CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Daelin T. Arney

Project Number
S0301

Project Title
Pneumatic Prosthetic

Abstract

Objectives/Goals
There is room for advancements in the field do human prosthetics. This project was developed to test the feasibility and applicability of pneumatic muscles in human prosthetics. Tests were carried out to measure the flexion of muscles at diffing lengths. Research indicated that a pneumatic muscle at 85 p.s.i would flex 25% of its original length. Once this data was gathered it was then applied to develop the muscles, that were then used in the model skeletal arm.

Methods/Materials
Latex tubing Woven nylon loom Zip ties/ Hose clamps Nylon bolts High pressure tubing Air Compressor Barbed male connectors-(nylon)

Results
The first pneumatic muscles built were not very applicable to what was need in the arm. After considerable experimentation the muscles began to operate with the degree of flexion that was needed in the human model.Once I had the ideology down of how the pneumatic muscles actually worked I was able to deduce that at any given length a muscle will flex 25% of its original measurement.I then was able to implement this concept into the model arm.After a minute amount of tweaking I construct my first model of P.A.M one, which operated with promising results and proved that the implementation of pneumatic muscles on the human phasic was possible at least at the skeletal level.

Conclusions/Discussion
Overall my experiment was a success I created an arm that sets the for-ground for the development of what I call advanced prosthesis now I# m held back by money, access to materials and the technology of my time. But if I#m capable of creating #P.A.M-1# with nothing but my imagination minimal funds and common materials imagine what is possible when this mentality is induced in a lab, with a team of scientists.The possibilities are endless we may actually be able to give disabled human beings the well desired right to walk or use their arms.We have the ability to change the way disabled individuals live their lives whether they be veterans or the victim of a tragedy we can change their lives for the better.

Summary Statement
The application of Pneumatic muscles in human Prosthetics.

Help Received
Mother assisted with editing, Family Friend provided tools as well as helped with building.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Makayla J. Campbell

Project Number
S0302

Project Title
Does the Direction of a 3D-Print Matter?

Abstract

Objectives/Goals
3D-printing is a form of additive manufacturing where materials are added layer by layer to create a three-dimensional object. If the orientation an object is 3D-printed at changes the object's strength, the 0° (horizontally printed) piece is expected to be strongest and the 90° (vertically printed) piece is expected to be the weakest.

Methods/Materials
3D hexagonal prism models oriented at three different directions were created using CAD based programs (SketchUp, MeshLab, Axon, and Pleasant3D). The files containing the G-code were then transferred using an SD card to a Bits for Bytes 3D-printer. Using PLA filament, the hexagonal prisms were 3D-printed. From there, the prisms were broken in a homemade cantilever system, with a bucket tied to a fixed point on the pieces of plastic. Rocks were used as weights and placed into the bucket until the pieces of plastic broke. After the plastic hexagonal prisms broke, the total rock mass was recorded.

Results
For the first round of trials, the standard deviation was 0.782 for the 0° prisms, 1.671 for the 45°, and 0.948 for the 90°. As improvements in the prints were made, the second round had a 0.0912 standard deviation for the 0°, 0.308 for the 45°, and 0.315 for the 90°. The 0° prisms were able to hold up to an overall average of 6.765 Kg. The 45° prisms were, on average, 24% weaker than the 0° (being able to hold up to an average of 5.154 Kg), took 507% more time to print, and 483% more material. On average, the 90° prisms were 32% weaker than the 0°, took 297% more time to print than the 0°, and 250% more material.

Conclusions/Discussion
The data supported the hypothesis: the 0° prisms were the strongest and the 90° prisms were the weakest. The 0° prisms were the best in all other aspects, as well: took less time to print, used less material, and were the most consistent in strength variance. This information can be used to help print creations such as 3D-printed houses, prosthetics, replacement organs and bones, and other products. Knowing which direction is strongest to print will improve the safety, manufacturing, design, and economics of the product by not making as many prints and, thus, wasting less time, money, and material.

Summary Statement
The orientation of a 3D-printed object changes the relative strength of the object, production time, and material consumption.

Help Received
Father provided his 3D-printer and printer materials.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Alex L. Chang

Project Number
S0303

Project Title
Surviving Seismically-Induced Liquefaction: Dynamic Centrifugal Modeling of a Novel Hybrid Floating Foundation System

Abstract

Objectives/Goals
To validate the feasibility and advantage of the novel hybrid floating foundation (NHFF) system in better surviving liquefaction than footing foundation (FF) and mat foundation (MF)at prototype-scale stress state utilizing a dynamic geotechnical centrifuge.

Methods/Materials
Construct model building and NHFF, FF, and MF foundations. Place them in model box filled with saturated sand. Assemble and secure dynamic geotechnical centrifuge. Place completed model box onto model platform and connect with shaker. Place counterweight on the other platform and balance. Measure initial positions of model building, foundation, and soil. Connect shaker with power through slip ring. Affix rotator to centrifuge. Install in-line camera and side camcorder. Perform dynamic centrifugal tests and videotape the process. Measure post-test positions of model building, foundation, and soil. Determine G-level.

Results
Rotational speeds for 15 tests ranged from 126 rpm to 144 rpm, equal to centrifugal accelerations from 12.05G to 15.73G, with an avg. of 13.89G.
Shaker cyclic speeds for 15 tests ranged from 204 rpm to 222 rpm, equal to cyclic accelerations from 0.66G to 0.79G, with an avg. of 0.72G.
At 13.89G, a model foundation of 104 cm2 and 812.8g supported by 13.51 cm-thick sand represents a prototype of 2 m2 and 21.35KN supported by 1.88 m-thick sand.
Avg. soil settlement for 5 FF tests was 0.5 cm, equal to 6.62 cm for prototype. Avg. max. FF model settlement was 2.72 cm, equal to 36.06 cm for prototype.
Avg. soil settlement for 5 MF tests was 0.5 cm, equal to 7.07 cm for prototype. Avg. max. MF model settlement was 1.12 cm, equal to 5.87 cm for prototype.
Avg. soil settlement for 5 NHFF tests was 0.46 cm, equal to 6.63 cm for prototype. Avg. max. NHFF model settlement was 0.34 cm, equal to 4.92 cm for prototype.

Conclusions/Discussion
1.The concept/design of the NHFF has been proven feasible through dynamic centrifugal modeling.
2.NHFF is very effective in reducing liquefaction-induced foundation settlement and maintaining the post-liquefaction functionality and intactness of the building than FF and MF.
3.Buoyancy developed within geofoam during liquefaction reduces foundation base load and isolates NHFF from soil deformation.

Summary Statement
Validate the feasibility and advantage of a novel hybrid floating foundation in better surviving liquefaction than footing and mat utilizing a dynamic geotechnical centrifuge.

Help Received
Father helped checking safety during tests. Mother helped plugging power source. Run tests in the stoarge area of Associated Soils Engineering, Inc. with permission.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Jerry Y. Chen

Project Number

S0304

Project Title

Time-Variant Damping Method to Reduce Vibration Damages to Civil Structures

Abstract

Objectives/Goals

The objective is to discover whether a time-variant damping coefficient in tuned mass dampers is more effective than constant damping coefficients at reducing earthquake movements in civil structures. Adjustable damping coefficients could be more effective than constant damping coefficients at protecting buildings from earthquake dangers.

Methods/Materials

The testing is performed mathematically using MATLAB. First, the performance of tuned mass dampers with a constant damping coefficient is studied. Then, the building's spring constant is increased 5%, and the damping coefficient is adjusted to see whether an adjustment can lead to reduced movements. Afterwards, a time-variant damping coefficient that varies throughout an earthquake is applied to the system to see whether it is effective at further reducing building movements.

Results

A 5% change in the building's spring constant can lead to a 30% increase in building displacements. Adjusting the damping coefficient in response to the increase in spring constant led to 18% reduced displacements. The time-variant damping algorithm led to 40% smaller building movements compared to the case of constant damping, and is very effective at minimizing building oscillations.

Conclusions/Discussion

The data from this study suggests that adjustable or time-variant friction coefficients are more effective than constant friction coefficients at decreasing earthquake-induced building movements.

