CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Taylor Bachelier; Phillip Houghton; Zachary Houghton

Project Number

S0201

Project Title

Can You Build a Working Ramjet in Your Garage?

Abstract

Objectives/Goals

The purpose of this project was to evalueate low-speed ramjet technology to see if it is possible to build and run a low-speed ramjet efficently, to get an idea of power to weight ratio, see how much power that would aquate in full scale and determine if that is enough power to power a full scale aircraft.

Methods/Materials

1. Ramjet body
2. Thrust testing cart
3. Propane delivery system
4. Air delivery system
5. Fuel ignition system
6. Digital fish scale
7. Propane tank

1. The ramjet body is fabricated.
2. The fuel system parts are purchased and set up.
3. Thrust testing cart is built.
4. Ramjet is thrust tested with 3 different flameholders.

Results

The 5 Point star flameholder obtained 0.19 Kg. of thrust on the first test, 0.15 Kg. on the second test, 0.35 Kg. on the third test and 0.26 Kg. on the forth test.
The 3 Spoke flameholder created 0.17 Kg. of thrust on the first test, 0.13 Kg. on the second test, 0.17 Kg. on the third test and 0.20 Kg. on the forth test.
The Drain style flameholder made 0.25 Kg. of thrust on the first test, 0.12 Kg. on the second test, 0.18 Kg. on the third test and 0.15 Kg. on the forth test

Conclusions/Discussion

We proved our hypothesis we were able to create a working ramjet in our garage. Our data collection proves that our low speed ramjet is inefficient in it#s current state and therefore needs improvement in power to weight ratio. Also our low speed ramjet required a lot more fuel to run full throttle then we planned for.

Summary Statement

Making a working ramjet in our garage that produces positive thrust.

Help Received

N/A

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Norman Bae

Project Number

S0202

Project Title

Magnetorheological Fluid

Abstract

Objectives/Goals

My objective was to find which tubing size and MR fluid mixture caused the greatest difference in force under different magnetic fields. In particular, how the iron particle size and amount of iron particle versus oil and grease combination affected force due to change in fluid viscosity.

Methods/Materials

The experiment was conducted using a fixture consisting of two syringes connected by tubing. Different MR fluid mixture was pushed through different size tubing to explore fluid characteristics under flow mode of operation. Permanent magnets were used to provide magnetic field. MR fluid mixture consisted of different size iron particles, light oil, and white lithium grease. Digital pull gage was used to measure the force. The syringe piston was moved slowly to keep the fluid flow speed constant for each test trial run.

Results

The results showed that the smallest (0.06 in) diameter tubing and mixture 3(smallest iron particle size and highest percentage of iron powder) performed the best. The largest 0.5 in diameter tubing and Mixture 1(larger iron particles) combination performed the worst with little difference in force under different magnetic fields.

Conclusions/Discussion

The mixture 3 with the highest percentage (71.5% iron particle, 26.2% oil, 2.4% grease) of smallest iron particles (35micron) moving through the tubing under different magnetic fields created highest difference in force under different magnetic fields. The small iron particles made significant difference in performance by reducing flow friction. It also allowed higher percentage of iron in the mixture to cause noticeable increase in viscosity under magnetic field. Mixture 3 opened up the possibility to explore force variation under different flow speeds. It is deduced from this experiment that further reduction in iron particle size would improve the performance.

Summary Statement

Using different size tubing and MR fluid mixtures, I tested the force required to move the mixture through the tubing under different magnetic fields.

Help Received

Father helped gather materials for project.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Christopher Barnum; Michael Struve

Project Number

S0203

Project Title

Fire!: A Scientific Study of the Ratio between Barrel Length and Compression Chamber Volume

Abstract

Objectives/Goals

To determine the ratio of compression chamber volume to barrel volume [using length] at which the projectile achieves maximum distance from the initial volume of compressed air in the compression chamber.

Methods/Materials

PVC pipe, potatoes, sprinkler valve, pipe cutters, scale, 9 volt batteries, air compressor, blue pipe primer, pipe glue, Teflon tape, 1'-1' pipe connectors, ball valve, deburring tool, wrenches, square, tape measurer, tape, potato cutter, PVC end cap, 1" to 3/4" elbow, 1' threaded to straight adapters.

Using a corollary of the universal gas law [V(1)P(1)/T(1) = V(2)P(2)/T(2)] to find the approximate (no friction) length of the ideal barrel, we constructed our first potato cannon, making it exactly what we had calculated for the ideal length and cutting lower, reasoning that friction would cause the actual ideal length to be less then the approximated length. Then, cutting off approximately an inch at a time, we continued to shoot and measure the distance the projectile traveled.

