CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Omneha Amujala; Elaine Luu

Project Number
S0301

Project Title
Sturdy Birdie

Abstract

Objectives/Goals
At our school, many people are interested in badminton and at their games or practices, they always try to choose the shuttlecocks with no damages. Some players believe that the shuttlecocks that are ripped usually affect their games; chance of winning. So by doing this project, we are trying to prove if the shuttlecocks that are ruined, will really affect the matches.

Methods/Materials
Our independent variable is the damage on the shuttlecock. We would control this by measuring each cut to make sure it follows are experiment. To make sure we were doing it as accurate it possible we would place the meter stick on the table and then cut the shuttlecock. When we cut the shuttlecocks, we would place the birdie right next to the meter stick side by side. After we get the right number of depths and cuts, we started to perform our experiment. The dependent variable is the decrease in speed. We controlled this by dropping each shuttlecock at a time, from the same hight every single time. After we cut the shuttlecock to the desired height we would then place it at the top of the meter stick and drop it. The cork of the shuttlecock would be at the edge of the meter stick. Which is a meter, but we captured our experiments in the range of 20 centimeters or 0.2 meters to have better control over the time the shuttlecocks took to fall.

Results
The data we collected has made our hypothesis inconclusive because it does not show if the damages has affected the shuttlecock#s speed of increase, or decrease. The reason for this is because we have measured our experiments at a low speed. Next time we could try again with a higher speed. Plus a better and more effective method.

Conclusions/Discussion
Our data shows that our hypothesis is inconclusive. The reasons for receiving these conclusions was because we might have made the cuts# depth slightly wrong, or it wasn#t captured to be measured right when we recorded it. Our data doesn#t specifically conclude if the damages has made our shuttlecocks increase in speed, or decrease in speed.

Summary Statement
The decrease in velocity caused by the damages on the shuttlecocks is affected by air resistance.

Help Received
Teacher helped with providing equipments

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

James D. Arias

Project Number

S0302

Project Title

A Study of the Relative Effectiveness of Two Building Foundation Isolation Techniques in Response to Equal Vibrations

Abstract

Objectives/Goals

This experiment compares two base isolation techniques [ball bearing and lead-rubber bearing] and documents their behavior during a simulated earthquake. Using a shake table and models of the two base isolation techniques, the tests document the relative effectiveness of the two systems in damping building motion during an earthquake.

Methods/Materials

The main components of the project were a shake table and three generic model buildings that each used a different base isolation method (ball bearing made from marbles and wood, rubber bearing made from corkboard and washers, and the control which had no base isolation device). First, the model is placed onto the shake platform. A 0.6 lb cement cone is fixed onto the top of the building. The shake table is turned on, and time is started. The building is subjected to the motion until it fails. When failure occurs, time is stopped and recorded. If the building survives past the point of one minute and thirty seconds, then the test is stopped and recorded as "90.0 sec." Each method undergoes 20 trials. An average survival time is calculated for every building. The greater survival time documents the base isolation technique#s overall success in limiting the potential damage a building might receive during an earthquake.

Results

The method that exhibited the greatest survival time was the ball bearing isolation; it had an average survival time of 90.0 seconds. The lead-rubber bearing isolation system averaged a survival time of 47.9 seconds. The building with no base isolation technique had an average time of 19.4 seconds.

Conclusions/Discussion

The most effective technique to lessen the movement of a building during an earthquake according to these trials is a ball bearing approach. It provided less friction for the building to move upon so there was no transfer of movement from the shake platform to the building. The difference in survival time, between this and the building that used no method, supports the use of base isolation in actual buildings. To conclude, this study strongly suggests that base isolation and energy dissipation should be considered in the construction of buildings. The ongoing seismic activity and increasing population will reach a point where earthquakes could prove more disastrous to human life than the present, and methods such as base isolation will be an important contribution to overall safety in any populated area.

Summary Statement

Through the recreation of an earthquake scenario, this project highlights the benefits of using base isolation techniques in the construction of buildings.

Help Received

Father used power tools to assist in the building of the project; Starting point for shake table taken from Casey Hagbo

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Rosario Arias; Angel Padilla; Jackelyn Sanchez

Project Number

S0303

Project Title

Aquatic Voyager

Abstract

Objectives/Goals

Our project is to build a submersible Remotely Operated Vehicle (ROV)to provide assistance for Search and Rescue teams in their attempts to save lives.

Methods/Materials

To obtain the materials that would be subject to underwater pressure and temperature differences for navigation and viewing of subjects. The materials consist of ASB/PVC pipe, servo motors, radio control device, bilge pumps to act as motors to propel the unit. Cat5 cabling to provide power and video output. A recording device to record expeditions. Using the Engineering Design Process of defining the problem, brainstorming ideas, proposing solutions, and developing a prototype, we then proceeded to receive feedback from community partners and choose a working model. Testing and continues feedback from team members has further developed the project.

Results

ROV navigation made it possible to view subjects underwater and navigate calm waters. Motors will be changed to endure colder temperatures and dive deeper.

Conclusions/Discussion

Stronger motors are being installed to navigate rough waters, but the concept and results do match our hypothesis and goals. In recent marine catastrophes, building our knowledge of ROV technology is necessary in order to save lives. Have equipment ready to assist divers in a timely manner is necessary to make every attempt a successful one.

Summary Statement

Manufacturing a Submersible Remotely Operated Vehicle that is able to assist Search and Rescue Personnel in their water rescue attempts.

Help Received

Advisor guided instructions for project. Advise in how to install electrical components from High School Mechanic Instructor.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Joshua M. Arreola

Project Number
S0304

Project Title
Well, Blow Me Down! Re-engineering Tesla's Turbine to Create a More Efficient Wind Turbine

Abstract

Objectives/Goals
In the early 1900's, an engineer known as Nikola Tesla designed an engine that, he claimed, was able to operate at around 90% efficiency. Today, engineers are trying to apply Tesla's concepts on traditional wind turbines. The objective of this experiment was to discover if it is at all possible to take Tesla's designs and ideas, and alter them, in order to create a more energy efficient wind turbine. I hypothesized that there was a method for doing so.

Methods/Materials
Five original designs were brainstormed and sketched, all based on the aerodynamic forces of adhesion and viscosity, and the resultant boundary layer effect, as Tesla intended. However, they were adapted to work in environmental wind conditions, instead of with high-pressurized fluids. Prototypes were created out of poster board, cardboard, and straws. A box fan was used as the wind source in the apparatus. A laser photo tachometer was to be used to measure the RPM of each prototype. Each prototype was to be tested 10 times for 30 seconds each, and the RPM readings would be recorded. After attaining results, larger-scale models of each turbine were to be made and tested for energy efficiency, which would be found by using the wind power formula. These efficiencies would be compared to that of a traditional turbine's efficiency in order to prove my hypothesis valid or invalid.

Results
The results of this experiment have been inconclusive thus far. The prototypes have been unable to turn in low-pressure wind conditions, thereby producing no recordable data.

Conclusions/Discussion
My hypothesis has not been supported thus far. Tesla's turbine has proven to be difficult to adapt to working in environmental wind conditions. The boundary layer effect created on the prototypes was not strong enough to spin the disks, and no viable data was able to be attained from the experiment. The next step that I shall take in order to achieve viable data will be to discover which of the designs is the most efficient, when used with a high-pressure fluid (as Tesla designed his turbine to work). After this data is attained, the most efficient design will further be tested and altered in order to discover if it can indeed work like a traditional wind turbine, under low-pressure fluids. After these tests are conducted, conclusive data should be reached, and my hypothesis will be either supported or disclaimed.

Summary Statement
This project was conducted to determine if it was possible to utilize Nikola Tesla's turbine designs, and alter them in order to create a more energy efficient wind turbine.