Summary Statement

This projects studies time-variant friction coefficients in tuned mass dampers to see whether it is effective at reducing building movements.

Help Received

UCSD Professor Chung-Kuan Cheng offered supervision and guidance, UCSD student Shih-Hung Weng helped setup a remote connection to UCSD's computers

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Noah B. Close

Project Number
S0305

Project Title
Magnetic Flow

Abstract

Objectives/Goals
Demonstrate that a magnet placed in the flow of different liquids will reduce the flow rate of liquids with ion concentrations.

Methods/Materials
Materials: ceramic Ferrite ring magnet with a max pull force of 65 pounds, two plastic crates, measuring device (cup that was able to measure up to 500 ml of liquid), stopwatch, calculator, metering device (plastic cup with a 5/64 inch hole diameter in the bottom), tap water, salt water (5:1, 10:1 and 20:1 water to salt concentration), apple cider vinegar.

Method: The project started with stacking two crates one on top of each other, putting the metering device in the top crate and putting the measuring device inside the lower crate. Each liquid was poured through the metering device and flowed into the measuring device, with the magnet and without the magnet present. The time it took for the liquid to fill the measuring device to 200 milliliters was recorded. The 200ml volume of liquid was divided by the time to determine the flow rate for comparison. This process was repeated five times for an average flow rate to be able to minimize human error and compare each test to one another. The hole in the bottom of the cup stayed the same to eliminate variables. The recorded data was then entered into tables and graphs for analysis.

Results
The tap water test had no significant change in flow rate with and without a magnet that could be accurately recorded without human error. The 5:1 salt water had a 56% reduction in flow rate, 10:1 salt water had a five percent reduction in flow rate, and 20:1 salt water had no change in flow rate. The vinegar had an eight percent reduction in flow rate.

Conclusions/Discussion
Considering that human error is present in this project, the results supported the hypothesis. The very low amounts of ions in water made it difficult for the magnet to slow down the flow. The vinegar had a flow rate of eight percent from magnet to no magnet. With a ph of about 3, vinegar has plenty of H+ ions which, as the data suggest, contribute to the slower flow rate. The ions in the NaCl (table salt) were slowed down by the magnet. The slowest liquid was the 5:1 salt water with 56% reduction in flow rate when a magnet was present versus no magnet.

Summary Statement
Magnetic fields and their effects on the flow rate of different liquids.

Help Received
Mother helped with artistic presentation of content. Brothers and sister helped take photos of experiment. Dad helped with mathematics and understanding how to use Excel computer software.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Michael Do; Wenhao Liao

Project Number

S0306

Project Title

Microstructural and Mechanical Characteristics of Alligator Osteoderms: Applications in Bioceramics

Abstract

Objectives/Goals

Although ceramics are versatile and similar to human bone tissue, they are somewhat fragile compared to real osseous tissue, which can lead to some physical complications when they are used as bone replacement materials. Therefore, an alternate synthetic material, one that is both structurally sound as well as lightweight and flexible, might be more suitable for bone graft procedures. Through analysis of the mechanical characteristics of alligator osteoderms and comparison to ceramics and osseous tissue, a more efficient material for human bone grafts may be revealed.

Methods/Materials

A compression test was run for each alligator osteoderm sample. From the attained values, graphs were created, from which the Young's modulus, ultimate compressive strength, and toughness were calculated for each stress-strain curve. The microstructure of alligator osteoderm tissue was observed with optical microscopy and electron microscopy. The data was compared to values of the same properties for mammalian cancellous and cortical bone, to determine the viability of a biosynthetic material modeled after osteoderm tissue as a bone replacement.

Results

The stress-strain curves produced average values of 2.263 GPa for Young's modulus, 57.53 MPa for ultimate compressive strength, and 10.59 MJ/m3 for toughness. Although differing in some values from the original hypothesis, the osteoderm proved to be stronger than mammalian cancellous bone and more flexible than mammalian cortical bone. The microstructural characteristics of ligament bridging and porous structure may account for these differences in mechanical properties.

Conclusions/Discussion

While the alligator osteoderm tissue yielded a lower toughness than mammalian cancellous bone, it had significantly higher ultimate compressive strength and Young's modulus. These results suggest that synthetic material modeled after alligator osteoderms could potentially serve as a feasible replacement for bone grafts.

Summary Statement

This project compared the mechanical properties of alligator osteoderms to those of mammalian bone to determine the practicality of developing an effective biosynthetic material modeled after osteoderm tissue for use in bone replacements.

Help Received

Used lab equipment and tissue samples at UCSD under the supervision and guidance of Dr. Joanna McKittrick and Ms. Irene Chen; Mrs. Cheryl Stock provided valuable feedback on notebook and presentation.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Charles Dobbin; Seth Platt

Project Number

S0307

Project Title

Lift: An Observation of Different Shaped Conventional Airfoils Creating Lift

Abstract

Objectives/Goals

The objective is to determine which conventional airfoil will create the most lift over 3 speeds & differing Angles of Attack (AoA), find the stall, which job each may best be suited for & which airfoil performs best at each speed. If Airfoil 2 & 3 produce the most lift, then Airfoil 4 will produce the least.

Methods/Materials

Wind Tunnel, Fog machine/fluid, Epoxy, Spray & Super Glue, Airfoil Diagrams, Disk & Belt Sander, Wood Filler, Balsa Wood, Scroll Saw, Medium Density Fiber Board, Clamps, Nuts/Nut Driver, Soldering Iron, Base, Plexiglas, Ruler, Electronic Scale, Polyurethane, Acid Brushes, Screw Eyes, Drill Press, Machine Screws, Rods/Clamps and Ruler. Build wind tunnel & airfoils. Open door, place airfoil, close door & perform 3 measurements, minimum 8 seconds. Record the lift in plus or minus ounces. Open door & remove airfoil. Adjust rods to new length for next AoA. Replace in wind tunnel, repeat test, increasing speed to medium. Repeat steps for High speed and additional airfoils until testing completed.

Results

Airfoil 1:Stalled at >30 degrees (deg.) <35 deg. had steady climb to 6.9 oz lift. Airfoil 2:Stalled at >20 deg. <25 deg. had steady climb & jumped to 5.7 oz lift. Airfoil 3:Stalled at >40 deg. <45 deg. had steady climb to 20 deg. & started jumping, reached 14.6 oz lift. Airfoil 4:Stalled at >35 deg. <40 deg. had steady climb & reached 15 oz lift. Airfoil 5:Stalled at >45 deg. <50 deg. had steady climb & jumped once at 15 deg., reached 8.5 oz lift. Airfoil 6:Stalled at >40 deg. <45 deg. had steady climb, reached 9.9 oz lift. Low Speed Comparison: Airfoil 4 performed best; Airfoils 1, 2 & 5 didn't have high climb; Airfoils 3,4 & 6 had steady climb; Airfoil 2 lifted least. Medium Speed Comparison: Airfoil 4 performed best; all Airfoils had steady climb; Airfoil 2 lifted least. High Speed Comparison: Airfoil 4 beat Airfoil 3; both had steep climb, others had lower climb, Airfoil 2 lifted least & Airfoil 5 did not drop off. Average Speed Comparison: Airfoil 4 lifted the most, then 3, 6, 5 1 & 2. Airfoils 1 & 2 did not climb stead; Airfoils 5 & 6 climbed okay and Airfoils 3 & 4 climbed well.

Conclusions/Discussion

The hypothesis was supported 1/3 of the time. Airfoil 3 did well but Airfoil 4 did great & Airfoil 2 did worst.

Summary Statement

The Project is about the measurement of lift generated by various airfoils to stall.

Help Received

Charles father helped build the wind tunnel/wings & explored test parameters. His mom took photos, proofread/helped format documents & helped with display board. The teacher/judges from school Science Fair made comments & suggestions for improvement. Seth's parents transported him to Dobbin house to

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Eleanor O. Frost

Project Number
S0308

Project Title
Producing Electric Power from the Wind

Abstract

Objectives/Goals
My objective is to evaluate the output and flow mechanics of three different windmill rotor blades to optimize performance. I want to calculate the dynamic angle of attack for each experiment. My hypothesis is that the symmetric airfoil will outperform the flat bottom and control blades.