Results

After the first battery of tests, our hypothetical barrel length proved to be correct for 7'5" with 80 PSI [pounds per in^2] behind it. After we cut the barrel down an inch the potato steadily decreased in distance.

The data show that as the barrel length increases, the distance of the shot increases until the barrel length reaches the point where the force of friction between the barrel and the projectile and the force exerted by the pressurized air are equal. After this point, increasing the barrel length decreased shot distance, until the shot did not have enough force to exit the barrel.

Conclusions/Discussion

The distance of the ideal barrel volume to compression chamber volume is fine-tuned by seal between the projectile and the barrel, whereas the PSI behind the projectile gives a kind of "ball park" figure, an approximation to be fine-tuned based on the coefficient of friction for the barrel and the projectile. The exact nature of this relationship is to be determined by further experimentation with a spring scale or similar instrument.

Summary Statement

This project focused on the optimization of a pneumatic cannon by varying the ratio between barrel and compression chamber volume using barrel length as the independent variable.

Help Received

Girlfriend major help with notebooks, Father taught us how to assemble PVC piping and helped with compression chamber design, Uncle gave basic pneumatic cannon design, parents bought some materials.

Name(s)

Natalie Bautista

Project Number

S0204

Project Title

Does Size Make a Difference? Vertical Axis Wind Turbine

Abstract

Objectives/Goals

My goal was to discover which size turbine on my vertical axis wind turbine would produce the most amount of voltage. I had a small turbine and a large turbine and tested both of them to see which would work best. I also hoped to use Ohm's Law to figure out how other factors such as resistance affected the results.

Methods/Materials

For this project I used some common materials and some harder to get materials. My turbine mainly consisted of wood and cardboard and a few other elements such as enameled wire and earth disk magnets. The main turbine is consisted of a clear bottle.

My testing method for this experiment was simple yet tedious and I tried to keep a lot of factors constant such as the power of the fan and the amount of time I measured for. I tested both of the turbines for voltage one hundred times using a fan and a digital multimeter and averaged those measurements. I also measured the turbines' resistance and average those one hundred measurements. I used Ohm's Law to figure out the average amount of currents for each turbine

Results

My results were very surprising. I discovered that the smaller turbine had a higher average of voltage compared to the larger turbine. I also discovered that the smaller turbine had a higher amount of resistance than the larger turbine. Once I plugged those two average measurements into Ohm's Law formula, V=IR, I found that the smaller turbine also had a slightly higher average of currents when compared to the average of the larger turbine.

Conclusions/Discussion

My conclusion for this experiment is that the size of the turbine definitely affects the amount of voltage produced and the overall efficiency of the turbine. I also concluded that factors in Ohm's law can help when trying to figure out what affects the results. In this case, the smaller turbine proved to be the most effective wind turbine of the two.

Summary Statement

My project is about discovering which size turbine, the larger or smaller turbine, on a vertical axis wind turbine will produce the most amount of voltage and ultimately prove to be a more efficient source of alternative energy.

Help Received

Father helped with construction of Turbine; Mother helped turn on/off the fan while taking measurements; Friend helped me make my graph

Name(s)
Michael Chu; Steven Davies; Trent Lawler

Project Number
S0205

Project Title
The Wing Structure Effect on Lift vs. Drag Ratio

Abstract

Objectives/Goals
There are many different types of designs of wings that can be created. However, some of these designs are more desirable then others due to the change in lift and drag of the wing. An increased lift and a decreased drag on a wing can impact the fuel efficiency of the wing. We have chosen to experiment with wing designs and hopefully find a design that will increase the fuel efficiency of a plane.

Methods/Materials
We first created 1 control wing and 5 different test wings with design tweaks. We then measured the lift of each wing by hanging the wings from springs and observing the change in distance between the original and the final length of the spring. To measure the drag we attached a spring to the wing in a horizontal direction and measured the change in distance. Then we compared this to the control wing to find out the difference in force exerted on the wing, giving us the relative drag. We kept the angle of attack constant.

Results
First, the control had a lift force of .075 N. The wing we created with bumps on the top had only a 0.0042 N increase in lift; however the wing had .061 N more drag then the control. The wing with grooves on top produced a lift of .0894 N and the wing with grooves on bottom produced a lift of .0972 N. But the drag, presumably form drag, increased slightly: in the first wing's case .0069 N and in the second wing's case, .0087 N. Furthermore we created wings with indentations on the sides of the wing, which had a lift of .0474 N and an additional drag of .006 N.