Help Received
My dad advised me on the tools to use to create my apparatuses. My good friend, Dr. Richard Chapleau, provided me with useful information on the aerodynamic principles and physics behind the Tesla Turbine.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Talen Barton; Rowyn Gilfillan

Project Number
S0305

Project Title
Propelled Potatoes

Abstract

Objectives/Goals
The objective of this project was to find which combination of propellant and barrel length will yield the longest launches.

Methods/Materials
The materials I used to make the cannons was ABS pipes with varying diameter. The propellants were Axe, Suave hairspray, and Engine starter fluid.

Results
We found that the hairspray gave the longest launches, the Axe gave the second longest launches, and that the engine starter fluid had the shortest, and fewest launches.

Conclusions/Discussion
We found that contrary to what we had expected, the engine starter fluid was the least explosive, not the most, and that the hairspray ended up as the most explosive. The barrel length difference didn't really seem to change much of the data, if there had been a larger difference in barrel length we probably would have seen a difference in launch distance.

Summary Statement
This project is about cannons, and how varying propellants and barrel lengths affect their power and the distance they shoot.

Help Received
Family helped with safety, and providing materials.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Ian J. Bennett

Project Number

S0306

Project Title

Can a Modified Lockwood-Hiller Valveless Pulsejet Engine Be Built that Maintains Self-sustained Periodic Combustion?

Abstract

Objectives/Goals

In the late 1950#s Ray Lockwood of Hiller Aircraft began his organized study of valveless pulsejet engines and developed the unique U-bend configuration. This study seeks to build a modified Lockwood-Hiller valveless pulsejet engine that maintains a self-sustained periodic combustion process, and test its performance against Tharratt#s 1965 theoretical thrust calculation. The modified Lockwood-Hiller valveless pulsejet engine#s experimental performance data, measured in pounds of thrust, will be less than the prototype#s theoretical thrust calculation, using C. E. Tharratt#s mid-1960#s mathematical analysis. The hypothesis is based on the literature that indicates with many valveless pulsejet engines the margin of error is small, and altering the dimensions incrementally can result in a significant increase or decrease in thrust.

Methods/Materials

A valveless pulsejet engine is a long hollow tube, open at its ends, with no moving parts. A mix of flat stainless steel and preformed mild steel conical and cylindrical shapes were TIG welded to make the body. Lockwood#s U-bend section is in the middle of the design. Frequent volume recalculations were made to rescale the pulsejet sections. An ignition system was assembled to start the engine and a propane fuel system started and maintained the pulse. Wheels were attached to the body and a simple performance measurement system using a fish-scale device was used to quantify the thrust generated.

Results

Tharratt#s mathematical model predicted 19.5 pounds of thrust (86.7 N) while 36 pounds of thrust (160.1 N) were measured.

Conclusions/Discussion

The data did not support the hypothesis and the modified Lockwood-Hiller valveless pulsejet engine#s experimental performance data, measured in pounds of thrust, was greater than the prototype#s theoretical thrust calculation, using C. E. Tharratt#s mathematical analysis. The results show a modified Lockwood-Hiller valveless pulsejet engine that maintains self-sustained periodic combustion can be built, and exceed the maximum pounds of thrust predicted by Tharratt#s theoretical calculation.

Summary Statement

This study seeks to build a modified Lockwood-Hiller valveless pulsejet engine that maintains a self-sustained periodic combustion process, and test its performance against Tharratt#s 1965 theoretical thrust calculation.

Help Received

Mr. Dino Fry at Dino Fry Racing Enterprises in Redwood City, CA for answered questions during the project, provided access to a machine shop, welding instruction, and fabrication assistance.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Supriya A. Bhupathy

Project Number

S0307

Project Title

A Comparative Analysis of Computer Simulated and Actual Rocket Launches

Abstract

Objectives/Goals

The purpose of this study is to determine whether there is a statistically significant difference between the maximum altitudes and velocities predicted by RockSim rocketry simulation software and those achieved by actual rocket launches. It is hypothesized that if the exact conditions from model rocket launches are inputted into RockSim, then the differences will not be significant.

Methods/Materials

The materials used in this experiment are as follows: RockSim rocketry design software, 3 Madcow Rocketry Kits (DX3, Momba, and Scooter), PerfectFlite Pnut altimeter, payload kits, materials to put together rockets (Epoxy glue, fin jig, electric sander, sheet metal, balsa wood), materials to launch rockets (weather recorder, launch pads, masking tape, control panel, wires), Cesaroni F59 WT model rocket motors and motor casings, and a computer to download altimeter data. The major steps in this experiment are as follows: obtain materials, design ideal rockets in RockSim, build actual rockets based on RockSim parameters, construct altimeter bays for rockets, launch rockets at Lucerne Dry Lake, record maximum altitudes and velocities from a total of nine actual launches (three for each rocket), and complete analysis with altimeter and RockSim data.

Results

The mean altitudes and velocities from the three flights for each rocket were compared to the corresponding mean altitudes and velocities of RockSim simulations, using paired T-tests. In each case, the comparison between the altitudes reached by actual flights and altitudes predicted by RockSim showed no significant difference. The comparisons of velocities for the Momba and Scooter showed no significant difference, but the velocity comparison of the DX3 did show significant difference (p value 0.0046). Secondary analysis, using one-sample T-tests and ANOVAs, was also done.

Conclusions/Discussion

The hypothesis for this experiment was validated for the most part. When means were compared with paired T-tests, almost all cases showed no significant difference. Based on this, RockSim is a reasonably accurate program and is a helpful tool in rocketry when limitations are taken into account. RockSim can be incorporated throughout the design process to eliminate the wasting of resources on rockets that will not launch or achieve the desired goals.

Summary Statement

This project compared the maximum altitudes and velocities from nine actual rocket launches to the corresponding values predicted by RockSim; parameters from rockets and conditions from actual launches were inputted into the software.

Help Received

Mr. Robert Koepke and Mrs. Jann Koepke of the AIAA OC Rocketry organization helped in the building and launching of the rockets. My parents assisted in the gathering of materials, such as rocket kits, motors, and RockSim software.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Erin Brown; Hannah Howerton

Project Number
S0308

Project Title
What Is the Effect of Propeller Size on Thrust Production?

Abstract

Objectives/Goals
The objective is to determine the effect of propeller size on thrust production.

Methods/Materials
This was tested by measuring the amount of time (seconds) it took a Styrofoam ball (38 mm) to be pushed by two different sized propellers through a cardboard tube (1 # in. diameter/ 40 in. length). Each blade was hooked up to a 3 Volt motor with 8300 revolutions per minute at maximum output, and each motor was powered by two AA batteries. Batteries and motors were connected by a system of wires. The larger blade measured 5 inches in length, and the shorter blade measured 3.625 inches in length.

Results
The larger blade produced more thrust to push the Styrofoam ball to the end of the tube in a shorter period of time.

Conclusions/Discussion
Wind energy created by the thrust of propellers offers a free and clean energy source, decreases the use of fossil fuels, reduces emissions from transporting materials, and eliminates the need for pipelines across the country. Determining the ideal propeller size will lead to a breakthrough in wind technology, allowing for the most efficient way to produce energy via windmills. From the observations of this experiment, it is proved that a longer blade is more efficient, sweeping a larger surface area and thus allowing for more energy to be produced.

Summary Statement
Our project tests how propeller size affects thrust production.

Help Received
Step father helped wire board.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Alex L. Chang

Project Number

S0309

Project Title

Surviving Seismically-Induced Liquefaction: The Development and Validation of a Novel Hybrid Floating Foundation System

Abstract

Objectives/Goals

The goal of this project was to develop and validate the effectiveness and performance of a novel hybrid floating foundation during liquefaction through model testing on a shaking table and compare the results to those obtained from experiments conducted on conventional footing foundation and mat foundation.