Methods/Materials
I tested two sizes (blade widths of 2"& 5") of three blade cross sections in two wind conditions (11.2 and 5.8 ft/sec) and set at 6 "Static Angles," (5 to 30 degrees) The blades were made by Flying Foam so that each 2" blade was the same thickness and weight and so too for each 5" blade. The blades were reinforced and pre-stressed (Sandia Labs 2010) during assembly. The windmill and wind tunnel were inspired by a 2009 Dept of Energy report. Before recording output, and rotational velocity data, the windmill rotor had reached steady-state. I used pink markings on one blade and a strobe light to measure rotational velocity. I averaged 6 observations for rotational velocity and 10 for output. I graphed output vs Static Angle. I graphed Dynamic Angle vs distance from rotor center and Static Angle (Petrov 2005) I graphed the Ratio of the Coefficients (Lift/Drag) for each point along the leading edge.

Results
Symmetric blades out performed the flat bottom and control at both 11.2 ft/sec and 5.8 ft/sec wind speeds. All output was at a maximum at 5 degree static angle except for four tests which showed the influence of the vector resulting from the starting vortex. Combining this vector with the dynamic angle of attack, results in the "net geometric angle of attack." The graphs of the dynamic angles along the rotors all start at a maximum value close to the center of the rotor and decrease in a sloping line as you go out the rotor blade. Just a small portion of the rotor producing near the maximum of the ratio of the coefficients is enough for the whole system to produce some level of power.

Conclusions/Discussion
The output graphs show the benefit of the airfoil and also show that that benefit decreases dramatically with increasing static angle. The Ratio of the Coefficients graphs showed that for all static angles there is some section of the blade that is producing at the maximum Ratio of the Coefficients (Lift/Drag), and area under the curve is related to output. The flow mechanics for the five and ten degree static angle setting are more productive than for the static angles greater than 15 degrees.

Summary Statement
My project is about evauating the flow mechanics and output of windmill blades to optimize performance.

Help Received
Prof. Farhat and Duraisamy were my project mentors; SC Academy meetings offered guidance on papers and boards;

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Jasmine J. Gray

Project Number

S0309

Project Title

Antibubbles: An Easy Effective Way to Make a More Stable Antibubble

Abstract

Objectives/Goals

The objective was to find an easier, more effective way to form a stable antibubble.

Methods/Materials

Room temperature carbonated water, distilled water, beer, and corn oil were placed in separate containers with clear dish soap.Two instruments were used, a plastic pipette and syringe, separately in all liquids for 60 seconds each to form antibubbles using the "Water Globule Method" (Beaty 1997). The number of antibubbles made by each instrument was counted and used to concluded the most effective instrument to use to form antibubbles.

In another test carbonated water, distilled water, and beer were heated and cooled to determined the effects temperature would have on antibubble life span. Dish soap was added to all liquids after heating and cooling.In heated liquids the "Water Globule Method" to form antibubbles was not used, instead the "Titled Method" was used. Only the syringe was used during all testing.

The last two experiments involved adding two different substances to room temperature distilled water to prolong antibubble life span. These substances were food coloring and a chemical called propylene glycol. Dish soap was added to the solution and the syringe was used to form antibubbles using the "Water Globule Method".

Results

Compared to the plastic pipette which made 32 antibubbles total, the syringe made 263 antibubbles.The longest antibubble life spans were in cold distilled water which made antibubbles lasting 64% longer the antibubbles made in room temperature distilled water and 81% longer than antibubbles made in hot distilled water. Distilled water with food coloring produced antibubbles lasting 76% longer then uncolored distilled water at room temperate. Distilled water with propylene glycol lasted 84% longer then distilled water at room temperate without propylene glycol.

Conclusions/Discussion

My results have lead me to conclude that the using the syringe in cold distilled water, with added propylene glycol would be an easier, more effective way to form an antibubble. Although, this antibubble is significantly stabler compared to a "normal" antibubble, it is still not completely stable.My results also suggest several opportunities for further study,including adding other hygroscopic chemicals like propylene glycol to expand antibubble lives even further.

Summary Statement

This project explores how different liquids, evironments, and equipment effect the stablitly of an antibubble.

Help Received

Parents bought supplies; Local stores provided some free equipment .

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Adyota Gupta

Project Number
S0310

Project Title
SmartVest: Redesigning and Revolutionizing the Bulletproof Vest

Abstract

Objectives/Goals
The purpose of my project was to seek a performance improvement over current body armor by using more economical materials in a novel way, changing the orientation and contour of armor tiles, to make a lighter, more comfortable, less expensive, and active bullet-proof vest.

Methods/Materials
Clear acrylic plastic, 1.25 inch thick, was chosen as the armor material. 18 tiles, 4 x 4 square inch, were mounted in six wooden carriers, each holding 3 tiles. The tiles in each carrier were shot with a 9-mm FMJ bullet, one shot per tile. Each carrier was placed at a different angle to the shooter, in 15 deg. increments. Damage to the acrylic tiles was assessed at qualitative and quantitative levels.
Using the results from firing at various angles from obliquity, a theoretical armor was created to induce ricochet and increase performance. The contour of the strike face was modified and resulted to a thinner armor. This increased the effective thickness of material experienced by the projectile, compared to that when the "tile" is oriented as normal. An increase in the angle of obliquity, theta, yields a greater areal density, pA, and mass efficiency, Em, resulting in better ballistic performance.

Results
It was shown that the optimum angle of obliquity was 45 deg. It further revealed that the performance of the acrylic increased exponentially as the angle of incidence was increased. In fact, at 45 deg, its performance exceeded that of ceramic, the material currently used by the US military.
The theoretical armor ensured that any bullet striking the armor would impact obliquely at or near 45 deg. By conducting a zebra analysis, it was shown that a projectile could never impact the armor obliquely. As a result, the proposed design with a modified surface contour is shown to actively induce deflection and effectively increase performance over the standard issued armor to defeat the projectile without increasing weight.

Conclusions/Discussion
With the surface modifications to the current bulletproof vest, I demonstrated that angling non-ceramic armor tiles 45 deg. led to increased performance of the armor without adding extra weight. In addition, the use of lighter materials increases comfort and mobility for the wearer.

Summary Statement
By exploiting the surface of the armor face, I demonstrated that angling non-ceramic armor tiles 45 deg. led to increased performance of a now lighter, cheaper, comfortable, economic, and more effective armor.

Help Received
Dr. Donald A. Shockey guided me through the project; Deputy Steve Lopez tested the plates; Mr. Stuart Calhoon gave access to saws and drills

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Max Halabi; Gregory Lum

Project Number

S0311

Project Title

The Effect of Dye Viscosity on the Power Output of Dye Sensitized Solar Cells

Abstract

Objectives/Goals

The purpose of this experiment was to determine if the viscosity of the dye used in the dye sensitized solar cells (DSSC) had an effect on the cells power output. It was hypothesized that the cells with the middle viscosities would have the highest power output because they would have enough anthrocyanins to power the cell and be thick enough to prevent leaking but thin enough to prevent inhibition of currents.

Methods/Materials

The dye sensitized solar cells were first created by making TiO(2) paste from 6 grams of TiO(2) powder and adding 9mL of vinegar 1mL at a time. The raspberry dyes were made by mashing raspberries in a bowl and adding different amounts of distilled water to create the different dyes. The viscosity was then measured with the formula: viscosity = grams/ (cm*sec). TiO(2) paste was spread on the conductive side of a glass slide that was then sintered on a hot plate and soaked in a dye solution. Another glass slide was passed through a flame conductive side down creating a carbon coating and the 2 glass slides were then binder clipped together and the electrolyte was added. The completed DSSC was then connected to a multimeter and data was recorded.

The materials used in this experiment were: conductive glass slides, frozen raspberries, TiO(2) powder, vinegar, iodide electrolyte, binder clips, hotplate, candle, multimeter, 50 watt lightbulb, mortar and pestel, beaker, electronic scale, and a timer.