Conclusions/Discussion
Side indentations lowered lift force, possibly due to disruption of airflow because of the increase in shearing forces on the air. The drag is not very bad, but it is clearly worse, so nothing is gained. The rough, bumpy textures applied to the wings only provided beneficial forces in the case of the rough top trial. This was such a small margin that it was probably an error. As for the grooves, they increase lift dramatically, while not increasing drag significantly. Unfortunately we cannot know the actual drag, simply the relative drag, so the lift to drag ratio cannot be calculated. We believe the added lift to be due to surface area that the wind must travel through on top, increasing velocity, and the bottom grooves must add to the angle of attack on the wing. Angle of attack will usually increase drag more than additional induced and form drag, so this fits with the data.

Summary Statement
In our experiment we tested wings with different designs to determine which wings had the most lift and drag in order to find a design that will increase the fuel efficiency of a plane.

Help Received
Our mentor Mr. Burns explained a couple tough aerodynamics concepts for us.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Dylan Freedman; Alexander Newton

Project Number

S0206

Project Title

Spoilers: Not Just for Looks

Abstract

Objectives/Goals

In our project, we tested the aerodynamics of spoilers to see whether there is a mathematical relationship between spoiler angle and traction produced.

Methods/Materials

To test our experiment, we constructed a wind tunnel and a spoiler. We then placed the spoiler on a scale in the wind tunnel and turned a fan on. We measured the effect of spoiler angle on traction by seeing how much the weight of the spoiler increased when in the wind tunnel. 600 observations were collected at 30 preset angles.

Results

These results were analyzed, and we constructed different regression lines for the data. We constructed linear, power, exponential, and quadratic regressions, along with residual plots for each angle. We found that a quadratic line best fit the data because it explained 96.46% of the total variation in spoiler traction.

Conclusions/Discussion

Through proper statistical analysis we concluded that there is a mathematical relationship between spoiler angle and traction produced. The quadratic line best fit the data. Knowing there is a mathematical relationship could be very useful in lowering gas mileage by changing a car's weight as needed. Our project produced excellent results and was a valuable learning experience.

Summary Statement

We tested the aerordynamics of spoilers to see whether there is a mathematical relationship between spoiler angle and traction produced.

Help Received

Both our fathers helped provide advice on building the wind tunnel and provided materials for construction.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

David G. Goehring

Project Number

S0207

Project Title

Preventing Pathogen Contamination in a Robotic Arm Specimen Tube Transport System

Abstract

Objectives/Goals

To determine the optimal tube transport carrier model, robotic arm tube gripper design, robotic arm gripper pad type, and Pressure (PSI) for proper extraction and insertion of medical blood test tubes into different automated testing lines.

Methods/Materials

#Specimen tube carriers, gripper pads, grippers, an air compressor, PLC (Programmable Logic Controller),PC (Laptop Computer) Robotic arm tube transport test stand, force gauge, and test tubes.
#Different carriers were tested for insertion force with different test tubes.
#Grippers, gripper pads, and air pressure (PSI) were tested for the slip force of different test tubes.

Results

#The FD (Final Design) carrier was best for test tube insertion, because of the minimal force required for the various test tubes to be inserted properly in the carrier when compared to the other carrier, gripper pad, gripper design, and air pressure (PSI) rating combinations.
#The B (60 degree modified) Design Gripper makes more contact with the tubes to be inserted properly into the FD tube carrier when compared to the other carrier, gripper pad, gripper design, and air pressure (PSI) rating combinations.
#The BP (Black) Gripper Pads grasped the tubes the best to sustain enough force for the tubes to be inserted into the FD tube carrier properly when compared to the other carrier, gripper pad, gripper design, and air pressure (PSI) rating combinations.
#The pressure set at 100 air pressure (PSI) gripper strength made for the best gripping force to prevent the tube from slipping in the robotic gripper arm and be inserted properly into the FD tube carrier when compared to the other carrier, gripper pad, gripper design, and air pressure (PSI) rating combinations.

Conclusions/Discussion

The data indicates significant improvement in the insertion and extraction of various test tubes into different automated blood testing lines using these optimal parameters: the FD Carrier Model with the BP Gripper Pad and the B Design Gripper at 100 air pressure (PSI) gripper strength.

Summary Statement

To test for the optimal settings for the proper extraction and insertion of various test tubes in a universal tube carrier to be transported to numerous automated testing lines and analyzers.

Help Received

Dad helped get the parts and I consulted with him on placement of parts and coding.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Chase D. Hagen

Project Number

S0208

Project Title

UV-Proof Clothing

Abstract

Objectives/Goals

The purpose of this project is to identify materials with the ability to absorb UV rays more efficiently to offer better UV protection than clothing currently available.

