**(DNFI – no Team ID, etc.)**

**The Analysis of the Effects of Pressure and Temperature on Li-Ion Battery Performance**

Shahadat Noor (T01)

1000884554

EE4340 Fall 2015

Little to no research has been done on the effects of air pressure and temperature on the performance of a lithium-ion battery. The space can become extremely hot and as well as cold while having no pressure, on the other hand underwater temperature is freezing and the pressure is exorbitant. In both cases if we want to send a self-sufficient robot to do scientific exploration, the robot itself may withstand the pressure and temperature but its primary life support which is the battery won’t. I am proposing a research that will identify the internal changes of Li-ion battery under pressure and temperature change. To calculate the results we are going to use Two-Level Factorial Design as our Design of Experiments (DoE); where for all the controllable input factors are varied at two levels - low and high. In our case pressure and temperature are the controllable (independent) input factors alternatively vibration and noise are the uncontrollable input factors. The output responses (dependent) considered here are maximum capacity, amperage rating and deformity of the battery. Maximum capacity and amperage rating is determined using stress tests. Moreover physical dimension measurements are taken to document the deformity. Therefore all the dependent variables (outputs) can be measure using existing models. After successful completion of this research we will have better understanding on how the internal components of li-ion batteries are affected by external pressure and temperature and possibly how to counter the effects.

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Wireless Power Transfer Implementation in Space

Jay Jen (T01)

This paper explores the possibility of using wireless power transfer through magnetic resonance in the space environment. Despite the efficiency at short ranges this method of power transfer has displayed on earth, the abundance of powerful electromagnetic waves in space have unknown interactions with this technology. If possible, wireless charging will make the maintenance of embedded sensors more accessible and open various new possibilities that were previously restricted due to the power supply issues. To obtain the results within the given time and resources, we will need to run simulations, create controlled simulated environments, and deploy experiments in outside of Earth’s Orbit. Through controlling the power transmitted, we will be able to observe the efficiency of this technology while influenced by various electromagnetic interferences and determine the optimal setup if implemented.

**(DNFI – Line spacing is 1.15 - not single space)**

**Investigation into Effects on Performance of Soft Actuators due to Extraterrestrial Environmental Conditions**

Kirk Nelson (T01)

Recent developments in soft actuator technology have demonstrated several advantages of soft robots (constructed with elastic polymers) over traditional hard robots (constructed with rigid metal or plastic frames), including lower materials cost, simpler control systems, lighter weight, and increased durability to impacts and stress. These advantages make soft robots an attractive proposition for remote exploration of hazardous environments, including other celestial bodies.

The Kavli and Wyss Institutes at Harvard have developed two air-driven soft actuators for gripping: the “starfish” and the “tentacle.” This experiment uses these designs with fluorosilicone construction, as this material retains its elasticity better than silicone at lower temperatures. The performance of each style of actuator is observed under conditions designed specifically to simulate conditions on Mars, as it is a likely candidate for further extraterrestrial exploration. The experiment takes a two-level design with four factors: the actuator being tested, temperature, atmospheric pressure, and solar radiation. Temperature and radiation levels represent the average high and low conditions as recorded by the Mars Climate Sounder; external pressure levels will represent the typical Martian atmosphere as well as near-vacuum conditions. Due to the small size and low cost of the actuators, four units are tested concurrently with a total of four batches for each actuator. From these observations, a linear model is developed to demonstrate the dependence of force output on each of these conditions. A comparison between the robustness of both actuator designs is also made.

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**Path to Flexibility**

Roger Gouanet (T01)

Like many innovations in the electronics field, flexible electronics have been extended to various applications. However, more research needs to be done to explore how to apply flexible electronics in smartphones and tablets. Such an advancement will allow the adaptation of the portable devices to various environments, the devices will be less spaced consuming, their longevity will be extend, and they will also be environment friendly. The main components of a mobile device are the LCD assembly, the motherboard and the battery pack. Recent advancements have been made in the flexibly of LCD displays. Our main concern will be to find ways to optimize the content of the motherboard and build it using a flexible surface and also design a flexible battery. We will present and discuss synthesis from findings carried through interviews and synthesis of past researches. The conventional wafers pose a rigidity limitation, thus the use of plastic substrates. In order to work on the plastic substrates, low temperature processing is required.

Our goal is push the boundaries of conventional fabrication processes to match the demand of soft, pliant and easily damaged surfaces. We are expecting to see new development in the form and constituents that make up mobile devices.