Methods/Materials

A shaking table, a model building, a mat foundation, a footing foundation, and a hybrid floating foundation. 100 kg of sand.

1. Place model building in a container pre-filled with sand and water.
2. Place the model set-up on shaking table. Measure initial positions of soil and foundation.
3. Subject the model set-up to shaking and liquefaction. Videotape the process.
4. Measure the final positions of soil and foundation. Calculate soil and foundation settlements.

Results

The hybrid floating foundation settles 40 to 90% and 45 to 95% less than mat foundation and footing foundation, respectively. The normalized foundation settlement (against soil thickness) of the hybrid floating foundation is 45 to 91% and 46 to 94% less than mat foundation and footing foundation, respectively. The normalized foundation settlement (against soil settlement) of the hybrid floating foundation is 52 to 98.6% and 57 to 98.7% less than mat foundation and footing foundation, respectively. The normalized foundation settlement (against initial soil density) of the hybrid floating foundation is 36 to 91% and 49 to 94.7% less than mat foundation and footing foundation, respectively.

Conclusions/Discussion

The geofoam providing both the support needed for static loading and the buoyancy during liquefaction is adopted in the novel hybrid floating foundation. The results of liquefaction experiments on model buildings subjected to shaking up to 0.82G clearly demonstrated the feasibility and advantage of the novel hybrid floating foundation. When buoyant force from geofoam offsets the entire building load, an average settlement reduction of 75 to 80% over mat foundation, which already settles less than footing foundation, could be expected. Even when a building supported by the hybrid floating foundation settles and is damaged by liquefaction, the required restoration will be considerably less in comparison to a building supported by either a mat foundation or a footing foundation, as the hybrid floating foundation will settle less than the surrounding soil.

Summary Statement

While conventional footing and mat foundations are prone to large settlement during liquefaction, a novel hybrid floating foundation using buoyancy from EPS geofoam has been shown to significantly reduce settlement.

Help Received

Use lab space at Associated Soils Engineering, Inc. under the supervision of Mr. Lawrence Chang

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Clay Coleman; Schuyler Turrill

Project Number
S0310

Project Title
Which Wind Sail Shape Is Best to Harness Wind?

Abstract

Objectives/Goals
Our goal was to test three different sail shapes, and find out which one is most effective at harnessing wind.

Methods/Materials
We made a cart out of K'nex building pieces, and mounted three different types of sail to it: a square sail, a triangle sail, and a parasail. The sails were made out of plastic trash bag material, and the square sail and the triangle sail each had a mast, both made out of a balsa wood dowel. They were tested one at a time. We tested it by measuring out twelve feet from a starting line, with a mark at every foot, and then placing the cart behind the starting line. We placed an electric fan behind the cart, and turned it on. We timed how long it took for the cart to reach the five foot mark, and then saw how far the cart would go in total. We recorded both how long the cart took to reach the five foot mark and also how far it could possibly go. Each sail was tested ten times.

Results
The results were that the parasail reached the five foot mark faster than both of the other sails, and also went a farther distance. The square sail came in second, with reasonable acceleration and reasonable distance. The triangle sail was much slower, and did not go quite as far.

Conclusions/Discussion
Theoretically, the parasail worked the best out of all three, but practically, it would not work as well due to its uncontrollability.

Summary Statement
Our project tests which of three sail designs harnesses the wind most effectively.

Help Received
Father helped with testing; mother helped with the display.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Eleanor O. Frost

Project Number
S0311

Project Title
Producing Electric Power from Wind Energy

Abstract

Objectives/Goals

My objective is to test two different airfoil cross sections in three wind conditions and compare the electrical power generated to the Betz's Law Theoretical Limit and to that produced by the control blade with a rectangular cross section.

One airfoil has a rounded cross section and the other has a flat bottom. I wanted to test a 3-inch blade and a 2-inch blade in three wind speed conditions. I tested the blades with an angle to the wind from 5 degrees to 50 degrees with 5 degree increments (static angle measurement, that is without taking into account the velocity vector due to rotation, which would be a dynamic measurement) I also wanted to test the best performing blade and test that blade in a two blade and four blade configuration. I hypothesized that the rounded blade would perform the best.

Methods/Materials

I made a long wind tunnel out of heavy plastic sheeting and attached two fans to it at one end and an array of pre-cut plastic pipe I found at Home Depot to smooth the air at the other. The windmill was inspired by a US Department of Energy report on building windmills out of sprinkler pipe. I purchased the blades online from Flying Foam and I glued the blades to small pieces of pipe which then fit into a pipe fitting that served as the rotor hub. The blades fit so snugly that I could get 5 degree increments to the wind. The angle was measured using a device I made from the packing foam in the box that came from Flying Foam. After reaching steady state, I measured the airspeed with ten readings from across the face of the smoother and then averaged them. For the blade output, after reaching steady state, for each experiment, I recorded ten output statistics; five each of millivolts and milliamps. I averaged, then multiplied and graphed the results.

Results

My hypothesis was wrong. I found that the flat bottomed airfoils consistently out performed the rounded. The flat bottomed 3 inch blade produced the most power in the high wind tests. This figure was 1.53% of the Theoretical Betz Limit. I also found that the two inch blades outperformed the three inch blades when compared to the control.

The tests of four blades vs two blades: In the high wind condition, I found that the two blade configuration produced 76% more power. In the low wind conditions, the results were just the opposite.

Summary Statement

Testing the power generated from two sizes of two types of blades, in three airspeeds, at 5 degree increments from 5-50 deg.

Help Received

Parents bought some materials, Dad helped move the smoother, Profs Farhat & Duraisamy helped describe the basic science

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Adyota Gupta

Project Number
S0312

Project Title
Smart Vest: A Novel Approach to Bulletproof Vests

Abstract

Objectives/Goals
The focus of my project is to develop an armor that reduces blunt-force trauma [Goal 1] and supports flexibility [Goal 2] for the wearer without compromising safety.

Methods/Materials
Goal 1: To achieve goal 1, I procured 2 identical Boron Carbide plates-experimental and control. I padded the experimental one with d3o in a staggering pattern and marked each plate with 9 distinct targets of 1" diameter circles. I mounted both plates in a scaffold containing ballistic clay. To test the plates, a city sheriff shot at both plates using 2 different caliber rounds while retaining the same testing conditions. To determine the performance of these plates, both qualitative and quantitative data analysis were performed. As part of qualitative analysis, the back face signature produced in the clay was visually inspected. The quantitative analysis involved comparing and interpreting the roughness of the clay surface's profile for both the plates, where a deeper deformation signifies less dispersion of shockwaves and a higher degree of blunt-force trauma. A homemade profilometer was built to capture X, Y, and Z coordinates of the surface.
Goal 2: To improve the mobility for the user, a design trade space was conducted to arrive at an optimized flexible armor design. A wooden mock up of a final design was built by machining and assembling tessellated tiles. The flexibility of the model was measured through the manipulation of CAD drawings and a protractor.

Results
Goal 1: The analysis of back face signature clearly showed that the control plate's clay had deep and centralized deformations, while the deformations in experimental plate's clay were barely visible. Additionally the quantitative analysis showed that on an average, the experimental plate was able to outperform the control plate by dispersing 57.7% of shockwaves, with 76.4% at best and 26.2% at least.
Goal 2: The resulting design was able to bend 16 degrees in any direction between any two given tiles and was an optimum to support priority movements, commonly observed during combat situations.