Methods/Materials

Microscope
Green: 60% cotton, 40% polyester (0.4mm), 0.25 Yd
Blue & White: 100% cotton (0.1 mm), 0.25 Yd
Red 100% nylon (0.1mm), 0.25 Yd
Brown: 58% polyester, 40% rayon, 2% other (0.5mm), 0.25 Yd
Black: 38% polyester, 24% nylon, 38% metallic (0.1mm), 0.25 Yd
Purple 100% cotton (0.2mm), 0.25 Yd
Blue & Green: 65% polyester, 35% cotton (0.2mm), 0.25 Yd
Silver 100% acetate (0.1mm), 0.25 Yd
Red & White: 54% linen, 43% Rayon, 3% spandex (0.3mm), 0.25 Yd
Navy Blue: 100% linen (0.4mm) 0.25 Yd
Pasco GLX Explorer
Pasco UVA Sensor for Pasco GLX Explorer
Mini-USB to USB Connector Cable
Fine Caliper with #mm# measurements
Digital Camera
Computer (PC or Mac) with Pasco DataStudio# V. 1.7 or higher
3 Fluorescent Bulbs: Exo-Terra Reptile Glow 5.0 (5%UVB, 30% UVA), Exo-Terra Reptile Glow 8.0 (8% UVB, 33% UVA, # Hagen T5HO #Marine Glo# 20 W; fluorescent lighting fixture
Tested the materials were also tested against the sun for more accurate results.

Results

Graphs detail the exact results for each material. See conclusion for explanation of results.

Conclusions/Discussion

After testing all the materials and comparing the data results I determined that my initial hypothesis was partially correct. Polyester any Nylon materials do protect better against UV rays than normal clothing, which is usually made out of cotton. However I discovered that fabrics containing large amounts of the fiber Rayon are more efficient and protecting against UV rays than Polyester and Nylon materials.

Summary Statement

Finding the best fabric to protect against UV rays.

Help Received

Name(s)

Matthew P. Hamilton

Project Number

S0209

Project Title

Get the Lead Out

Abstract

Objectives/Goals

Does steel shot or lead shot produce the best pattern when fired from a shotgun?

Methods/Materials

Materials: 12 guage shotgun, shotgun shells, wood for building target stand, 200 35"x35" pieces butcher paper, large handmade compass.

Procedure:1) Cut 200 pieces of 35x35 inch butcher paper for targets. 2) Draw a 30 inch circle in the middle of each with compass. 3) Cut open one shot shell in each size and metal and count how many pellets are contained in each in order to calculate the percentage that struck inside the circle. 4) Assemble framework to hold targets at a measured 40 yards. 5)Shot each type of metal and size 50 times, each time labeling the target for identification. 6) Divided each target into four segments for counting the number of pellets that hit inside the 30 inch circle. 7) Recorded data in log book. 8) Calculated pattern density by dividing the number of pellets in the circle by the total number of pellets in the shot shell.

Results

Steel shot consistently produced higher density patterns.

Conclusions/Discussion

My conclusion is that steel shot will produce the best pattern. After firing an extensive amount of lead and steel shot shells, it is easy to see that not only will steel produce a higher pattern percent but it will also be more evenly spread throughout the target.

Summary Statement

My project is to test pattern charactaristics of lead VS. steel shot.

Help Received

Mother helped proofread report; Father helped build target stand.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Haylie Hansen; Kristen Jundt

Project Number

S0210

Project Title

Moisture Migration through Concrete

Abstract

Objectives/Goals

This continuation project progresses from examining the effects that subgrades and vapor barriers have on concrete moisture emissions; in order to study vapor pressures, which will allow us to observe the limitations of moisture testing equipment including calcium chloride testing kits.

Methods/Materials

Our research has shown us that moisture floor covering problems still occur on concrete slabs even when calcium chloride testing has been used to indicate the concrete is dry enough to accept a floor covering. This project investigates the role water vapor pressure plays on moisture migration, utilizing data loggers to record temperature, humidity, and dew point above and below the concrete samples. We exposed the test samples to different variations of heat using insulation boxes that we made.

Results

Test samples were exposed to sunlight in the testing dome when the concrete was dry and their change in humidity was 6%. When they were exposed to sunlight below the concrete the results were similar. Furthermore, when the concrete samples were wet relative humidities, when exposed to sunlight in the testing dome, decreased by 5%. When they were exposed to sunlight below the concrete the results were similar. However, the calcium chloride test kits became saturated when the wet concrete samples were exposed to sunlight in the testing dome, but the test kits did not become saturated when the buckets below the concrete samples were exposed to sunlight.

