES

Victor L. Taylor, (Jamesina Simpson), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

A Cartesian, three-dimensional, finite-difference time-domain (FDTD) model was modified to simulate the effects of terrain on the propagation of nuclear electromagnetic pulses (EMPs). Two locations were modeled. The first location was a large valley in Lone Pine, California that contains a high voltage power line. The second location was the second largest hydroelectric generator in the U.S. located in a smaller mountain range in Virginia. It was found that the Lone Pine model, in comparison to the Virginia model, experienced a smaller initial impulse, but the pulse resonated in the valley for longer. In both models, a waveguide-like effect was observed.

A STRUCTURAL HEALTH MONITORING SYSTEM WITH ENVIRONMENTAL SENSING

Yisong Zhang (Joel B. Harley), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

Metal fatigue is a major cause of aircraft structural failure. In this project, I use ultrasonic guided waves to monitor structures for such damage. While effective in ideal circumstances, these methods and their results are often distorted by environmental factors, such as temperature, humidity, and other effects. This project is aimed at building an experimental system and algorithms to decipher the effects of environmental conditions and distinguish them from damage. The experimental system synchronously collects 16 channels of ultrasonic signals as well as data from environmental sensors. The algorithm then removes the environmental variations from the ultrasonic signals.

DESIGN AND IMPLEMENTATION OF A VIDEO CODING APPLICATION ON FPGA USING ADVANCED LOGIC SYNTHESIS TECHNIQUES

Gang Liu, Jacky Hu, Jason D. Blackburn (Pierre-Emmanuel Gaillardon), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

A video system was realized on the Xilinx Zybo development board. This system consists of reading a sample video from external storage, storing the video in DDR3 memory, then outputting the video onto a display. A driver was created to control this system from the Linux OS. The initial goal of this project was to implement a hardware decoder capable of decoding a high resolution video. However, due to budget limitations, acquiring a high-resolution decoder was not possible. An open-source decoder was sourced, but due to technical challenges, the decoder has not yet been implemented at the time of writing; work is ongoing.

PLANNING SMART BUILDING TECHNOLOGIES WITH DER-CAM

Ben Lewis, Naveed Aghdassi, Hui Jing, Shreyas Choudhary, Richard Wiggins, (Masood Parvania), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

The Distributed Energy Resource Customer Adoption Model (DER-CAM) software is used to model and optimize energy consumption of the University of Utah campus. This software recommends different strategies to reduce electricity costs and meet sustainability goals by adopting DER technologies. The University of Utah Campus was modeled with utility tariffs, weather, solar radiation, electricity load, CO2 emission rates, DER technology data, etc.. Scenarios considered for the University of Utah campus involved load shifting, energy storage, electric vehicles, and solar panels. The DER-CAM results show how the campus will benefit environmentally and economically from these cases.

ANALYSIS OF J-V CURVES IN NANOSCOPIC REGIONS OF SOLAR CELLS

Ruixiang An (Mike Scarpulla), Department of Electrical and Computer Engineering, University of Utah, SLC, UT 84112

J-V curves based on equivalent circuit(current densities vs voltages densities) for any region of solar cells can help to generate solar cell performance parameters directly which include V_oc ,J_(sc), P_max , FF. Fitting the real J-V curves to the model J-V curve based on equivalent circuit can help to find the remaining performance parameters : m, R_s , R_sh , I_0 , I_light. An analysis procedure created to generating the J-V curves and outputs to analyze the properties and performance of common solar cells.