Results

It was found that the DSSC dyed in 40% viscosity raspberry solution had the overall greatest average energy output of all the DSSC, with an average of 401.9 millivolts. Overall, the data showed trends from having rather high outputs at 100%, then decreasing until 50%, then exponentially increasing at 40%. which appeared to be the optimal viscosity for the DSSC, with a viscosity of 0.020g/(cm*sec).

Conclusions/Discussion

Based on this experiment, it was concluded that the findings supported the hypothesis that the dyes with the middle viscosities would have the greatest energy output. The DSSCs with low viscosities had low energy outputs possibly because there were problems with leaking since the solution was very thin. The DSSC dyed in 40% viscosity raspberry solution appeared to be the optimal viscosity for the DSSC, with a viscosity of 0.020g/(cm*sec) possibly because the dye was thick enough to prevent leaking and there was enough water to sustain a current.

Summary Statement

The purpose of this project was to determine the effects of the viscosity of the dye used in dye sensitized solar cells on the cells energy output.

Help Received

Father helped buy materials

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
V. Maria M. Hanes

Project Number
S0312

Project Title
Concussion Cushion

Abstract

Objectives/Goals
In a high school football season, a player takes and average of 650 hits to the head. These hits can cause severe concussions and even permanent damage. This project was designed to calculate the amount of decrease in impact when two helmets with both outer and inner absorbable layers collide versus two helmets colliding with only inner cushioning.

Methods/Materials
To begin this project, 2 helmets were borrowed from the high school football team. The helmet covers were made with a polyurethane material. Memory foam and gel insoles were then bought to be placed inside of the covers. 2 robots were then borrowed and used manually, not mechanically. The robots were disassembled and then reassembled to mount the helmets at a downward facing angle. A rail system was made using metal pieces. The track was sized at 75 in. to allow build up of acceleration. Stoppers were placed at the ends of the track and one placed 25 in. away from an end. Once the helmets were set on the track, a 1 in. elastic band was tied onto the front of 1 robot, ran through the 2nd robot and tied to the opposite end of the track. Each test began with the 1st robot, which was tied to the elastic, pulled back to the end of the track at the stopper. The 2nd robot was moved to the 25 in. stopper. The 1st robot was then released and rolled down the track until it hit the 2nd robot, causing it to roll backwards. A measurement was taken to calculate the distance it traveled. The designed nine tests, each tested 20 times, were as follows;
Test #1: (Control) No Outer Covers Test #2: Gel vs. Gel Test #3: Foam vs. Foam Test #4: Gel Vs. Foam Test #5: Foam vs. Gel Test #6: Gel vs. No Cover Test #7: Foam vs. No Cover Test #8: No Cover vs. Gel Test #9: No Cover vs. Foam. * "vs." rather means, the first material named ran into the second material.

Results
After the 9 different combinations were tested 20 times each, for a total of 180 individual tests, the measurements for how far the second helmet moved were averaged for each combination. Test#1 none (control). Test#2 46% decrease. Test#3 15% decrease. Test #4 30% decrease. Test #5 18% decrease. Test#6 29% decrease. Test#7 27% decrease. Test#8 21% decrease. Test#9 13% decrease.

Conclusions/Discussion
The experiment reported that the best combination, gel versus gel, decreaded the movement by 46%, softening the blows to the head and reducing the chances of receiving a concussion.

Summary Statement
This project was designed to calculate the amount of decrease in impact when two helmets with both outer and inner absorbable layers collide versus two helmets colliding with only inner cushioning.

Help Received
The robotics material was supplied by Mr. Mickey Bowan. Mother pulled the first robot back and released, while I messured the distance moved.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Ajay Jain; Paras Jain

Project Number
S0313

Project Title
Rapid Aerial Outdoor and 3D Indoor Mapping by Autonomous Quadrotor UAVs with CV Feature Targeting for Disaster Recovery

Abstract

Objectives/Goals
Our engineering goal is the design and construction of an affordable autonomous quadrotor based aerial photography system for rapid acquisition of accurate and up-to-date maps to aid disaster response or commercial interests coupled with indoor 3D scanning to allow responders to locate victims in a damaged building.

Methods/Materials
After developing 3 main hardware prototypes, our final drone uses a self contained image and telemetry collection unit, while initially we used the Arduino microprocessor. Our system 1) captures low resolution imagery with a high altitude drone to 2) automatically identify damaged areas where 3) low altitude drones capture very high resolution imagery. Data is 4) presented on existing aerial mapping tools used by first responders.
Within dangerous buildings, quadrotors with 3D cameras capture full 3D maps of building interiors where bodies are detected and sent to doctors for remote diagnosis. This technology saves the lives of first responders as they do not need to search inside a collapsing building.

Results
Our system captures outdoor aerial imagery, First Person View panoramas and 3D indoor point clouds. Each intelligent quadrotor drone is under $400 per unit. It has a maximum angular resolution of under 5 cm, while the GeoEye1 satellite has an angular resolution of 41 cm; our drones are almost an order of magnitude better.

Conclusions/Discussion
We effectively produce up to date, high resolution maps and models that assist with fast damage assessment in disaster response, search and rescue, and indoor survivor search. Our system has an order of magnitude better angular resolution than current satellite imaging, and each drone is under $400, compared to current UAVs ranging from tens to hundreds of thousands of dollars.

Summary Statement
We created an autonomous quadrotor system to: 1) quickly map outdoor disaster zones to prioritize rescue efforts and 2) create 3D maps of building interiors for remote diagnosis of trapped victims.

Help Received
Bruce Kawanami and our parents guided us, gave us advice, helped with motivation and ensured our safety, and our parents helped with board assembly.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Hee Soo Angela Jang

Project Number
S0314

Project Title
The Science of Traffic

Abstract

Objectives/Goals
To find the reason behind traffic and solve traffic congestions.

Methods/Materials
Procedures:
1. I built the endless round road by connecting the electric magnetic rail pieces.
2. I connected the two engines to the road instead of one, because the electricity has to be strong enough to move the 5 model cars.
3. I spaced the 5 model cars equally and started the engines, to observe the pattern of detonation waves.

Materials:
Electric Magnetic Rail Pieces
5 Model Magnetic Model Cars
2 Rail Engines
6 D Batteries
2 Controllers

Results
The 5 model cars on the road all have different speeds, because the detonation waves are caused by the different and inconstant speeds of each of the cars. After the engine is started, the cars start to go and eventually all get clumped together, even when the force of the engines are equally distributed along the road.

Conclusions/Discussion
The reason of the longer time, traffic, is the inconstant speeds of the cars as shown in the results. In order to eliminate traffic from our roads, we need to have all cars go at equal and constant speeds. The cause of unequal and inconstant speeds is because humans control the speeds of each car; humans are not robots that are able to keep an exact speed. The solution to this is to have robot cars with equal mass that will have each car go at a constant speed, and also have cars go at perfectly equal speeds to each other.

Summary Statement
My goal was to find the reason behind traffic and solve it.

Help Received
Mother helped glue paper on board.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Wei Jing; Steven Tan

Project Number

S0315

Project Title

The Effects of Man-Made Structures on Wind Patterns

Abstract

Objectives/Goals

Urban heat islands cause uneven distributions of heat between urban and rural areas. Wind is one way to direct heat away from cities. Analyzing building structures' effect on wind flow can help select locations with maximized wind speeds for more efficient turbine use. New buildings and cities can be designed to generate wind flow that maximizes the usage of natural energy.

Methods/Materials

Data was collected from 11 locations in 2 minute intervals at the Gabrielino High School campus using anemometers, the Apple application SPARKvue, and an Airlink device that connects to the SPARKvue software through bluetooth. The data included the average wind speed, the maximum wind speed, wind direction, temperature, and barometric pressure of the 2 minute intervals. Another experiment involved using Particle Image Velocimetry (PIV), capturing the movement of neutrally buoyant particles moving across steps constructs that represented the steps of the bleachers. To parallel the PIV, 4 additional points were added on the bleachers in hopes of comparing the two experiments.