Conclusions/Discussion

Our results meant that calcium chloride kit results are affected by environmental changes because relative humidities were staying stable, but calcium chloride test kit results were varying wildly when the buckets were exposed to varied environmental conditions. The results of this experiment will assist in modifying moisture migration test procedures to insure that results will become a more accurate measure of moisture migration.

Summary Statement

We studied the limtations of calcium chloride kits, which measure moisture migration through concrete as they were exposed to varied enviromental changes.

Help Received

Kristen's dad, Hugo Kevorkian with BSK Labrotories and Associates, Eddie Robinson with Stonehard, Ashok Kahkade with Concrete Sciences

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Thomas M. Hess

Project Number
S0211

Project Title
High Performance Rocketry

Abstract

Objectives/Goals
I wanted to see what type of rocket motor will achieve the highest altitude in a high performance rocket, testing a low-thrust sustaining burn, or a high-thrust short burn motor.

Methods/Materials
I used a C6-5 and a C11-7 class rocket motors for the rocket, also used was a "scratch" built rocket with fiberglass construction. A logging altimeter to get the altitude. Also a triangulation measurement device for backup in case the altimeter failed.

Results
I found that the rocket with the C11-7 flew to 1300 feet and the C6-5 flew to 900 feet.

Conclusions/Discussion
Based on my experiment, I concluded that my hypothesis of low-thrust sustaining rocket motor was wrong. The C11-7 boosted the rocket to highest altitudes. I did have a few difficulties executing my experiment, and I plan on further research.

Summary Statement
The main idea of my project was to find what type of rocket motor would propel a rocket the highest.

Help Received

Name(s)

Tom J. Hiel

Project Number

S0212

Project Title

Load Carrying Capacity of Cylindrical Shells

Abstract

Objectives/Goals

Cylindrical shapes are commonly used in items ranging from soda cans to the body of a wind turbine. Researchers are constantly testing building materials to minimize the risk of failure. In this experiment, I analyzed how much load a cylindrical shape could carry before it buckled or the material failed.

Methods/Materials

In the experiment, I tested three different types of empty cans: an aluminum Coke can, a narrow aluminum Starbucks (double shot) can, and a steel Slim Fast can. In addition, I tested unopened cans as well as cans filled with sand. The cans were compressed in an Instron, a machine used for testing of materials. The compression test displayed a graph which showed how much the load increased until the can buckled or the material failed.

Results

All my data has been described and graphs have been created showing my findings. Using the max load found in my experiments, the stress on the cans was calculated. In addition, the weight of the curves (Showing force on the can varying with displacement) was used to determine the ratio of the energy needed to crush a can. These ratios were used to calculate the exact amount of energy required to crush the cans.

Conclusions/Discussion

The max load and stress were used to determine which can was the most efficient at carrying high load. Real world applications have been added to the project demonstrating the value of my research.

Summary Statement

How does a cylindrical shell behave when compressed by load?

Help Received

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Paulina M. Hlavacek

Project Number

S0213

Project Title

Simulating the Optimal Golf Swing

Abstract

Objectives/Goals

I strive to determine the effect of adjusting gravitational potential energy and effort force on a golf swing and the resulting ball flight. I hypothesize that the maximum gravitational potential energy, in conjunction with the maximum effort force, will produce the most desirable resulting ball flight.

Methods/Materials

I constructed one catapult-styled testing mechanism, using a 9-iron golf club as the lever and placing the fulcrum on the grip were the player's hands are used. I could adjust the weight (input force) used by adding ankle weights to the shaft above the club head and the height (potential energy) by measuring the distance from the club head to the ground.

Results

The results of the experiment were drawn using a swing-simulator at a golf shop. The simulator is a wall designed to interpret ball speed, total distance (including curved roll), carry distance (the actual linear distance), and the loft of the shot using the impact of the ball.

Conclusions/Discussion

Full swing trials were successful in achieving the maximum distance records; however, they were also inconsistent. The half-swing trials produced considerable distance with regularity, although the greatest distance never matched that of the full swing. Adding mass to the club did increase distance in some cases, but more frequently decreased swing accuracy and detracted from distance. In fact, the greatest distance was achieved in a trial with no weight added to the club.

Summary Statement

Using experimental data to understand the relationship between output distance, flight trajectory, and ball speed, and gravitational potential energy and input force.