Conclusions/Discussion
The results were very promising. With the mere use a non-Newtonian gel to existing plates, I was able to effectively disperse the shockwaves and greatly reduce blunt-force trauma. The flexible design proves that a comfortable armor is possible without compromising the user's security.

Summary Statement
By exploiting the properties of non-Newtonian substances and utilizing an interlocking flexible armor design, a safe, comfortable bulletproof vest is achievable.

Help Received
Mr. Stuart Calhoon guided me through the project; Sergeant Jim Cannan tested plates

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Hunter Z. Karr

Project Number
S0313

Project Title
Comparing the Efficiency of Two Wave Energy Converter Designs and Their Potential for the Santa Monica Bay

Abstract

Objectives/Goals
The objective of my experiment was to explore the possibility of wave energy for the Santa Monica Bay. The voltage output and efficiency of two specific wave energy converter designs was analyzed.

Methods/Materials
Two designs that worked on different mechanics were tested: the attenuator and point absorber. The attenuator was designed to lie parallel to the predominant wave direction and 'ride' the waves, and the point absorber was designed with small dimensions to absorber shorter wavelengths. The point absorber was constructed from two segments of PVC pipe interconnected with flexible joints.The point absorber was composed of a small wood apparatus connected with a hinge. A air pouch was attached to the lower segment to act as a float. The same enameled copper wire and n54 magnets were used in both designs.

Results
The attenuator had the highest averaged voltage output. The point absorber performed best in small conditions but was quickly outmatched in larger wave conditions.

Conclusions/Discussion
The lack of refraction and consistency of the wave direction leads me to believe that the attenuator has the greatest potential for the Santa Monica Bay area. With our electricity needs only growing, the ocean offers an excellent solution to many of our energy problems.

Summary Statement
My project was conducted to test the efficiency of two wave energy converter designs and evaluate their potential for the Santa Monica Bay.

Help Received
My dad assisted me in cutting out a few pieces of my projet with eletric power tools.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Seung Hwan Lee

Project Number

S0314

Project Title

Modeling Acidic Gas Removal Efficiency for a Semi Dry Reactor

Abstract

Objectives/Goals

To study the hazardous gas removal efficiency for SDR as a function of the stoichiometric ratio and the gas amount.To simulate SDR shape, reaction condition, and operating condition.To confirm and improve the design factor to increase the hazardous gas removal efficiency for SDR

Methods/Materials

This project was conducted using a computational fluid dynamics software called Ansys

Results

When the stoichiometric ratio was 1.0, 1.2, 1.5, the acidic gas removal was 37.9%, 44.9% and 55.7% respectively. When SR was 2.0 the removal efficiency did not change as much. The gas outlet temperature of SDR ranged from 175 ℃ to 200 ℃. For the base case velocity model,the inlet gas flowed down and diffused. The upper part of the gas was turbulent and caused the flow of gas to stagnate.The steam-line was sided near the outlet duct. For the base case pressure model, the inlet gas pressure was 30 Pa and the pressure was maintained throughout inside the SDR, but significant pressure loss occurred as the gas entered the outlet duct.

Conclusions/Discussion

Stoichiometric ratio of 1.5 showed the optimum removal efficiency.

When the nozzle placement was modified, the removal efficiency was 72.8%

Though the stoichiometric ratio was changed, the gas velocity remained constant. So when the amount of lime injection was changed, the total pressure drop from the inlet to outlet in the SDR stayed almost the same.

Based on the data collected from the modeling, it can be expected that the pressure drop loss of SDR can be improved if the outlet duct shape is modified

The gas velocity and the pressure drop were increased as the inlet gas amount increased and the most pressure drop took place at the gas outlet duct.

If the Stoichiometric ratio is constant the acidic gas removal efficiency does not get affected by the gas amount change. The gas outlet temperature of SDR well satisfied with the guide line of SDR design.

Summary Statement

The project was about finding the optimum condition of acidic gas removal efficiency for SDR(Semi Dry Reactor), system checking and finding the design factor of SDR to develop a more efficient SDR

Help Received

My supervisor helped me with technical parts using Ansys

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Alison N. Logia

Project Number
S0315

Project Title
The Role of Reynolds Number in Liquid-Liquid Drop Experiments

Abstract

Objectives/Goals
The purpose of this experiment is to determine the most favorable conditions for forming very thin liquid columns, with drops of polyethylene oxide, in order to make very thin fibers.

Methods/Materials
Drops of polyethylene oxide were ejected from a pressure regulated syringe into a bath of water. As the drop fell, it disrupted a laser trigger which began a video recording at 1000 frames per second. A computer code was used to analyze the images. The code determined the drop diameter, as well as the impact velocity. The viscosity was determined using an existential rheometer. Varying drop regimes were observed subjectively. 32 trials were collected.

Results
Three ranges of drop regimes were explored: a ballistic range with no bubbles, a breakthrough range with bubbles, and a catch range with no bubbles. Drops were found to transition between five unique regimes. From highest Reynolds Number to lowest Reynolds Number regimes transitioned as follows: Inverted Torroid, Flat Bottom Pendant Drop, Break Through with Bubble, Torroid, Catch. A phase diagram of Froude Number vs. Reynolds Number was created to show the transition between the three ranges of drop regimes.

Conclusions/Discussion
Drops with Reynolds number in the catch range would be most favorable to create very thin fibers. The break through range formed liquid columns using bubbles which could be another useful method of creating liquid columns and fibers.

Summary Statement
This project investigates the Reynolds number of a drop and the formation of liquid columns in order to produce very thin fibers.

Help Received
Used lab equipment at Stanford University under the supervision of Travis Walker; mentor wrote my drop analysis code; mentor assisted in designing apparatus

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Patrick A. Lowe

Project Number
S0316

Project Title
Comparison of Fanwing Configuration Efficiency: Year III

Abstract

Objectives/Goals
This project was designed to continue research into finding the optimal ducting configurations of a fanwing propulsion system in respect to its efficiency in lift and thrust.
Year I confirmed the feasibility of improved efficiency through ducting. Year II identified optimal ducting configurations and the variables under which these ducts performed best. Year III focused on dynamic duct designs in conjunction with a morphing wing to increase the efficiency and performance.

Methods/Materials
A new wing was designed with the cross flow fans running almost the entire length of the wing and a twin drive system, reducing weight from 0.9 kg to less than 0.75 kg (16% reduction). Two remote control servos were installed to adjust the duct angle and to adjust camber by curving the bottom of the wing (without flaps).
This remote control fanwing was tested in a subsonic wind tunnel. The fanwing was tested in over 45 different configurations each with different duct shapes, positions, and wing shapes. The inherent lift and drag of all configurations were measured and factored out of the raw data. Additionally, smoke tests were performed on all high performance configurations to gather qualitative data that could lead to a trend or pattern behind successful fanwing ducting designs. All data was compared to the control configuration of a ductless wing.

Results
The average lift of configuration F (6,5) was the greatest at 173.2 grams resulting in a 64% improvement over the control configuration of 105.9 grams of lift. The average thrust of configuration A (6,5) was the greatest with 36.3 grams of thrust resulting in a 154% improvement over the control configuration of 14.3 grams of thrust.

Conclusions/Discussion
Because the Fanwing is ideal for low speed high lift applications configurations F (6,5) was selected as the best overall configuration. The smoke tests revealed that the control configuration had airflow separation over the trailing edge of the wing while the ducted versions vectored the airflow and improved laminar flow
Even though configuration F (6,5) was found to be the best out of all tested configurations, research is not over. Internal ducting, genetic programming, larger scale models, and many other modifications could reveal more efficient designs. This experiment, however, has determined several trends that further reinforce the promise of efficiency improvement through ducting.