(DNFI – minor – space between title and author lines)

A Navigation Demand Model for Pedestrian Navigation at Close-Set Crossing

Daniel Gattorna (T02)

Sometimes when using your phone to guide you places in an sheltered area like a airport or bus station your phone can have a hard time knowing what direction you are facing that makes it hard knowing you’re going the right direction when using your GPS (global positioning system). The following is a model for a way to make sure your GPS memorizes where you are facing so it can still guide in places where you lose the signal of your GPS.

This model is a good way help with pedestrians who are just passing through areas they are not familiar with and if they lose GPS coverage, the system will estimate their direction and lead them to the user’s destination.

The way I will test to see if the model can work is that I will be testing 20 pedestrians to see how long they can retain directions to follow; this will be the independent variable, also the distance of how far they have walked before forgetting. This will tell me how many parts to break down each path while the phone is able to estimate where they are relative to where they started from and where they need to be.

From this, the phone should be able to guess its location when the signal is lost and give just the right amount directions at a time before the user forgets what turn to take next in their trip.

**The Investigation of Movement Energy**

Jason Reist (T02)

Wouldn't it be nice to plug in your smart phone or laptop into a power outlet less often or never to prevent it from dying? This would be especially useful in situations where power outlets are not available or when someone is "on the go". One possible solution to the problem powering mobile devices is movement energy. This a recent innovation that can harness the kinetic energy of the human body to generate power. Kinetic energy is defined as the energy that is generated due an object's movement. But is a movement energy device advanced enough to generate energy to fully power common mobile devices?

The proposed research will be conducted in order to determine if the sole utilization of movement energy by students generates enough power for their common mobile devices. This research is important because it will generate data that will help determine whether this movement energy device can provide a solution to the problem of our mobile devices dying.

The estimated cost of research will be $200K and will be conducted over a period of one year. Since the independent variable in this research is the physical activity of students an observation study will be conducted. 50 UTA students will be selected at random to wear the device and record their activities. Then each student will enter their activities into a calorie calculator to find their approximate calories burned. In addition, energy generated by the device the dependant variable will also be recorded. This will be compared to the average energy consumption of smart phones, the iPad, and laptops.

The expected results will be that the power generated using the movement energy device will be proportionally related to the activity level of the students. In other words the calories burned vs. energy generated will be a linear model. Analysis of these results will determine if enough power can be generated by various levels of physically active students to completely or partially run the common mobile devices.

**The Investigation of Adding Tidal and Wave Energy into the Grid System**

Ismail Yesildirek (T02)

Power generation by renewable energy resources is evolving due to the increase of energy demand. There are many different types of renewables that are being incorporated into the grid, but one that is not fully explored is the use of tidal energy. Tidal energy is the use of tides to generate electricity by the use of turbines. Wave energy is created by harvesting the energy of waves moving hydraulic pumps to generate electricity. The purpose of this research is to show if the current technologies in the tidal energy field would be adequate or cost efficient to integrate into the concept of smart/micro grid in the United States. Smart grid is defined according to the department of energy as “a class of technology people are using to bring utility electricity delivery systems into the 21st century, using computer-based remote control and automation” and micro grid is defined as “localized grids that can disconnect from the traditional grid to operate autonomously”.

When talking about renewable energy that goes into the smart/micro grid, solar and wind energy are the main focus points. The addition of tidal and wave energy into this concept would increase the power generated by renewables and lower the carbon dioxide emissions. This research is going to be performed by collecting the energy output to cost ratio of different types of energy generators. The factors for this experiment are going to be the location’s kinetic energy, cost of equipment, and energy output. The levels are going to be the three different types of energy generators that are going to be tested. The energy output to cost ratio is going to be the determinant of which of these energy source methods would be the most suitable to put into a smart/micro grid system.

The expected elapsed time for this project is going be a year with an estimated cost of $350,000. The expenses of adding tidal or wave energy sources into the grid would be able to overcome its cost. The integration of this system into the grid is going to help with increasing power generation by renewables and will expand on the potential of integrating more renewables throughout the grid system. It will also help the environment, since it is a clean energy source. Finally the cost of integrating it to a smart/micro grid will improve the costs in the energy industry.