Help Received

Used golf swing simulator at The Golf Mart Superstore (2040 Fremont Blvd, Seaside, CA, 93955); assisted by Jeffree, a sales associate; Father helped construct machine

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Dave S. Ho

Project Number

S0214

Project Title

Stress Analysis on the Length of Compression Chord Affecting the Efficiency of a Cantilever Structure

Abstract

Objectives/Goals

The purpose of the project was to discover a correlation between the compression chord of a boomilever and its structural potential to lift and sustain a principal load. The manipulated variable was the length of the compression; and the responding, dependent variable was the subsequent.The utmost successful outcome of this task would be discovering how each individual element interacts and distributes the load of the structure. It was hypothesized that the structure with the longest compression chord will hold more, but the weight would make it a less efficient boomilever.

Methods/Materials

10 boomilever structures were made with the variable components at either a constant or in proportion. A boomilever is a triangular structure with a 90 degree angle at the base supporting the structure. With the principal load affecting the end of the free supported leg, the hypotenuse of the structure would be in compression. By altering the compression chord, forces within the structure will be distributed in varying ways. In order to maintain the form of the cantilever structure, the longer leg was extended accordingly. The leg that was supported against the wall and the depth of the boomilever was set at a constant. The trusses intersected in a Warren Truss pattern at 3 points. These points were equidistant along the hypotenuse as well as the freestanding leg. These described structures were then placed on a testing rack. Weight was then poured into the free-standing angle by the means of an attached bucket until the structures became unsupportable.

Results

Unlike the previously-thought hypothesis, there appeared to be a negative correlation between the length of the compression chord and the weight it could carry.

Conclusions/Discussion

This was reasoned to be because as the length of the compression chord increases, the concentrated weight is farther away from the testing wall, making the structure more unstable with moment force. In conclusion to the experiments, as the length of the compression chord increases; the maximum potential loads, as well as the efficiency, decreases.

Summary Statement

The project is on altering the length of the chord in compression on a boomilever structure in order to find the structure that can carry the most wieght as load in kilograms.

Help Received

Father helpd with construction (ie. jigsaw)

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Tyler E. Howell

Project Number

S0215

Project Title

Kinetic Effects

Abstract

Objectives/Goals

The goals of this project is to better understand the direct factors that effect a bullets amount of kinetic energy. These factors include mass and velocity.

Methods/Materials

This project requires a Chronograph to measure the bullets velocity and an assortment of different caliber firearms with varying types of ammunition. The bullet must be weighed so the formula (half mass times velocity squared) can sucessfuly calculate the projectiles Kinetic Energy. A steel plate will be fired into to give a visual aid of the bullets force.

Results

It seems that the faster bullets had more penetrating power and less shear force but the heavy slow moving bullets had the most "punch." In fact when I fired the highest caliber round it went so fast that it did not even move the steel plate. It cut right through it while the slower heavier rounds knocked the plate over

Conclusions/Discussion

Technically mass is the amount of gravitational pull that the earth has on the object in question. Therefore a heavier bullet requires more energy to drive it forward and the more force it produces

Summary Statement

My project is about comparing the amount of Kinetic energy produced by different projectiles.

Help Received

Supervised by dad and certified NRA saftey rangemaster Ben Whitaker.

Name(s)

Chris Kazanchyan

Project Number

S0216

Project Title

Adjustable Damper for Shock Absorbers

Abstract

Objectives/Goals

I intend to use a fluid consisting of nano and micro magnetite particles, whose viscosity will react to a magnetic field. It was incorporated into a model automobile shock absorber. Since the viscosity of the fluid controls the stiffness of the shock absorber, the stiffness of the shock developed can be altered providing the driver with the drive sought instantly.

Methods/Materials

I synthesized nano and micro sized magnetite particles by mixing $FeCl_2$ and $FeCl_3$ with HCl and NH_3. The size of the particles was controlled by adjusting the rate at which NH_3 was added. Then it was suspended in tramethlyammonium hydroxide. I then poured it into two separate dampers and screwed on the top. The top of the damper was secured to a mounting device, and a set weight was hung from the rod. The time for the rod to go from completely depressed to extended was recorded. This was repeated thirteen times per damper. This recording process was repeated thirteen times again for three magnets of differing magnetic strength. A control was also done where water was used instead of the nano/micro particle solution to see if it was something beside the fluid which was reacting to the magnetic field.

Results

The times for the dampers with the strongest magnet was increased by over 50%. The two other magnets with less strength had faster times, but they were much slower than the time for the damper without a magnet. The results were consistent with both dampers, and the times for the control experiments were much closer.