Summary Statement
This project used dynamic ducting and morphing wing technology to increase the efficiency of the Fanwing propulsion system to unprecedented levels.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Loren Newton

Project Number
S0317

Project Title
Loads On Roads: Loading for Safety and Efficiency on Roads

Abstract

Objectives/Goals
My objective was to investigate the load placement of our vehicles, so as to ensure safety and efficiency in driving up and down, over bumps and dips on roads.
This project was prompted by my concerns over the bumps and dips on roads that caused drivers to lose control so readily; as well as my curiosity over the loading of weight that might cause loss of the vehicle balance. Besides, during the course of my research, I found no analysis on the effects of different centers of gravity (CG) upon objects moving on inclines and declines.

Methods/Materials
First, I constructed a model roadway with 9 different settings of bumps and dips, and recorded the time taken for the R/C vehicle, with 9 different load placements, to travel at a constant speed for a fixed distance. I also observed and recorded the frequency that the vehicle went airborne.
Then, I derived from vector diagrams and constructed an adjustable vector model to analyze and explain how and why the resultant force (driving force altered by various settings of rises and drops) behaved under the different center of gravity (by the placements of weight).

Results
My test data showed that, in general, it took shorter time while also presenting higher tendencies to send the vehicle off the ground, to travel over bumps than dips, with weight on back than on front, and with weight on low than on high.
From my experiment results, I made a new concept discovery and an in-depth attempt to justify the assertion that high CG is better for uneven roads, scientifically and mathematically.

Conclusions/Discussion
1. Bumps accelerate the drive and tend to cause loss of control, and therefore it is more critical to level bumps than to fill dips.
2. While low CG is faster for moving forward on flat roads, high CG proved to be more stable for uneven roads.

Summary Statement
To investigate the placements of different centers of gravity affect driving over bumps and dips on roads.

Help Received
My dad helped shop for material and supervised use of power tools during construction and configurations of my experiments. My mom helped with the board presentation.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Dillon M. Patel

Project Number

S0318

Project Title

Perching a Fixed Delta M-Wing UAV with a Variable Incidence Tail

Abstract

Objectives/Goals

The objective is to determine the perching fesability of the novel design, a Delta M-Wing aircraft with a variable incidence tail, by finding the optimum design and weight required for a successful perching manuver through practical applications. Perching, or spot landing on a structure, allows a fixed-wing aircraft to land on a specified point with minimal horizontal and vertical velocity, permitting the vehicle to safely land in any terrain including urban environments while also providing an alternative pathway to loitering, decreasing overall energy expenditure and increasing mission time.

Methods/Materials

Four independent designs were constructed in the programs XFLR5 and Solid works to attain the aerodynamic data and physical properties of each model at tail deflection angles varying from zero to seventy degrees. This data was used in coding written in Matlab to determine the angle of attack, velocity and trajectory of the model at an initial velocity of 15 f/s.

Results

Optimum results obtained from experimentation included a 50° sweep with NACA 9410 airfoil at a deflection of 40° with a weight of 0.002 slugs, decreasing the initial velocity from 15 ft/s to a terminal velocity of approximately 5.5 ft/s while exhibiting the perching trajectory. Results from the initial design had an insufficient lift coefficient, design two produced instabilities due to a positive moment, and design three was impractical due the low lift coefficient and high mass.

Conclusions/Discussion

A successful perching maneuver was exhibited at a 50° sweep with NACA 9410 airfoil at a deflection of 40°. This design can be directly applied to civilian and military situations, solving two main problems; the massive energy expenditure due to loitering UAV's as well as landing in urban and dangerous environments.

Summary Statement

To determine the optimum deflection angle and mass per design to successfully perch a Fixed Delta M-Wing UAV with a variable incidence tail, while attaining an optimum perching trajectory and a landing velocity under 9 f/s.

Help Received

Mentors Dr. Gustaaf Jacobs and Daniel Nelson mentored me by teaching how to use the programs XFLR5, Solidworks and Matlab, but took no part in the conception, building, attaning data or data analysis. All equipment was self provided.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Adam M. Prentice

Project Number
S0319

Project Title
The Effects of Varying Lever Arm Length and Fulcrum on a Catapult's Efficiency

Abstract

Objectives/Goals
The longest lever arm will deliver the farthest launch.

Methods/Materials
Trebuchet kit, Sanding Sponge, Wood Glue, Elmer's Glue, Drill, Weights (1, 5, & 8 oz.), Metric Tape Measure, Pencil, Paper, Notebook, Poster Board, Computer, Printer, Scissors, Border, Construction Paper

Results
The results from my experiment showed that hole 1, which was -4 cm from the control, had an average of 424.8 centimeters per launch, hole 2, which was -2 cm from the control, had an average of 366 centimeters, hole 3, which was the control, had an average of 308.8 centimeters, hole 4, which was 2 cm from the control, had an average of 224.55 centimeters, and hole 5, which was 4 cm from the control, had an average of 117.2 centimeters. As a result of my tests, hole 1 appeared to be the most successful and hole 5 the least successful in affecting distance and accuracy. This conclusion was supported by my ANOVA test. From this test I determined that there was less than a 3% chance of another factor affecting the distance, such as, wind, friction, or user error. Statistical analysis also supported the idea that a negative change in arm length improved distance and accuracy by increasing the influence of the counter balance.

Conclusions/Discussion
My results didn't support my hypothesis. I had hypothesized that the longest lever arm would yield the farthest launch, but actually the shortest lever arm yielded the farthest launch. I think my hypothesis was wrong because when I went farther down the arm, less force was created by the falling counterweight, decreasing the distance of the launch.

The data that I recorded shows that changing the length of the lever arm directly affects the distance of the projectile. This is proven by the one way ANOVA test that I conducted, which stated that there was a 3% chance that another factor could have affected the distance of each launch.

I learned from this project that little things make a big difference. For example, I changed the fulcrum of the arm by 2 cm, added a few more ounces to the original counterweight, and allowed the sling to swing freely which made a big difference on the experiment. This experiment relates to medieval weapons used to seize castles and hobbies such as Punkin Chunkin where contestants build trebuchets and other machines to launch pumpkins.

Summary Statement
I changed the length of the lever arm in order to discover which yielded the farthest launch.

Help Received
Dad helped me measure the distance of the launch; Mom helped me prepare my board; Advisor helped me revise my work; Neighbor helped me drill holes in catapult's arm

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Caitlin A. Redak

Project Number
S0320

Project Title
A Comparative Analysis of Silk Strength

Abstract

Objectives/Goals
I hypothesized that the orb weavers would have a higher tensile strength and so a higher energy required to break the silk because their silks are built in the open and subject to more disruption. This means that orb weavers would be able to capture more flying insects or larger insects because their silk would sustain more force before breaking than the silk of a brown widow. In addition, because tensile strength adds to the elasticity of an object, orb weaver webs would be more elastic in the face of harsher environmental conditions (wind, rain etc.).

Methods/Materials
I extracted silks from four orb weaver spiders and four brown widow spiders and placed them on hand made slides. I imaged the silks and used the images to calculate the cross-sectional diameter of the silk. I used a Nano Bionix Universal Testing System (a machine that measures, stress, strain and tensile strength) to determine the silk strength of each spider. The measurements taken were then used to calculate the energy required to break the silk. I also used known mass and flight velocity data for flying insects (a typical fly and a bumblebee) and a bullet to calculate the subsequent velocity needed to break the silks.

Results
I accepted my hypothesis that orb weaver dragline silk has a higher tensile strength and subsequent energy and breaking velocity than brown widow dragline silk.

Conclusions/Discussion
I concluded that tensile strength (a measure of how much a material can stretch without breaking, or elasticity in general), is a substitute for stability.