Results

The data showed that urban structures create localized areas with higher wind speeds. The taller the building, the stronger the updraft of wind is created over the structure. A difference of 3 meters in height between area B and both areas A and C induced an average increase of 2.5 km/hr in wind speed of the higher area B. When warmer areas are surrounded by cooler denser air, there are surges in velocity. The temperature of the football field causes the wind to increase in velocity by an average of 1.65 km/hr over 119 meters. A series of T-tests revealed significant differences in locations, indicating the structural impacts on wind flow. A weak correlation was found between height and wind speed with the data from the bleachers.

Conclusions/Discussion

As the temperature difference widens, wind velocity increases, as seen in the increase in wind speed across the field. General wind direction reflects the effects of local orography on wind flow. On the field, wind normally heads north or northeast due to the placement and elevation of surrounding houses. The parallels between the data from the PIV and the bleachers are currently being analyzed. Preliminary analysis indicates that wind increases as it travels up the steps, despite creation of eddies. Thus, it is possible to predict prime locations for setting up wind turbines.

Summary Statement

Analyzing and quantifying changes in wind speed due to building structures

Help Received

Daniel Araya helped us conduct the experiment using PIV; Aiwen Miao (mother) helped us organize our data on Excel; participants in Southern Junior Academy of Sciences; Eileen Tan (sister) helped record data; Matthew Escara helped review our research paper; Kevin McClure gave us suggestions to improve

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Larson T. LeDuc

Project Number
S0316

Project Title
Slowing the Flow: Saving Society from a Tsunami

Abstract

Objectives/Goals
If an object in water can change the flow of the water and decrease its momentum, could a structure be placed in the path of a tsunami to weaken its impact?

Methods/Materials
Wave tank dimensions were 4x8x2ft. Measurement lines were made on the side & back walls of the tank & the top of the continental shelf. When a 25-lb weight was dropped, the lever forced a hinged flap to raise, producing a wave. 2in tall shaped wood dowels with diameters of 1/4 to 3/4in & were used to simulate structures. They were mounted on the continental shelf using brad nails which had the heads cut off. Three cameras were located at various angles around the tank. One was positioned to view the continental shelf & the measurement lines from above to measure the wave velocity & the wave wake. The second was positioned at the side of the tank to measure wave height. The third camera was positioned above mid-tank aimed at the wall behind the beach to measure wave impact height on the back wall. Wave footage from each camera was then analyzed frame by frame & the resulting data is below.

Results
Tested Models: Control, Small Circle, Med Circle, Lg Circle, Med Square, Med Diamond, Lg Square, Lg Diamond, ¼ Round Curve, ¼ Round Inverse, L Catch, and L Shape.
Avg Wave Height (in) Results for Each Model: N/A, 6.39, 5.25, 5.05, 4.28, 4.42, 4.07, 3.89, 3.81, 3.54, 4.2, 4.9, 4.91, 5.82, 4.64
Avg Wave Wake (in) Results: 0.84, 1.05, 0.92, 0.95, 0.86, 0.92, 0.82, 0.91, 0.97, 1, 0.96, 0.9, 0.94, 0.88, 1
Avg Velocity @ 5in (in/sec) Results: 27.5, 25.5, 27, 25.23, 21.67, 24, 26.25, 25.83, 27, 27.75, 26.25, 26.67, 24.75, 27, 26.25
Avg Velocity @ 12in (in/sec) Results: 25.5, 27.75, 26.25, 27.27, 21.67, 27, 29.25, 28.33, 30, 28.5, 26.25, 28.33, 27.5, 27, 27

Conclusions/Discussion
The dowels along the continental shelf did have an effect. All the dowels changed the wave to some extent. Most shapes actually increased the velocity of the wave after the dowel. Taking all the data results together, the medium square was the most beneficial of shapes to achieve the desired effect of lessening the impact of a tsunami wave. Applying the results to real life, four 20-foot wide rectangular posts at 360-feet apart could reduce the velocity of the wave by 15-20% after impacting the posts.

Summary Statement
Testing if tsunamis can be slowed or weakened by objects on the edge of the continental shelf.

Help Received
Mother assisted in camera and wave initiation operation; both parents in tank construction.

Name(s)
Yu-chieh Lee

Project Number
S0317

Project Title
A CFD Study of the Effects of Horizontal Tail Geometrical Properties on Stability Derivatives of a Boeing 787-8 Model

Abstract

Objectives/Goals
The goal was to analyze stability derivative changes based on manipulation of horizontal tail geometrical properties of a Boeing 787-8 Vortex-Lattice model.

Methods/Materials
A Vortex-Lattice Boeing 787-8 model based on the Piano-X Boeing 787-8 geometrical report was set up in the CFD program SURFACES under cruising conditions. Two varying flight conditions were modeled with different flow stream properties in angle of attack, angle of yaw, roll rate, pitch rate, and yaw rate. After HT geometry was manipulated based on 10 geometrical variables into 8 models (including the control), stability derivatives related to lift, drag, and rotational moments were calculated using the function of the vortex-lattice grid console and stability derivatives at both flowstream.

Results
Because over 2720 variables were important in the result, the general trends found were shown instead. HT span, area, arm, volume, and aspect ratio were shown to be directly related, while HT geometric chord inversely related to lift-related and drag-related derivatives, dihedral effect derivative, pitching moment, and distance between the neutral point and CG. Increasing location of centroid with taper ratio was shown to increase longitudinal stability. Sweep, dihedral, and washout were shown to be directly related to directional stability derivatives while inversely related to side force variation, increasingly so at more turbulent conditions.

Conclusions/Discussion
Increasing HT length-related geometrical variables were suggested to increase longitudinal stability, lift to drag ratio until stall drag, and dihedral effect, but decrease directional stability coefficient and side force derivative. However, the lateral instability from increasing HT length-related variables was shown to be reduced by the direct, though insignificant, relationship of incidence angle and sweep to dihedral effect coefficient and side force derivative. From the trends found, five mathematical equations considering stability based on varying HT geometrical properties, and a Boeing 787-7 horizontal tail suggested to be more favorable toward stability than tested models was developed.

Summary Statement
The study found trends between HT geometrical properties and stability at Boeing 787-8's cruising conditions, and developed a horizontal tail indicated to be more favorable toward stability at cruise than the tested horizontal tails.

Help Received
Mother helped make board; Mr. Antrim proofread and gave advice toward project, giving presentation opportunities before science fair; Snorri Gudmundsson, a Surfaces software developer, gave advice on fixing CFD program and online sources regarding derivation and analysis of stability derivatives.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Sean T. Luna

Project Number
S0318

Project Title
Seismic Vibration Control: Finding the Best Strategy for Minimizing Damage to a Structure During an Earthquake

Abstract

Objectives/Goals
The objective of the experiment was to determine the most effective mechanism to reduce structural vibration during earthquakes.

Methods/Materials
A plywood and metal structure was constructed and installed on a shake table, which was designed to to simulate an earthquake. Devices such as a tuned mass damper and base isolator were installed in different configurations and combinations on the building and were tested. Each earthquake engineering strategy was evaluated based on the model building#s sway relative to a rigid structure mounted on the shake table. The extent of the usefulness of each device was determined based on video of the test, viewd at a slower speed. To maintain a consistent shake magnitude, only the intervals during which the shake table was moving at a specific speed relative to a distinct, immobile entity were assessed.

Results
The base isolator and mass damper combination, with the mass damper located at the top, was the most effective. However, the system using only the mass damper located at the top was the least effective, allowing the most sway. When the base isolator and mass damper were used in tandem, effectiveness decreased as the damper was placed progressively lower on the structure. However, the opposite effect was observed with the damper alone, with effectiveness increasing as the damper was situated lower and lower on the structure.

Conclusions/Discussion
Every system provided a significant improvement over not having any control mechanisms at all, indicating the importance of vibration control during earthquakes. The experiment also demonstrated the importance of a holistic approach to earthquake management; the base isolator and mass damper interacted at times, affecting each. When used together, a mass damper located near the bottom of the structure interfered with the base isolator, allowing more sway than the isolator alone. When located at the top, it was able to nearly eliminate the remaining sway not prevented by the isolator. When used alone, the mass damper was ineffective when located at the top; the amount of sway near the highest point of a building was simply too much for the damper to compensate for. Instead, it was most effective near the bottom, where the building was moving less. Without the distinction between combined and separate mechanism, earthquake management strategies can work to each other's detriment, ultimately destabilizing the structure.