Conclusions/Discussion

If this fluid were to be used in the damper of shock absorbers, the stiffness of the shock absorber can be changed by increasing or decreasing the strength of the magnetic field. This technology can also be applied in other materials where viscosity is a factor.

Summary Statement

Using magnets to change the viscosity of nanofluids in the damper of a shock absorber to alter the stiffness of the shock.

Help Received

mother helped put together board; teacher helped acquire materials

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Jaquelyn M. Lauletta

Project Number

S0217

Project Title

Tennis Players Need Resistance

Abstract

Objectives/Goals

To find whether air resistance affects the trajectory of a tennis ball. If one can predict an objects trajectory using the kinematic equations, and if air resistance is dependent on speed, then will the difference between the predicted horizontal distance and the real distance the ball lands at increase as speed increases?

Methods/Materials

Measure the initial speed of a tennis ball launched by the ball machine at five different speed settings by using a Ballistic Pendulum. Measure the change in height that the pendulum swings to and use the principle of Conservation of Linear Momentum to find the final and initial velocity. Then in a large, flat open area, launch ten balls each from the ball machine at 45o at five different speeds with spin setting off. Measure the range of all fifty ball landings. Compare the expected range of trajectory (without air resistance) to the average range of tennis balls in the experiment (with air resistance) by using the kinematics equations and the ball machine#s range results.

Results

As expected, the average range that the tennis balls traveled during the experiment increased as the speed increased. The ballistic pendulum also helped find the initial velocity of the tennis balls so that I could accurately predict the range the balls would travel without the influence of air resistance. The data from the experiment shows that from speeds 1-5, the range continues to increase, but not at the same rate as the range without resistance. Because the distances that the tennis balls travel arent the same value as that which is expected, the data reinforces how air resistance has a significant effect on the trajectory. The data also depicts how as the speed increased the effect of drag also increased, making the range increasingly different than that which is expected.

Conclusions/Discussion

This experiment shows how the force of drag on an object increases with velocity. The results of this experiment show a greater difference in projectile range between actual and calculated as speed increases. Using just kinematics equations alone will not accurately predict where an object will land because its trajectory is shortened by air resistance. These results support my hypothesis.

Summary Statement

Whether using the equations of kinematics for constant acceleration can accuratly predict where a tennis ball, affected by drag, will land.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Richard Martinez; Kaitlyn Wakefield

Project Number

S0218

Project Title

Barrier Beat Down: A Study of the Efficiency of Six Barrier Configurations

Abstract

Objectives/Goals

To measure the force of impact of a simulated vehicle on a set of barriers arranged in various configurations to determine the configuration that most safely and successfully slows the vehicle (i.e. provides the largest change in velocity over the longest time interval).

Methods/Materials

Six barrier formations were tested at three different velocities to determine what formation yielded the safest and most successful stop of the simulated vehicle. The six different configurations used in this project closely resemble the following shapes: a straight line, a rectangle, a horizontal wedge, a pyramid, an ellipse, and a pentagram.

Each configuration was tested at three velocities (the vehicle was raised to either the 30°, 60°, or 90° mark on a pendulum setup) and the deceleration of the vehicle after impact was determined. In order to find the deceleration of the vehicle (and therefore the effectiveness of each configuration), the velocity and time interval of the vehicle's travel were measured. To find the velocity, the vehicle travel distance was divided by the time interval over which the vehicle traveled. The travel time was determined by reviewing a frame-by-frame replay (at 26 frames per second) and measuring the number of frames of travel.

Results

At all three travel speeds (30°, 60°, 90°) configuration three (the "wedge") most safely and effectively decelerated the vehicle over the longest time interval (with average acceleration measurements of -63.0 cm/s2, -94.6 cm/s2, and -92.6 cm/s2, respectively). The least effective overall was the fourth configuration (the "pyramid"), which received the highest measurements for all three velocities (with acceleration measurements of -583.3 cm/s2, -1342 cm/s2, and 1608 cm/s2).

Conclusions/Discussion

The data do show that a horizontal "wedge" with spacing between the individual barricades is the most effective way to safely (largest change in velocity over longest time interval) slow a moving vehicle. These data could easily be adapted to real-world crash barricades as the simulated objects in use are in a specific ratio to their real-world counterparts.

Summary Statement

To measure the force of impact of a simulated vehicle on a set of barriers arranged in various configurations to determine the configuration that most safely and successfully slows the vehicle.