**Methods of Optical Concentration to Increase the Efficiency of Transparent Solar Panels**

Robert Medrano (T02)

Solar technology has ample possibilities to become more efficient and versatile in the way they are utilized. Optical methods such as Nano-lenses and Nano-waveguides will be researched to discover methods that increase the absorption of light through the active organic material that is transparent. The purpose of this research is to find a method that is more efficient in energy absorption through the solar transparent material. Achieving a method that is more efficient will allow for a more accurate cost benefit analysis of this new technology with respect to future use in consumer applications.

The research is going to have two experimental levels, starting with the first level defining what active organic material to use for the bases of the research. These active organic materials only absorb certain non-visible wavelengths in order to keep the solar material transparent. The second series of test will be comprised of Nano-lens technology, Nano-waveguides, and the combination of the two methods to achieve better absorption efficiency through the active organic material.

The research is a year and a half project with an estimated cost of $400K. This data will determine the most efficient method to increase optical absorption by transparent solar material without going into the category of a semi- transparent material. Due to Nano-optical lens formation and the use of Nano-waveguides to direct certain wavelengths to the active organic film, there will be a new method to improve absorbed energy from sunlight with existing technology.

(DNFI - Name in header, no team number, student ID included, no title!)

Brian McRee (T03)

**Abstract**

The widespread use of portable electronics has made energy generation and storage an important issue for scientists and engineers. The possibility to harness energy from ambient sources of energy, such as vibration, friction, and sound, has been realized as triboelectric generators. However, the comparison of the combinations of materials in these generators have not been addressed in detail [1]. Knowledge gained from studying the output parameters of triboelectric generators with different material components will provide new insight on effective material selection for further research and applications. The main focus of this research is to investigate how the material composition affects the triboelectric generator’s process of producing electric power. All other factors, such as temperature, device construction, device layout, and measurement procedure will be held constant. Given differing material combinations, sets of triboelectric generators will be fabricated and tested. Once data has been collected, the combinations will be ranked based on performance in different parameters. In addition, any trends between electrical performance and material/chemical properties will be investigated. The impact of improving our understanding of these generators is widespread, as advances can provide solutions to telecommunications and low power electronics companies looking for promising technology for charging and powering the near universal use of their portable devices.

**References**

[1] Zhong Lin Wang. (2014, Sept. 8). *Triboelectric nanogenerators as new energy technology and self-powered sensors – Principles, problems and perspectives* [Online]. Available: http://www.nanoscience.gatech.edu/paper/2014/14\_FD\_01.pdf

(DNFI – minor, Title, bold face)

**Radio Frequency Interference Effects on Microcontroller Clock Accuracy**

Jason Dykes (T03)

**Abstract**

While most microcontrollers can be used with a variety of clock sources, the device's internal oscillator is the preferred source if it is present, and if application requirements allow for its use. The internal oscillator is the smallest and least expensive option for clocking, as it adds no additional cost and requires no additional space, unless an otherwise appropriate device is available at lower cost without an internal oscillator. However, the R-C circuit usually used for this purpose is less accurate than a ceramic resonator, crystal, or oscillator; it also drifts more with temperature and other environmental factors. However, the more data is available on its performance, the more applications it can be used for. With adequate data, the source selection is based on known risk and performance, rather than a conservative approach to an unknown. This could be useful to anyone who uses microcontrollers in a high-interference environment, such as an RF testing lab, near a radio transmitter, or even near WiFi devices.

This experiment is designed to determine what, if any, effect radio-frequency emissions from external sources have on clock drift, and the consistency of that drift within different examples of the same MCU. MCUs from 4 popular vendors will be tested in this manner: Microchip Technologies, Texas Instruments, STMicroelectronics, and NXP Semiconductor. 5 part numbers from each manufacturer will be tested, and 6 examples of each part (3 under test and 3 control.) Several treatments will be applied to each of the experimental units, in which the temperature will be held constant, all MCUs will be powered from identical power supplies, and RF radiation of 10 selected frequencies and 4 different power densities will be applied, one treatment at a time. For each treatment, a random selection of half the IUs under test will be placed in the test chamber at a time. Frequencies will be selected to correspond to commonly used radio services or other sources of RFI, and will range from 48KHz to 5GHz. Power densities selected will be frequency dependent, again to correspond with common real-world scenarios.