Summary Statement
This project determines the most effective combination and configuration of earthquake-control strategies to find the ideal earthquake protection system for a structure.

Help Received
Father provided advice for the construction of the apparatus.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Kai E. Marshland

Project Number
S0319

Project Title
The Effect of Disk Number on Tesla Turbine Efficiency

Abstract

Objectives/Goals
The project examined Tesla turbines to measure how changing the disk number changed the efficiency of the device.

Methods/Materials
A Tesla turbine was constructed, using bearings, a dowel, and old CDs. Powered by a vacuum blowing out air, the turbine rotated, lifting up a weight, which was timed. The turbine was reassembled with a different number of disks, and the experiment was repeated.

Results
More disks allowed the Tesla turbine to raise the weight faster, therefore giving it a greater efficiency, up until seven disks, where the device was wider than the vacuum nozzle.

Conclusions/Discussion
More disks dramatically increase Tesla turbine efficiency, likely due to a greater surface area to utilize air flow.

Summary Statement
This project measured how changing the number of disks on a Tesla turbine changed its efficiency.

Help Received
Borrowed tools from friend; Father helped edit

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Dillon M. Patel

Project Number

S0320

Project Title

Perching a Fixed Delta M-Wing MAV: Year 2

Abstract

Objectives/Goals

The perched landing maneuver allows a fixed-wing aircraft to land on a specified point with minimal horizontal and vertical velocity, permitting the vehicle to safely land in adverse terrain while decreasing energy expenditure. The deepstall maneuver, demonstrated in avian landings, is the most pragmatic approach toward perched landing.

Methods/Materials

A novel fixed wing MAV with an M-wing configuration and variable incidence tail was designed and aerodynamically verified. Based on previous aerodynamic analysis, a preliminary design was developed through modifications to the conceptual design through Solidworks. Design changes from the conceptual design include the addition of a fuselage for structural integrity and electrical component housing, a detailed design of the tail hinge, and a size increase of the wing tips to a tip airfoil of three inches for manufacturing reasons. Materials were selected based on their strength to weight ratio and durability. Specific materials used in the preliminary design include Pink Extruded Polysterene foam core, the primary structure, with a biased stitched layer of carbon fiber and 8.5## carbon spars length with a 0.138## radius to reinforce the wings. Preliminary structural testing was conducted in Solidworks on the carbon fiber spars, and the max stress at the base of the wing was 3.159e6 N/m2 and 61.0N/m2 was below the factor of safety. A wind tunnel model was constructed out of wood via CNC machining and 3-D printing, with modifications to mount onto the wind tunnel force balance.

Results

As the angle of attack increases, it is evident that the flow remains attached with minimal vorticies. At a 40° tail deflection, the flow remains attached with minimal vortices, with a large increase in lift. The maximum lift coefficient of 1.56 occurs at a 15 degree angle of attack and 40 degree tail deflection angle, while the largest drag coefficient of 0.017 occurs at a 20 degree angle of attack and 40 degree deflection angle.

Conclusions/Discussion

Results confirm aerodynamic and structural testing, where lift and drag are comparable to previous analysis, while flow proves to be attached with minimal vortices.

Summary Statement

Using perching methods to analyze the fesability of a Delta M-Wing MAV with a variable incidence tail.

Help Received

Daniel Nelson and Dr. Gustaaf Jacos

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Karen V. Pham

Project Number
S0321

Project Title
Go with the Flow: The Effect of Solute Concentration on Viscosity

Abstract

Objectives/Goals
The objectives are to determine if varying concentrations of sugar and salt affect the viscosity of water, and if so, see which solute has the greater effect on viscosity.

Methods/Materials
A falling ball viscometer was constructed using a 120 cm plastic tube capped on one end and sealed with clay, tape, rubber bands, and plastic wrap. 40 different sugar and salt solutions were prepared, ranging from 0.04 M to 0.80 M in increments of 0.04 M. A stopwatch was used to measure the amount of time it took for a stainless steel ball bearing to travel through 1000.00 mL of the solution. Each trial of each solution was videotaped, and the recorded video was imported into Windows Movie Maker to ensure the accuracy of the recorded times. This time was used to find the velocity of the ball bearing so that the viscosity of each solution could be calculated using the velocity, the acceleration due to gravity, the radius of the ball bearing, the densities of the ball bearing and the fluid, and the volume of the ball bearing.

Results
The average time of all trials for the control solution (pure water) was 0.030 seconds, which when calculated, yielded a viscosity of 0.0107 P. A total of 410.8 g of sugar were added to 1.5 L of water, resulting in an overall increase of about 0.030 P. 46.8 g of salt were added to 1.5 L of water, resulting in an overall increase of about 0.005 P.

Conclusions/Discussion
Because perspectives can differ, neither solute consistently affects the viscosity of water more than the other. When comparing the solutions in terms of solute concentration, the sugar solutions caused a greater increase in the viscosity of water; however, when comparing the solutions in terms of grams of solute added, the salt solutions caused a greater increase in the viscosity of water. Regardless of the solution, the addition of solute resulted in a near linear increase in the viscosity of water. Equations for the best fit lines of the graphed viscosities were created; using these equations, a scientist could potentially find the solute concentration of a body of water (e.g. the salinity of an estuary) if the viscosity is known. Said scientist could then deduce the living conditions of organisms that dwell in the body of water. In this way, the solute concentration of a body of water can be found with only knowledge of the solute within the body of water and the viscosity of the water or vice versa.

Summary Statement
This project examines the effect of various solute concentrations on the viscosity of water and explores the differing relationships between the viscosities of sucrose water and saline solutions.

Help Received
Materials were lent by cousin; Tube purchased by father; Sister took pictures and videotaped; Ms. Judy Fusco verified the equation for viscosity; Mr. Paul Hunt provided advice.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Tyler J. Regli

Project Number
S0322

Project Title
LocFan: A More Efficient Way to Power a Jet Engine

Abstract

Objectives/Goals
I have studied various designs of jet engines, specifically Turbofans. Turbofan blades are rather simple in design; however, the efficiency could be increased.
HYPOTHESIS: I can design and build a fan blade that has a higher mass flow rate and tolerance rate than a traditional fan blade with the same surface area.
GOAL: Increase the efficiency of the blade by using these guidelines:
1. The surface area, volume, and weight of the new blade can not be larger than the original design.
2. The new blade must be able to handle its stress and impact loads without increasing blade displacement.
3. The blade must require less power to drive (be more aerodynamic in its design).
4. The new blade design must have a higher mass flow rate than the traditional design.

Methods/Materials
I will use AutoDesk Inventor (a CAD program) to design two different blade types: a traditional flat leading edge design and my own rigid scimitar design. These blades would be used on turbofan engines to power a commercial jet. Using Inventor's Stress Analysis Simulation, I will test and compare both blades in three categories: strain, displacement, and safety factor. After testing the blades on the computer, I will then print out the blades on our school's u-Print Plus 3D printer by Dimension which uses ABS plastic. The blades will be attached to a spinner (also made on Inventor and the 3D printer) and spun on our wood lathe at approximately 1200 RPM. While they are being tested on the lathe, I will use an Anemometer to measure and calculate the mass flow rate. To fully test the mass flow rate, I designed and built a fully functional model of a geared turbofan on which the blades will be mounted.

Results
My blade design proved to perform better than the traditional blade design in the test conducted using both the virtual stress analysis in AutoDesk Inventor and an actual physical test on the wood lathe. My blade decreased the strain by 5.3%, increased the safety Factor by 9.2%, decreased the stress displacement by 33.2%, and increased the air velocity and mass flow rate by 9.7%.

Conclusions/Discussion
My blade design performed better than the original blade design in all the tests.

Summary Statement
I built and tested a more efficient fan blade which performed better than a traditional fan blade design

Help Received
Teacher helped with CAD; professors from different universities helped me with my blade concept; studied designs on Pratt & Whittney and GE turbofans; reviewed designs with turbine blade engineers; used shop equipment at high school.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Yevheniya Shevchenko

Project Number
S0323

Project Title
The Effect of Different Glues on Holding Cuts in Pigskin

Abstract

Objectives/Goals
The objective of my project was to test the strength of different glues on holding 5cm incisions in store bought pigskin closed when stretched.