Summary Statement
I tested the tensile strength, energy to break, and velocity to break black widow and orb weaver spider silks

Help Received
1. I used lab equipment at UCR under the supervision of Dr. Richard Cardullo; Mr. Tom Prentice and Dr. Cheryl Hayashi helped in providing and the collection of spiders; I used lab equipment at UCR under the supervision of Dr. Cheryl Hayashi; I had help from Dr. Richard Redak proof-reading my calculations.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Reagan Risk

Project Number

S0321

Project Title

To Surge or Not to Surge: Modeling the CVWD Gravity-Fed Canal Water Surges as Determined in USBR Monograph 17

Abstract

Objectives/Goals

Model USBR Monograph 17 which describes the surge issues causing water loss in the Coachella Valley Water District's (CVWD) gravity fed canal system.

During a prior year's project, I was traveling in Alaska and observed the Alaska Pipeline and was fascinated by how oil was transported from the Arctic Ocean to the ports of Alaska. Upon my return to California, I saw the canal system that brings water from the Colorado River to Los Angeles. That sparked my interest in this subject.

Methods/Materials

Design a series of clear baffles and tubing, ranging from 6-10 inches in height. Connect baffles in series. Allow 8 liters of water to flow through the system and observe location & timing of any surge/water flow issues.

Results

Backflow and surges occurred numerous times, ranging from 0:21 to 2:19 into the tests. The causes were (1) end line was not primed, (2) change in hose diameter, and (3) pressure/water flow differential in the system.

Conclusions/Discussion

The Coachella Valley Water District's canal system is gravity fed. Surging issues have occurred and were documented in the USBR Monograph 17. I modeled this system to recreate the issues using clear tubing and baffles so that I could observe the issues.

The backflow and surging issues caused by sediments and sands are a significant problem. Additionally, if end-user issues cause a drop or increase in pressure in the system or a lack of priming in the system, then surging and related water loss can occur.

Summary Statement

Model USBR Monograph 17 which describes the surge issues causing water loss in the Coachella Valley Water District's (CVWD) gravity-fed canal system.

Help Received

I consulted with CVWD Engineer Dan Charlton to review the CVWD canal system & USBR Monograph 17.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Alap A. Sahoo

Project Number
S0322

Project Title
Designing the Optimal Winglet for Flight

Abstract

Objectives/Goals
My objective was to determine the aerodynamic capabilities of winglets # the tips at the ends of wings that point up. I wanted to test the differences between different sizes as well as different models of winglets and discover which was the most effective. I believe that a ½# winglet on a 7 wingspan # a 1:14 ratio # will be the most effective, and that a translated winglet (a design which tapers to an upward point) will be more effective than a regular one.

Methods/Materials
I constructed 5 balsa wood airplanes with winglets of different sizes (none, 1#, ½#, ##, and ¼#) as well as 3 paper airplanes with 3 different models of winglet # none, regular, and translated. I measured the lift and drag of these models, as well as how the air flowed around the balsa wood models, using a wind tunnel and some punks.

Results
The balsa wood plane with ½# winglets had the most lift and least drag, with no other plane being as effective, while the translated winglet produced more lift than the regular winglet on the paper airplanes, even though they both produced the same drag. In the airflow experiment involving punks, the ½# winglet had the least turbulent airflow.

Conclusions/Discussion
The data confirmed my hypothesis, confirming that the 1:14 ratio is indeed the best, and that a translated winglet is better than a regular one.

Summary Statement
My project seeks to find the best size and best model of winglet - an add-on to a wing that is supposed to reduce drag.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
John T. Schwartz, III

Project Number
S0323

Project Title
The Effect of an Electrolytic Cell on the Power Output of an Internal Combustion Engine

Abstract

Objectives/Goals
The objective of this experiment was to find how the introduction of on demand oxy-hydrogen produced by an electrolytical cell affected the power output of an internal combustion engine.

Methods/Materials
The main materials used in this experiment included a weed whacker engine, an electrolytic cell, and a dynamometer. The electrolytic cell system and dynamometer were constructed by myself. I also created an organized bench testing station with these components mounted.

To preform the experiment, the small, two stroke engine was run on a constant flow of gasoline. In conjunction with this, oxy-hydrogen was introduced through the air intake at flow rates of 0.0LPM (liters per minute), 0.5LPM, 1.0LPM, and 1.5LPM. The power output of the engine was recorded in watts for each rate of introduction. After performing eighty-four test on the data, twenty-one for each rate of introduction, I concluded my experiment.

Results
The mean values for the 0.0LPM, 0.5LPM, 1.0LPM, and 1.5LPM test groups were 435.89 watts, 462.05 watts, 474.16 watts, and 487.33 watts respectively. Statistical tests revealed significant increases between the control and all experimental test groups. A significant increase was also found between the 0.5LPM and 1.5LPM test groups.

Conclusions/Discussion
The hypothesis was if oxy-hydrogen was introduced into an internal combustion engine, it would increase the power output. Also, a further increase in oxy-hydrogen introduction would correlate to an increase in power output. The data supported the hypothesis. In light of this, the experiment expands the knowledge of the application of an electrolytic cell system.

Summary Statement
This project was about testing the effect of introduction rates of supplemental oxy-hydrogen on the power output of an internal combustion engine.

Help Received
Grandfather supplied drill press; Machinist helped lathe dumbbell weight to make flywheel

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Alysa S. Shin

Project Number
S0324

Project Title
An Analysis of Energy Output by Water Turbines Due to Excessive Rainfall in a Third World Country

Abstract

Objectives/Goals
My objective for this science project was to determine the potential energy output from turning water turbines in a Third World country location with a greater than average amount of rainfall. After determining this, my goal was to provide enough energy to keep a 25-watt light bulb on for 8 hours at night.

Methods/Materials
In the initial experiment, I constructed two systems of water turbines made of metal blades stapled to wood stick shafts. The turbines were placed in gutters about 90 centimeters long with channels that narrowed the flow of water. In the first system, a Pelton wheel style turbine was fastened on the top of the gutter with PVC pipe rings on both sides of the shaft. The second system had a water wheel style turbine in a hole on the bottom of the gutter with a PVC pipe ring. To calculate the electrical output, alligator clips connected a dynamo to a multimeter were used to measure the voltage and amps and their production as wattage.
I calculated the quantity of water that would fall off a roof of a typical house. For the initial experiment, water was poured down horizontally and vertically into the gutters at the rate of 1 liter per minute for 30 seconds. In the modified experiment, two water turbines were removed from the gutters and placed directly under the bathroom sink faucet, with water released onto the turbine blades for 30 seconds.

Results
During the initial experiment, an insufficient water flow and force did not turn the water turbines in the gutters to get data. For the horizontal design, water went down the water channel straight, but the force of water could not push the water turbines. For the vertical design, the speed and path of water flow was hindered because water crawled along the metal of the water channel.
To get an energy reading directly from the turning turbines, I modified the initial experiment. The turbine from the first system produced an average of 0.0000356 watts per 30 seconds and the second system produced an average of 0.0000535 watts per 30 seconds.

Conclusions/Discussion
Therefore, the systems could not provide enough energy to light a 25-watt bulb. However, with changes and improvements it could be developed into a small, inexpensive energy source in Third World countries that have heavy annual rainfall. For example, this system could be adapted into a micro-mini dam attached to a house and its gutter system.

Summary Statement
My research project analyzed the flow of excessive rainfall in Third World countries that would be needed to turn turbines to generate electricity.

Help Received
A professor and two students at CSU,Chico helped with mechanical concepts; My science teacher helped getting materials and brainstorming

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Navjot Singh

Project Number
S0325

Project Title
Utilization of X-Ray Triboluminescence from Stick-Slip Friction in Peeling Tape

Abstract

Objectives/Goals
The objective of the project is to be able to utilize the X-ray triboluminescence, emission of radiation through friction, from peeling tape by making an X-ray machine. Once the X-rays have been detected, the secondary objective is to find the most efficient method of producing X-rays. The goal is to be able to produce 100 counts of X-ray radiation, which will be detected by a Geiger counter, and use that radiation to create an X-ray image.