Relations between Compressive Sensing Data

Jacob Sanchez (T3)

Compressive Sensing (CS) is a way of compressing data under the Nyquist Rate and still getting zero loss. One thing that is to be noted is that the compressed data is essentially random, possibly causing the data between two CS files to be completely uncorrelated when the original data of the two may be very similar. If data is saved in the CS format, possible relations between the data could be present. These relations could make finding consistent data faster and easier. If relations between data could be found, the ability to locate what one is looking for would reduce the time and possibly the error of the findings.

The experiment would have files of the same size (N) with their corresponding sparse sizes (K). The sparsity is found by doing a Discrete Cosine Transform on the data. Creating the DCT matrix will be constant by using to make the N by N matrix. The measurement matrix will be held at a constant K value high enough for each of the files used. This will keep the randomness of the measurement matrix in as much control as possible, so it will always be a K by N matrix.

Using already known similar data, experiments will be done on the CS data to look for trends, constants, or similarities in the CS data. The method will be as follows: First, a CS file will be compared with itself. Then the same file will be compared with a known unrelated file. A possible trend line will observed with these two experiments done. More experiments would be followed by varying the value of N and K, will keeping the DCT matrix creation the same. Possible trend lines are those of the correlation coefficient, L1-Norm, Mean Squared Error (MSE), or any defining characteristic of the compared signals.

(DNFI – Individual assignment, just your name; bold faced title)

**Environmental Effects on Transient Voltage in Avionics and Vehicle Subsystems**

Jason Dykes, **Bryan Luu**, Brian McRee, Jacob Sanchez (T03)

**Abstract**

The electrical power system of an aircraft generates, regulates, and distributes electrical power in order to operate many different avionics and vehicle subsystems that control critical flight functions like flight control, communication, navigation, and auxiliary power systems. The electrical power system of an aircraft typically operates on a 115 Volt, 3 phase, 400 Hz AC voltage and a regulated 28 Volt DC voltage, and the various subsystems and avionics components that use the power system are designed to operate on the same steady state voltage levels. Like any other electronic device, there are also fast, short duration, transient voltage spikes present when increasing and decreasing the power load or main power system failure. These transient voltage spike peaks are normally considered in aircraft avionics and subsystem design. However, unlike normal electronics, aircraft systems must operate in harsher environmental conditions that can exaggerate these transient voltage spike peaks to the point in which the initial design may or may not be able to handle them. In the case of an abnormally high peak transient voltage, there may be a loss of the component, and in the case of an abnormally low transient voltage, the component may not activate at a time in which it is flight critical. Thus, the ultimate goal of this experiment is to create a reliable model or relationship between these environmental factors and the transient voltage spike peaks in order to predict and account for them in the initial design of different avionics and vehicle subsystems, reducing repair costs and redesign costs, as well as increasing the overall safety of the pilot and passengers.

The experiment will test 5 specific power loads under both 115 Volt, 3 phase, 400 Hz AC as well as regulated 28 Volt DC. Additionally, the system will be subject to 10 different temperatures as well as 7 different altitude pressures in each case. All of these variables are designed to simulate real world environmental conditions and assist in creating a usable model for normal and abnormal transient voltage prediction and protection.

Team ID missing T4

David Fabia

Research Proposal Project

EE 4340-001

09/07/15

Animals’ Taking the Veterinarian Home

The progress in nanotechnology has increased over the years. Nanotechnology is the manipulation of matter on an atomic scale, where “nano” is scaled to be one billionth. The need for research began to increase as new material and technology was designed. Researchers began testing new ways to find how nanotechnology can impact the medical field. Researchers are looking and discovering for new ways to cure or maintain diseases with nanotechnology. On the other hand, there is little to no research on helping animals. The experimental research will use nano-electronics, which is the electrical components or devices scaled to a molecular level. This experiment is to be conducted on a two to three year span. The nano-electronic devices will be constructed and designed to attach to the blood vessels and follow to the targeted area. The targeted would be the problem area of sickness, damaged tissue, viruses in the system or etc. The devices will also be used to help fight alongside with immune systems. The experiment will require testing on household pets such as dogs, cats, and etc. The testing can be done on animals impounded; instead of euthanizing them. With money funded, a place to house and feed the animals will be provided. When feeding the animals, they will consume some nano devices into their body. Another way of testing the efficient way of nano devices in the body will be through injection as well.