Methods/Materials
In my experiment I had 8 slices of pigskin, which were store bought, I then made 5cm incision in them. Then I took 8 different glues which were E 6000 glue, 527glue, G-S hypo glue, school glue, Krazy glue, superglue (gel), superglue (quick fix), and vetbond adhesive and glued each incision with a particular glue. I then left the glues to dry for 24 hours and the next day I stretched all the pigskins using a mechanism I made.

Results
In the data I collected the superglue (quick fix) was the strongest and lasted up to 3000g and still didn't rip. The Krazy glue and the Vetbond adhesive lasted up to 2000g. The superglue (gel) ripped at 650g. The other four glues, E 6000 glue, 527 glue, G-S hypo glue, and school glue ripped under 500g.

Conclusions/Discussion
I can conclude that store bought glue can be used to close cuts in pigskin and that if superglue was less toxic it could be used to close incisions made in human skin depending on the size of the wound and how deep it is.

Summary Statement
In my project I took store bought pigskin and using various glues, closed the incisions I made in them to test the durability of glues that are similar to ones used in surgery.

Help Received
Mother helped cut pieces of store bought pigskin; Mrs. Ramirez-De La Cruz helped come up with project idea and provided the necessary material for stretching procedure

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Ernesto R. Soto, Jr.

Project Number
S0324

Project Title
A Quantitative Analysis of Venturi Effect to Fabricate a Novel Prototype to Maximize Air-Intake on a Naturally Aspirated

Abstract

Objectives/Goals
Our objective was to create an apparatus that would successfully increase the intake of air, while decreasing backpressure after it passes through a velocity stack and carburetor essentially increasing the potential horsepower.

Methods/Materials
We constructed a controlled experiment in a controlled environment to determine how we could improve the air intake of a velocity stack and carburetor after each variable change we would repeat the experiment three times each.

Results
1. When the air passed through the velocity stack and carburetor without the shroud roughly 30% of air intake was lost. In actuality, we found that in front of the velocity stack the air intake speed peaked at 19.7 m/s, which converts to 44.06 miles per hour. While behind the carburetor it reduced to (average of peak speeds) approximately 13.33 m/s or 29.82 mph, consequently resulted in a 32.31 percent drop in air intake speed.
2. Adding the shroud increased the air intake speed to an average of 13.36 m/s, which is a slight margin (an increase of .08 miles per hour) of change.
3. After rotating the shroud 45 degrees the air intake speed reduction was to a lesser extent and actually increased the air intake speed to 14.23 m/s or 31.83 mph. Which turns out to be a 2.01 mph boost in air intake speed.

Conclusions/Discussion
Our conclusion is that the shroud successfully created backpressure resistance outside the velocity stack and increased the intake by 2.01 mph when rotated 45 degrees. This is an important discovery because, although a 2 mph increase does not seem significant, it can translate to a substantial increase in rear wheel horsepower.

Summary Statement
The central focus of my project was to increase the air intake of a 4-stroke internal combustion engine that has a ram-air intake system.

Help Received
Jacob Bagnell, Jim Snyder and Elizabeth Gonzalez provided the materials, time, space, and guidance

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Jordan W. Wang

Project Number
S0325

Project Title
The Effect of Airfoil Design and Angle of Attack on Lift

Abstract

Objectives/Goals
The objective is to find the optimum airfoil design and angle of attack to generate the most amount of lift. In doing so, I hope to find whether the bernoulli principle or newton#s third law have more to do with the generation of lift.

Methods/Materials
Seven airfoils and nine angles of attack were each tested in a wind tunnel. The airfoils were created with balsa wood, wooden dowels, paper, and super glue. The wind tunnel was made out of gatorboard, hot glue, a fan, plastic sheets, and a protractor. Each airfoil was paired with each angle of attack, and those combinations were tested five times each. The wind tunnel was able to measure the lift by balancing a rig made of foam on top of a scale. The rig held the airfoils in place at whatever angle of attack they were meant to be in.

Results
The third airfoil with a curved top and bottom and long curved tail produced the most amount of lift (in grams) paired with the 15 degree angle of attack. A trend in the information revealed that the 15 degree angle of attack was the high point in terms of lift for all the airfoils.

Conclusions/Discussion
I found through much experimentation that the third airfoil and an angle of attack of 15 produced the most amount of lift. Because of the large curve in the design of the third airfoil, the bernoulli effect created higher pressure zones. At the same time, a trend showing one angle of attack was best also shows that newton#s third law has as much reason to affect it as well.

Summary Statement
My project is about testing wing section designs and the angles at which the wind hits them to determine the amount of lift.

Help Received
My dad helped me construct the wind tunnel and airfoils and also oversaw testing.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Kaylie A. Ward

Project Number
S0326

Project Title
CSI: Comprehensive Spatter Investigation

Abstract

Objectives/Goals
The objective is to determine how accurately one can calculate the impact angle of a drop of blood based on bloodstain measurements, and how the characteristics of the target surface affect bloodstain formation.

Methods/Materials
In the first experiment, I dripped 4 blood drops onto paper samples for each known angle (10°-90°). I then performed trigonometric calculations, averaged them, compared the result with the known angle, and noted the differences between the known angles and calculated angles. In the second experiment I dropped blood onto various surfaces with different textures and analyzed them through the use of high-speed video. I documented the differences in the shapes of the bloodstains and noted which would be appropriate for angle calculations.

Results
Experiment 1: The largest error occurs at 90°. 30° and 40° are the values that show both precision and accuracy. Measurements at 60° and 20° show the most precision but are not accurate. Experiment 2: Only relatively smooth surfaces produced bloodstains that would be suitable for angle calculations. While the wood surfaces are smooth to the touch, they have fibers that cause the blood to disburse in an irregular pattern along the wood grain. The cloth sample scattered some of the blood and absorbed the rest. The asphalt and concrete had very rough surfaces and caused the blood to, in a sense, shatter and disburse in random patterns.

Conclusions/Discussion
Calculating impact angles from bloodstains is possible from well-formed stains. The accuracy of such calculations is dependent on the angle measured, the accuracy of the bloodstain measurements and the smoothness of the surface impacted. If a surface is rough or fibrous, the bloodstains will be irregular and thus, no longer suitable for angle calculations.

Summary Statement
CSI: Comprehensive Spatter Investigation is meant to determine how accurately one can calculate the impact angle of a drop of blood by analyzing bloodstains using trigonometric functions.

Help Received
Father helped film the experiment while in progress and print the board once complete; Used equipment at Biodynamics Engineering Inc. under the supervision of Parris Ward.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Sidney E. Wilcox

Project Number
S0327

Project Title
Comparing Horizontal and Vertical Axis Wind Turbines in Different Wind Conditions

Abstract

Objectives/Goals
The objective of this experiment is to compare the efficiency and overall production of horizontal axis wind turbines (HAWT) and vertical axis wind turbines (VAWT) in different wind speeds and in wind coming from different angles relative to the turbine.

Methods/Materials
In order to accomplish this, I built a horizontal and vertical axis turbine and, utilizing the same generator, built a base to mount the turbine on. I set up a rig where the fan had the ability to be positioned at zero and thirty degrees relative to the turbines. I measured the mAmps produced and the RPMs generated by the turbines in all combinations of conditions, such as high wind speed, zero degree angle with the vertical axial configuration and so on and so forth, until I had tested each of the combinations three times.

Results
From this experiment, the data showed that the VAWT had a higher mAmps produced and RPMs than the HAWT. The vertical turbine also produced a higher percentage of its theoretical output than the horizontal turbine, even though the horizontal had a higher theoretical output. The higher wind speeds produced a higher mAmps and RPMs than the lower winds speeds in all conditions. The angle of the wind had no significant impact on the vertical axis wind turbine, but the angle was very significant for the horizontal axis wind turbine: the average mAmps produced at thirty degrees were only twenty percent of the average mAmps produced at zero degrees.