Methods/Materials
To create the X-ray machine, a program was first made, using C++, that would allow a light sensor to be used as a switch to turn a motor on and off. One stand was then constructed to hold the motor and a roll of tape while another to hold a Geiger counter in front of the point of partition of the tape. The entire set-up was then placed in a vacuum chamber. Next, a hole was drilled in the lid of the vacuum chamber, and the wire connecting the Geiger counter to the computer was inserted. After the sealing glue was applied to close the hole, tests were conducted with various tapes. Also, a package of photographic paper was made to conduct X-ray scans by going into a completely dark room and placing two metal washers as targets in front of the photographic materials and wrapping them in dark paper.

Results
Peeling regular Scotch tape produced a maximum of 329 Counts per second (CPS) of X-ray radiation. Furthermore, in every test the slope of the line of best fit was at an average of positive 1. Scotch sealing tape produced an external radiation level of 30 CPS. Electrical tape produced a maximum of 3 CPS. Photographic paper was then used with an exposure time of 15 minutes with regular Scotch tape and 7 minutes for Scotch sealing tape, which is 3 centimeters wider than regular Scotch. Both of these test produced a clear X-ray scan of the two washers placed in each package of photographic paper.

Conclusions/Discussion
Not only was the goal attained but was far surpassed by producing over 300 counts of radiation per second. Regular scotch tape proved to be the most efficient method of producing X-rays. Furthermore, a direct correlation between speed of partition and X-ray production was discovered: a faster rotation speed resulted in a greater production of X-rays.

Summary Statement
A portable, more cost-efficient X-ray machine was created through triboluminescence in peeling tape.

Help Received
Various materials were provided by science teacher, John Allen; assistence in developing the photographic material was provided by photography teacher, Jarrod Thompson

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Mihir S. Sirdesai

Project Number
S0326

Project Title
Coanda Effect: The Effect of Vectorial Flow of Air on a Central Processing Unit (CPU)

Abstract

Objectives/Goals
Will a vectorial (laminar) flow of air cool a CPU more efficiently than the air flow generated by a traditional fan?

Methods/Materials
The following experiments were carried out.
Procedure 1: The bulb was switched on. After the bulb had achieved its maximum temperature, the bulb was switched off and the fan was turned on simultaneously. The fall in temperature was recorded every thirty seconds using thermocouple until the temperature reaches the minimum. The same experiment is repeated with the other fan (the one using Coanda principle).
Procedure 2: The bulb was switched on. After the bulb had achieved its maximum temperature, the bulb was left on (simulating real situation) and the fan was turned on. The fall in temperature was recorded every thirty seconds till the temperature reaches the minimum. The same experiment is repeated with the other fan (the one using Coanda principle).
Procedure 3: The fan was switched on. Then the light bulb was switched on. The rise in temperature was recorded every 30 seconds and the maximimum temperature achieved was recorded. The same experiment was performed using fan with Coanda principles.

Results
In the first experiment the bulb was cooled only 16% faster than control by fan using Coanda principles and 6% faster with regular fan. The results were surprising, but I guess the cool temperature of the room swamped the airflow effect due to Coanda principles.
The results in the 2nd experiment provided real life scenario. Here the fan using Coanda principles cooled >4 times compared with traditional fan and the minimum temperature achieved by Coanda fan was 130 deg. F as opposed to 150 deg. F achieved by traditional fan. (The highest temperature achieved by the bulb was around 156 deg F)

Conclusions/Discussion
The results showed that vectorial (laminar) airflow using Coanda's principles provide a lower maximum temperature and more rapid cooling for my simulated CPU.

Summary Statement
A vectorial flow of air using Coanda principles cools more efficiently than a chopped flow of air generated by a traditional fan.

Help Received
Friend helped to build the apparatus according to my designs

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Russell K. Sobota

Project Number
S0327

Project Title
What Is the Difference in Power Output between a Gasoline and Hydrogen Fueled Internal Combustion Engine?

Abstract

Objectives/Goals
Environmental concerns about global warming have increased the interest in internal combustion engines that can run on hydrogen instead of gasoline, because hydrogen combustion emits no carbon dioxide into the atmosphere. It is our objective to see if a hydrogen engine is a practical alternative to a gasoline fueled engine. As part of this goal, our immediate objective is to compare the power output of a hydrogen engine to a gasoline engine of the same type and size.

Methods/Materials
To obtain my data I used a small single cylinder four stroke engine. I modified the engine so that it would run on both gasoline and hydrogen. I constructed a dynamometer using a positive displacement hydraulic gear pump. The dynamometer was used to measure the maximum power output of the engine at different speeds for both gasoline and hydrogen. Materials included, a four stroke engine, gasoline/hydrogen carburetor, motor oil, gasoline, pressure regulator, hydrogen fuel tank, hydrogen fuel hose, dynamometer, heat exchanger, workbench, clamps, digital tachometer, white-out, and other miscellaneous tools.

Results
I recorded two sets of results. First I ran the engine on gasoline and recorded the maximum power output at several engine speed. Next I ran the engine on hydrogen and recorded the power out put for the same speeds. Results showed that the power output of hydrogen was about half as much as the power output of gasoline at any give RPM. I also discovered that it was difficult to start the engine on hydrogen alone so I had to start the engine using gasoline and switch to hydrogen.

Conclusions/Discussion
I was able to conclude that the power output of a gasoline-powered engine was higher than the same engine using hydrogen. The power output of hydrogen was about half of gasoline at the same engine speed. Hydrogen is better for our environment because it produces water vapor and no carbon dioxide. By analysis, I found that gasoline produces much more greenhouse gasses than hydrogen. Therefore gasoline produces a higher power output, but hydrogen has a more environmentally friendly exhaust. Also in order to have a practical hydrogen, I would have to figure out how to start it using only hydrogen.

Summary Statement
I compared the power output of a hydrogen fueled internal combustion engine to a gasoline engine to establish the praticality of using hydrogen as a fuel for transportation.

Help Received
My father helped me in procuring the equipment I needed. He demonstrated the use of certain machine tools to me. He ensured that I was using hydrogen safely.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Jessica C. Whiteley

Project Number
S0328

Project Title
The Effect of Weight on LEGO Brick Bonds

Abstract

Objectives/Goals
The Effect of Weight on LEGO Brick Bonds was designed to test the structural support of LEGO bricks, which can be paralleled to actual brick bonds used for brickwork buildings. My experiment focused on testing the brick bond that can support the most weight and seeing which beam has the highest deflection (and therefore is the most straight). The four brick bonds I tested were the Stretcher (control), the Flemish, the English and the Header bonds.
My hypothesis; if the bonds in the bricks overlap more, then the more weight the LEGO bricks can sustain.

Methods/Materials
I gathered LEGO bricks, made them into beams of about 92.5 cm long, and placed weight upon them until the beams broke. The beams were supported at either end with 30.5 cm tall structures, to test deflection. I measured the bonds' deflection and weight support through five experimental trials. I kept the number of bricks used in each beam experiment constant, the length and height at which the individual beams were placed constant and the weight placed upon the beams in constant increments. I also kept all outside variables constant.

Results
My major finding was that the Flemish bond can support the most weight. The beam could support 1600 grams, on average, before collapsing. It also had a deflection of 26.16 cm. This is because it has the greatest surface area overlap, making for the greatest static loading allowance and the tolerance of compression and tension. This made the Flemish bond beam my definition of the strongest LEGO brick bond beam. I also found out that the Stretcher bond has the highest deflection (was the straightest).