The experiment will focus on how to help the animals with diseases, to enable the nano devices help repair tissue, and to give more insight on the body of animals. Animals sometimes battle with unknown diseases and when discovered, it is usually too late for the animal to survive. The experiment will test how fast the nano device will detect any changes in the body like temperature, blood flow, or rate of electrical pulses in the nervous system. Nano devices will also be tracked and watched through wireless communication to computers. This will allow new information about how animals react to pain or some type of discomfort to the body. New information like toxicity levels, pH levels, glucose and other readings can be done at a faster rate. The devices will provide information on how blood flows in the body and how the cells will work with nano devices to battle against viruses and bacteria on a molecular view point.

This experimental research can help provide animals to live with little to no problems. If the research is successful, then the nano devices can be used on other exotic animals in the world. The innovation and research can enable animals from being endangered species. Essentially the devices tested will then be pushed on to plant testing as well.

Lightning All Around Us

Ricardo Cruz, (T4)

The purpose of this research is to investigate if power can be stored and distributed from lightning strikes. Lightning could potentially represent an important way of using renewable energy. It would allow people to live months out of the year without having to pay an electric bill. There are a lot of factor that make this process appealing such as one lightning strike contains five billion joules of energy. Each year there is around one and a half billion lightning strikes that occur and we are able to determine regions in the world that receive larger amounts of lightning strikes. For example the empire state building get hit by lightning twenty to twenty five times a year, that’s 100 to 125 billion joules for one building. Florida is known for having a lot of lightning strikes but northwest Venezuela and Democratic republic of Congo are two places that receive more lighting strikes. This is a lot of energy that’s there for the taking especially since energy prices are rising.

We created giant lightning rods made out of copper then wired them together to large capacitors connected in parallel. The lightning rods will create a large positive charge for our lighting to strike. Having numerous lightning rods increased our chances of capturing the lightning. Once the lightning hits the rod it will be captured and stored in the capacitor. The stored energy can then be used for powering homes. The results show that capturing energy from a lightning strike has the potential to power several homes. The new knowledge that will come from this is being able to live months out of the year without having to pay for electricity maybe even the whole year. The budget for this project would be roughly around one hundred and fifty thousand dollars. Most of the cost would be attributed from the copper rods and the capacitors. The rest of the budget would be from the price of the facility that we decide to use. To get an accurate reading, the project period should be around 2 year,

**(DNFI – Title BF, 2nd line name – no space)**

**Proposal to Research Ability of Drones to Provide Internet Access to Remote Areas**

Lorenzo Martinez (T04)

The purpose of this research is to analyze the capabilities of drones to provide internet to areas that currently lack of this service. In specific, the altitude that these drones need to fly in order to provide strong signals without being affected by weather, the signal strength needed to provide quality internet access on the ground and how these are affected by the change in weather, also how different climates affect the signals received on the ground and the drones itself. The importance of this research is that as of today, only about one third of world’s population has access to the internet. Facebook and Google are trying to provide the rest of the population with internet access. Facebook is proposing to use drones as mini satellites to provide WiFi signals to the areas that currently lack of internet. If the research provides with positive results the rest of the world’s population currently without internet service will benefit from it.

In order to successfully complete this research the following plan of action will be followed. I am going to divide this research into 2 experiments:

1. Optimal altitude in which the drone needs to fly.
   1. A test signal is going to be sent from the drone and measured at the ground.
   2. The altitude from which the signal is being sent is going to change.
   3. In this case the independent variable is going to be the altitude while the signal strength received at the ground is going to be the dependent variable.
2. Once finding the optimal altitude, we can move to how the weather is going to affect our signal.
   1. A test signal is going to be sent from the drone and measured at the ground
   2. This time the weather conditions are going to be changed: hot weather, cold weather, rainy weather, dry weather.
   3. In this case the independent variable is the weather while the signal measured at the ground still the dependent variable.

After performing these experiments we are expecting to find an optimal altitude and the signal strength needed during different environments in which the drone can provide efficient internet service to remote areas but overall the most important is to know if drones can satisfactory be used to provide internet service. The data coming from these experiments will be mostly from spectrum analyzers, which are going to be plot on different graphs to be better analyzed and visualized.

Piezoelectricity in Different Types of Bones

Charles Nybeck (T04)

Bones have the ability to produce an electric charge as a response to mechanical stress due to their piezoelectric properties. Piezoelectricity is the charge that is produced in specific solids when under mechanical stress or excitation. These solid materials mostly consist of crystals and ceramics but also include some biological structures such as bone. This experiment is designed to explore the difference in the piezoelectricity of bones in different types of animals. Many different animals will be tested during this experiment ranging from large to small including, horses, cows, sheep, donkeys, Terriers, and Labrador Retrievers.