Conclusions/Discussion
In conditions with relatively low wind speeds, the VAWT was by far more efficient than the HAWT. This result can be attributed to the fact that the HAWT has higher initiation energy than the VAWT. This means that the HAWT requires a higher wind speed in order to get started. To the contrary, the VAWT has lower initiation energy and works better in the lower wind speeds. The higher wind speeds result in a higher power available in the wind and thus a higher production. For the VAWT, there was a minimal difference because of the axial orientation: the cylindrical shape of the turbine allows it to harvest wind coming from any direction without any difference. HAWTs are a flat disk shape and, because of this, require the wind to come perpendicular to the front of the turbine.

Summary Statement
This project aims to compare the horizontal and vertical axis wind turbines in different wind conditions in order to determine which is more efficient and has a higher production in different wind speeds and different angles of the wind.

Help Received
Father helped build the turbine.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Lucas G. Wong

Project Number

S0328

Project Title

The Effect of Bridge Design on the Amount of Weight that can be Sustained

Abstract

Objectives/Goals

The objective is to see which design out of the 3 truss designs of 30-60-90 triangles, right isoceles triangles or eqilateral triangles sustain a larger weight load.

Methods/Materials

The objective is to see which design out of the 3 truss designs of 30-60-90 triangles, right isoceles triangles or eqilateral triangles sustain a larger weight load.

Results

Out of the three designs, the equilateral truss bridge ended up sustaining the most weight, holding an average of 114.08 pounds. The second best design was the 30-60-90 truss bridge which sustained an average of 74.94 pounds. Lastly the right isoceles truss bridge sustained the least weight, holding an average of 46.81 pounds.

Conclusions/Discussion

In conclusion my hypothesis was supported. My initial logic of "equally" distributing the weight with equal angle measures proved to have a role in this experiment.

Summary Statement

My project is about the effect of different bridge designs on the amount of weight that can be sustained

Help Received

None

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
David A. Zarrin

Project Number
S0329

Project Title
Turbopulse: A Hybrid Pulsating Turbine Jet Engine

Abstract

Objectives/Goals

Air transportation has become an integral aspect of today's society. The FAA Aviation Safety record documents hundreds of aircraft accidents that have resulted in thousands of fatalities caused by aircraft engine failures. Many of these accidents were caused by ingestion of birds, ice, precipitation, and volcanic ash leading to engine flame-out and numerous other malfunctions resulting in turbine failure.

The objective is to study the properties of jet engines and design a new engine concept that eliminates the common turbojet failures. In theory, the property of zero moving parts in a Pulse Detonation Engine (PDE) can be used to increase the resilience and safety of modern jet engines.

I plan to build a prototype of a hybrid pulsating turbine jet engine. Such a design would eliminate all failures caused by flame-out conditions. The new design should offer the following key properties:

-Allow safe landing after complete turbine air compressor failure

-Have the ability to recover from ingestion of foreign objects by transitioning from Continuous Combustion Engine (CCE) to PDE mode in flight

-Start the engine without turbine compressed air or an electric starter motor

-Minimize the number of moving parts.

Methods/Materials

I intend to build a jet engine prototype to demonstrate the new turbopulse concept. The prototype will be built from steel and carbon iron by machining each piece of the engine. I also plan to use some off-the-shelf components such as spark plugs and coils. The prototype will house four combustion chambers and two compression chambers.

Results

I was able to build a functioning prototype of a jet engine and use it to demonstrate fulfillment of the key objectives. The final revision of the prototype engine operates in both CCE and PDE modes. I was able to perform numerous measurements including thrust power, combustion temperature based on radiant frequency, combustion frequency based on Fourier Transforms, ambient noise, air to fuel mix, and compression ratios.

Conclusions/Discussion

The prototype experiments demonstrated the viability of building a safer turbojet engine that can operate with failed turbines and therefore tolerate flameout due to the ingestion of foreign objects and compressor failures due to bearing failure, engine seizure, and a number of other common jet engine malfunctions. The economics of deploying pulsejet engines in future aircrafts requires further study.

Summary Statement

I created a new design for a resilient jet engine that improves the safety of modern jet engines.

Help Received

Occasional help from experienced machinists operating metal machining tools.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Loren J. Newton

Project Number
S0398

Project Title
A Novel Approach to Capture Wingtip Vortices

Abstract

Objectives/Goals
1.) To design a method to "print" vortices, on physical permanent medium, like the Richter Scale recording earthquake activities, could facilitate comparison and historical analysis on the nature of the wingtip vortices.
2.) To incorporate winglet lengths and angles into the computation of induced drag and vortices, in order to save time and cost as currently the designs of winglets for various aircraft were trials and errors, build then test.

Methods/Materials
With help and reference to NASA website, I designed and built a Baals wind tunnel test rig. I also crafted 5 different winglet lengths, each had 5 different winglet angles. And there was one straight wing with no winglets as benchmark reference. All test wings were of the same weight, wing area, and airfoil shape. For each wing I mounted on the platform, I recorded the lift and drag generated in equal duration and charted the vortices at fixed distance. In other words, I had recorded a total of 390 data; 3 readings from each of the 5 trials for each of the 26 test wing.
I also derived formulas to predict the effect of winglets and vortices so as to better plan for efficient and safe operation of aircraft.

Results
Lift, drag and vortices generated did not change with respect to the various winglet lengths or angles but change with my proposed "virtual span;" the effective wingspan of wings with winglets derived from the Cosine Law based on the Lifting Line Theory. I also derived formulas to compute Induced Drag by wings with winglets, Induced Deflection Angle, and Radius of Induced Wingtip Vortices.
I knew my results were accurate because my test data agreed with my analysis mathematically. Also, the vortex sizes recorded varied reasonably with the readings of lift and drag generated. Hence, this experiment I designed and the formulas I derived were validated.

Conclusions/Discussion
1.) True measure of winglet efficiency should be by increased Lift-to-Drag Ratio, not by Lift, Drag, or Vortices' sizes alone.
2.) Length and angle of winglets could be factored into the calculation of the Induced Drag by my proposed "virtual span." 3.) Wingtip Vortices could be "printed" and that the paint coverage reflected the size of the vortices.

Summary Statement
To measure wingtip vortices graphically, and to design winglets mathematically.

Help Received
NASA Glenn Research Center Website - the Beginner's Guide to Aeronautics. My dad helped shopping for materials, supervising construction, and trouble-shooting of the test set-up.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Reagan A. Risk

Project Number

S0399

Project Title

To Surge or Not to Surge: Solutions to Coachella Valley Water Districts Canal System Water Loss (Year 3)

Abstract

Objectives/Goals

Model USBR Monograph 17 describes the surge issues causing water loss in the Coachella Valley Water Districts (CVWD) gravity fed canal system. I tested to see if the surging problem could be reduced or eliminated by adding a permanent cover to create a sealed system or by allowing water to remain in the line.

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. Last year I designed and built a model and was able to recreate the surging effects experienced. This year I attempted to create solutions within my model to minimize the water loss.

Methods/Materials

I designed a series of clear baffles and tubing, ranging from 6-10 inches in height to model the Coachella Valley Water District's gravity fed water canal system. I connected the baffles in series and then allowed 8 liters of water to flow through the system and observe location & timing of any surge/water flow issues. I ran series of tests based on (1)my control (unsealed, lines left dry), (2) sealed system with lines left dry, (3) sealed system with water left in lines, and (4) unsealed with water left in the lines.

Results

I ran four series of tests (of four tests each) using my baffle models. My control series had a dry line and the baffles were not capped; the average length of water surging in the first baffle was 5:24. In my second series of tests, I added water to the upstream line; the water surges decreased to 3:47. The third series sealed the system; the average length of surge was 3:55. When water was added to the upstream line (with sealed baffles), the surging lengthened to 5:37. The surging in the second and third baffles replicated these results.

Conclusions/Discussion

By observing my model, I can extrapolate to CVWDs gravity fed system. Surging in an open system (where it is not sealed) can be minimized by leaving water standing in the system. If the system is sealed, surging will be increased when water is left in the system. This is caused by the difference in water to air pressure.

Summary Statement

Can the water loss experienced in the Coachella Valley Water District's gravity fed canal system be minimized by either sealing the system or allowing water to remain in the lines?

Help Received