Conclusions/Discussion
My original hypothesis was refuted by my data findings. I thought that because the English bond has the most physical overlaps, it would be the strongest. But, no; it is the amount of surface area, static loading allowance and the tolerance of compression and tension that the Flemish bond beam could maintain that made it my definition of the strongest LEGO brick beam.
This project expands our knowledge about weight allowances on different brick bonds. It addresses which bond to use when building a structure both with LEGO bricks and the real world. This project also encompasses the subject of how buildings and structures can support weight.

Summary Statement
The Effect of Weight on LEGO Brick Bonds was designed to test the structural support of various LEGO beams which were made using different brick bonds (how bricks fit together) for weight and deflection; this can be paralleled to brickwork

Help Received
I received a very small amount of assistance on my experimental design outline from my science teacher.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Haotian Xu

Project Number
S0329

Project Title
Super-hydrophobic Surface for Anti-Icing Applications

Abstract

Objectives/Goals
This experiment was conducted to determine if a super-hydrophobic surface repels ice. I believe that the surfaces with higher contact angles (and thus higher hydrophobicity) repel ice more effectively than the surfaces with lower contact angles.

Methods/Materials
Naturally-occurring super-hydrophobic surfaces provide good models for constructing an artificial copy. An investigation of the surface structure of lotus leaves enabled the design of a bionic super-hydrophobic surface coating made with Teflon micro-particles coated onto metal plates using an adhesive layer. Six super-hydrophobic surfaces were fabricated with different adhesives and the contact angle of each was measured to determine its hydrophobicity. The best hydrophobic surface was identified to have a contact angle of 170° and its practical applications were tested by applying it to the rotor blades of a model helicopter.

Results
It was found that a super-hydrophobic surface with a well-designed surface micro-structure does repel ice. A surface with higher hydrophobicity is more efficient at repelling ice; a surface with a contact angle of less than 140° only has a limited ice-repelling capability, while a surface with a high contact angle (170°) is an effective anti-icing surface. The super-hydrophobic coating was then applied to a rotor blade of a model helicopter. When tested in both on-the-ground and in-flight conditions, the rotor blade with the coating was free from ice while ice accumulated on the control blade without the coating.

Conclusions/Discussion
This project confirmed that a well-designed super-hydrophobic surface does repel ice and that a surface with a higher contact angle is more efficient at repelling ice. The super-hydrophobic surface applied on a model helicopter did prevent ice formation in both on-the-ground and in-flight scenarios. This data suggests that icing problems in many other applications can be prevented using a super-hydrophobic surface coating.

Summary Statement
This project examines the ice-repelling capabilities of super-hydrophobic surfaces made with Teflon micro-particles and different adhesives; it also explores the applications of this ice-repelling surface in preventing icing on helicopters.

Help Received
My parents helped me purchase experimental materials. Dr. Lily Wu (researcher, UCI) trained me with lab safety and use of lab equipment. Mr. Martin Lopez supervised the experiment and supplied lab equipment at Physical Optics Corporation. Mr. Tim Smay (AP Physics teacher, University High) guided

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
James Xue

Project Number
S0330

Project Title
Rubberized Concrete: An Integration of Dynamic Performance and Environmental Protection

Abstract

Objectives/Goals
Evaluating the dynamic properties of rubberized concrete including the damping ratio and the seismic response will enable us to identify its niche applications. Investigating the effects of rubber crumb and silica fume on the compressive strength will help us assess the strength and deformation properties, understand the bonding mechanism between rubber crumb and cement paste, and thus optimize the mixing process. Furthermore, utilizing the recycled crumb rubber and silica fume for concrete structure opens up a new field for the green technology.

Methods/Materials
Rubberized silica fume concrete was designed by replacing coarse aggregate in concrete. To evaluate the dynamic properties of rubberized silica fume concrete, free vibration and shaking table tests were conducted to measure the damping ratio and seismic response. To assess the ductility of rubberized concrete structural members, experiments on compressive strength, Young's modulus, and deformation were conducted. Rubber particles were also coated with nano-porous thin films (NPTF) to observe the bonding interface between rubber and cement paste using a scanning electron microscope (SEM).

Results
The experimental results showed that the average damping ratio of the rubberized concrete columns is 7.7 compared to 4.7 for the normal concrete columns. The peak response acceleration of the rubberized concrete columns in the shaking table tests was 26% less than that of the normal concrete columns. The compressive strength of the rubberized concrete at 20% replacement dropped as much as 57%; however, adding silica fume improved compressive strength significantly. The SEM images confirmed the absence of bonding at the rubber-cement interface. Coating NPTFs on the rubber crumbs unveiled little improvement on bonding.

Conclusions/Discussion
The rubberized concrete demonstrated superb dynamic properties in free vibration and seismic shaking tests. Introducing silica fume on the aggregate#s surface is an effective way to improve compressive strength and elasticity. The SEM images unveiled reasons for the compressive strength loss. Overall, the experimental results show that the proposed rubberized silica fume concrete is promising. As a new construction material, it has its niche because of its superior performance in absorbing kinetic energy and reducing impact. Furthermore, the rubberized silica fume concrete is a future green material.

Summary Statement
Rubberized silica fume concrete shows potential as a new construction material based on its superior dynamic performance in absorbing energy and reducing impact.

Help Received
Used lab equipment at University of California, Irvine under the supervision of Dr. Masanobu Shinozuka

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
David A. Zarrin

Project Number
S0331

Project Title
The Z-Engine: My Internal Combustion Rotary Engine with Only Four Moving Parts

Abstract

Objectives/Goals

I researched internal combustion engines. Unlike traditional engines, Wankel rotary engines have few moving parts but have other problems.
HYPOTHESIS: One can architect a rotary internal combustion engine that doesn't have Wankel rotary engine issues and yet, offers advantages over traditional combustion engines.
GOAL: eliminate such problems through the following properties:
1) Has no more than four moving parts.
2) Resilient compression & oil seals design that don't wear out due to lateral motion of compression seal.
3) Combustion forces must be fully aligned with rotation tangential forces.
4) Combustion force must drive the main shaft at 100% duty cycle.
5) Full-cycle engine - one combustion for every cycle vs. one combustion every four cycles.
6) Each combustion must drive the main shaft nearly 300 degrees instead of 180 degrees in traditional four-stroke engines.
7) No pistons, valves, valve rods, valve springs, cam-shaft, cams, timing chain, or such moving parts.
8) Eliminate or minimize reverse motion of mechanical parts such as pistons, piston rod, valves and the Wankel core.

Methods/Materials

To better understand motors,I will take apart several motors (two lawnmowers a trimmer and a rototiller). Next, I will build prototypes. The first prototype with clear Plexiglas to view motion. The next prototypes will be hard steel by machining to a +/- 0.008" accuracy. I plan to use some off-the-shelf components such as sparkplugs, coil, natural gas carburetor, or fuel injector. The prototype will use two steel chambers: one for air intake and compression and the second for combustion. Each chamber will have a solid core that rotates around the main engine shaft. The prototype will be designed for a 301cc rotary engine. The properties of the rotary engine are compared to both a conventional and rotary engine with the same combustion volume of 301cc.

Results

My final prototype was a success and proved the concept. It worked.

Conclusions/Discussion

The design eliminates some of the flaws of the Wankel engine; is more efficient and has only four moving parts. To my knowledge, such a rotary engine is novel and has never been built. This engine can be used in many applications.

Summary Statement

I built an internal combustion rotary engine with only four moving parts that solves the Wankel engine flaws.

Help Received

I told my advisor where to make the cuts and then he operated the power equipment .