Three of each of the animals, for a more accurate outcome, will be individually tested to identify the produced voltage amplitude and its corresponding frequency using an oscilloscope. The produced voltage will be read from the oscilloscope while the animal is carrying out their daily activities and depending on the animal while it is coerced into more physical movements such as running or jumping. The idea is to create more voltage or a steady supply as the animal moves, causing mechanical stress to their bones. The voltage produced is dependent on the animal’s activeness; the more active the more mechanical stress to the bones and therefore more voltage produced. Size is also another factor as larger animals would have more mechanical stress due to the weight they are supporting, especially horses. All of the data from each of the animals will be compiled and compared to identify which of them have the most piezoelectric bones and therefore create the most voltage.

Most of the budget is attributed to compensating farmers for using their animals during our testing, the three TDS3032C digital phosphor oscilloscopes, and lab expense. The experiment will be conducted over a period of a year to ensure accurate results and data. This puts the expense for the entire experiment around $220,000. The smaller animals can be observed in the lab but the larger animals will be tested in a larger environment such as a field. The information gained from this experiment will show just how much piezoelectricity is produced in the bones of different animals, and in time maybe this electricity can be harnessed and stored for other uses.

(DNFI - Name in header!, no team ID, “Abstract at end of title”,…)

Virgilio Martinez (T05)

Effects of electromagnetic noise on Migratory birds : Abstract

There are many known species of birds that migrate long distances across the world in order to survive. These birds make use of the Earth’s magnetic field, through the means of a built in compass, to accurately navigate. In recent years the growing use of electronics and radio wave channeling has polluted the environment with abundant electromagnetic radiation, making it very difficult for migratory birds to navigate adequately. Their (birds) flight patterns have been disrupted and influenced by the enormous electronic noise of large cities. The purpose of this research is to find the threshold of interference that a migratory bird could handle without distortion of its flight pattern. In order to test this notion, several different aspects of electromagnetic waves will be analyzed including but not limited to: frequency, amplitude, and phase spectra of radio waves as well as electromagnetic radiation. We will determine which type of interference and level of spectra makes the greatest impact on the migratory patterns of several North American bird species. When analyzing radio waves, frequency and amplitude will be tested in order to see which combination makes a larger impact on the birds. Varying amplitudes and frequency ranges will be taken into consideration. In order to conduct this experiment several birds of many species will be tagged and implanted with an electronic device that tracks their flight patterns via GPS throughout several months. This implanted device will also be capable of radiating different types of electromagnetic interference such as low to high frequency and amplitude radio waves. Their experimental flight patterns will be mapped and compared to previously observed normal migratory patterns. By discovering this we can help reduce the impact of electronic noise on the migratory patterns of birds therefore reducing the negative impact on the ecosystem.

(DNFI – Labels “Title” and “Name” not requested. Team ID should be in parentheses, …)

Title: **3D glasses and its effects on children eye developments**

Name: Noah M. Shmais

Team: T5

This paper describes an undergraduate research project conducted in the Electrical Engineering Department at the University of Texas at Arlington.

As 3D TVs and 3D glasses gain popularity among Film makers, TV producers, and gamers, customers might wonder if the 3D glasses have an impact on the human eyes, and whether the new technology poses a threat on our precious children’s eyes. Many children complain of vision sickness and headaches after constant use of the 3D glasses for a period of time. This research addresses the connection between these issues and the usage of 3D glasses. There are many parameters that are involved in this research some are independent like the eye damage and some dependent like age of children in the control group, duration of watching, and the quality of the material they are watching. For example, if there are higher frames per second, then it will require more time and effort for the eye and the brain to process the data or visual pictures.

The experiment that tests this hypothesis is carefully designed. We will choose three teams of control groups and expose each team to a different duration of material watching per day, and each team will have two members that are 14 year old boys. We chose 14 year olds because they are the ideal age for testing since their eyes are still developing. The teams are divided as follow:

* Team1 has an exposure of 1 to 2 hours a day.
* Team 2 has an exposure of 3 to 5 hours a day.
* Team 3 has an exposure of 6 or more hours a day.

The duration of this experiment will last four weeks, during which the children are examined by the Ophthalmologist\* at the end of each week.

Ophthalmologists have developed a ten level ranking system that will express the damage caused to the eye. Zero being not effected and ten being severely damaged. Then the data will be collected weekly and developed into a formula and a model according to the result. Later, the same experiment will be conducted to 14 year old girls to examine the effect on girls. The experiment budget expenses for this research are between 100,000 US Dollars to 250,000 US dollars.

The research results will be so critical and inspiring to modify and add the appropriate filters that will ease or prevent headaches and motion sickness for the consumers and hopefully an inspiration for further research in the future related to the same field.

\*an eye doctor

Network Optimized Distributed Energy Systems (NODES)

Daniel Bennett (T05)

With an increase in the addition of Distributed Energy Resources (DERs) into the existing power grid, we must start planning how we will shift the way that we manage the transmission of plant generated electricity. This shift will come in the form of real time monitoring of both systems and a way to control and coordinate the behavior of each system. Before we can implement a system, research in several areas must be done. Because of the dependency that some DERs have on uncontrollable factors like the weather, we must first try to understand the behavior of the existing DERs systems before we can develop a real time way to control them. We will start by observing the current state of the transmission network to understand how locations with a larger amount of installed DERs utilizes and effect plant generated power versus areas that have very few DERs. From there we must consider how the areas that do have a large amount of DERs contribute to the overall power grid in favorable and unfavorable weather conditions. As an outcome of the research we are expecting to have a broad model that shows how much the contributions of DERs fluctuate. With this knowledge we will have gathered enough data to allow the designers to make decisions on how they want to implement their real time monitoring system.

Investigating the solar efficiency of graphene combined with two different metals

Tina Geairn (T06)

Graphene, a one-atom thick sheet of carbon with a honeycomb-like structure, is a transparent and highly conductive material that has great potential for solar panel. However, it does not absorb light very well. Combining it with other thin materials that also have high electron mobility, such as molybdenum diselenide and tungsten disulfide, can help minimize this problem and provide better efficiency. The purpose of this research is to observe the effect of these graphene combinations to determine the best solution for a solar panel. There are four combinations: graphene layered on molybdenum diselenide, graphene layered in between two molybdenum diselenide layers, graphene layered on tungsten disulfide, and graphene layered in between two tungsten disulfide layers. This discovery can lead to the elimination of silicon solar panels, resulting in higher efficiency and lower manufacturing costs.

(DNFI – 1st line, 2nd line, location of Team ID)

Ryan Longwell Energy Generated vs. Distance Traveled of Piezoelectric Shoes

(T06)

In a technological world with an increasing dependence on electronic devices such as cell phones, tablets, and smart watches, the momentum of such devices seems unstoppable, except for one aspect: power. As the functionality of these electronic devices increases, so does the energy needed to power them. This is why inventions, such as Dr. Ville Kaajakari’s

shoes that function as a piezoelectric generator, are gaining so much interest. Simply stated, the way these shoes work is by converting the mechanical energy created when walking, into electrical energy and then storing it in a battery. This battery then has potential to charge your everyday electronic devices. However there is an uncertainty with such a device. How far would you have to walk to attain a certain state of charge? I am proposing an experiment that will correlate energy generated, with the distance traveled. The experiment is to gather test subjects to wear the shoes and travel specified distances. Since energy generated by piezoelectric technology is dependent on the stress applied to the system, test subjects of varying weights will be used. This will allow us to correlate energy generated per unit of distance for varying weight classes. The data collected will most likely follow a linear trend with the energy generated depending on the weight of the test subject and distance traveled. To account for anomalies in the data, many test subjects for each weight class will travel the same specified distances, and the average of their results will be taken. Using linear regression a model of energy generated versus distance can be created for each weight class. Then after comparing the results of the different weight classes, a model can be created describing how a person’s weight affects the system, which will most likely come in the form of a multiplied gain. Since the goal of most battery designers is to keep a constant voltage throughout the operation, another method to measure the state of charge must be used such as a “coulomb catcher”. Such a device would measure the current entering and leaving the battery giving a more accurate result of the energy generated. Since the results of this experiment will be specific to the brand of shoes used, the only shoes used will be those developed by Dr. Ville Kaajakari. The data gathered from this experiment can be applied to other brands of shoes that operate the same way, only if the differences in the efficiency of the mechanical to electrical energy conversion can be determined in both brands of shoes, and thus can be accounted for. The timeline needed to conduct this experiment would take six months, and would use a budget of 100,000 dollars.