Help Received

none

Name(s)

Morgan A. Matzke

Project Number

S0219

Project Title

The Effect of Varied Tennis String Tension on the Coefficient of Restitution

Abstract

Objectives/Goals

This project will find the effect of varied string tension on the coefficient of restitution for tennis ball and racquet collision. The hypothesis is that if the string tension on a tennis racquet is changed, then the coefficient of restitution will be changed in proportion to the increase or decrease in tension.

Methods/Materials

A special test set up was built to repeatedly drop balls into racquets and capture the height of the rebound.

Results

Between five different string tensions, the height at which the ball rebounded varied by a small amount. Large measurement variations made data analysis difficult. With further reading, it was found that the coefficient of restitution of a tennis ball is much smaller than the string's coefficient of restitution.

Conclusions/Discussion

This lead to the conclusion that less string tension increases the collision coefficient of restitution and this was verified by experimental results. the hypothesis is accepted, and the coefficient of restitution is marginally affected by an increase or decrease in string tension.

Summary Statement

This project looks at the coefficient of restitution and, using error analysis to decipher the results, attempts to find out if a lower string tension actually causes significantly higher rebound heights for the tennis ball.

Help Received

Mother helped type report; Father taught me some physics; CAMS loaned me racquets; Advisor gave me good tennis advice; Sister helped clean up tennis balls

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Shane C. McDonough

Project Number

S0220

Project Title

The Intonation of Natural and Synthetic Clarinet Reeds

Abstract

Objectives/Goals

My project's objective was to compare and test natural cane and synthetic plastic clarinet reeds in order to determine which material can produce better intonation over a greater range of registers.

Methods/Materials

My materials included an electric tuner, two brands of medium strength natural cane clarinet reeds, and two brands of medium strength synthetic plastic clarinet reeds. My project involved four volunteer clarinetists as well. I had each volunteer play the concert B flat tuning note in all three octaves and used the tuner to see whether the note was flat, sharp, or in tune. Each volunteer tested all four brands of reed (I used one volunteer per trial). The level of intonation produced by each reed was recorded and converted from qualitative data to quantitative data using a scale that I created. The numbers produced by this scale were than turned into averages that indicated which reed produced the greatest range of in tune pitches.

Results

Overall, the natural cane reeds were generally more in tune than the synthetic plastic reeds. The cane reeds were more in tune in the lower and middle octaves, while the plastic reeds were slightly more in tune in the high octave. The overall averages indicated that the cane reeds produced better intonation levels over a larger range of notes.

Conclusions/Discussion

I predicted that the natural cane reeds would produce better intonation over a broader spectrum of octaves than the synthetic plastic reeds because cane is a naturally flexible (flexibility is an essential trait required for a material to carry vibrations) and has been used and perfected as reed material for a longer amount of time than plastic. This hypothesis was correct according to the overall average level of intonation. However, although the natural cane reeds had more in tune averages in both the low and middle octaves, in the high octave the synthetic plastic reeds averaged slightly more in tune. This suggests that the high octave requires less reed flexibility and shorter vibrations than the low and middle registers meaning that synthetic plastic clarinet reeds could perform as well or better than natural cane reeds in musical pieces that involve many notes in the high octave. In conclusion, the natural cane reeds had a greater range of intonation than the synthetic plastic reeds.

Summary Statement

My project examines the effects of synthetic and natural clarinet reeds on a clarinet's range of intonation.

Help Received

My clarinet ensemble director helped my in forming a hypothesis and gathering background information. My Band Director provided the facilities and the tuning equipment for my experiment. My parents helped me to pay for the clarinet reeds used in my experiment.

Name(s)
Michael R. Mendiola

Project Number
S0221

Project Title
Which Blade Design Is Most Efficent?

Abstract

Objectives/Goals
Some of my objective is to prove that their is more than using electriity and solar power. However, as you will learn windmills are some of our best invention we could possibly could of thought of. My goal is to see if the wind speed from different numbers of blades will affect the wind speed produced by a motor.

Methods/Materials
I am using a motor so that I would place the windmill in the compartment so I can test the wind coming from it. I will use a meter to test m/s and mph. In addition I will change the wind shear in order to test and see if the angle of the wind will also change it. Thier are a total of six diffrent numbers of blades. the numbers are:two, three, five, six,ten, twelve, fourteen, and fifteen. Each blade will also be angled differently to make this project more intresting as well.

Results
I found out that when changing the angles of the blades, you also can create the wind speed to either go forward or backward. Doing this was tricky, but it also led me to discover that even the most slightest change in the blades can make the wind speed go eratically. The fastes windmill was the windmill with two blades and the slowest was the windmill with fifteen blades. All the other blades did show signs of a reading, but both windmills' two and three showed the most readings by far.

Conclusions/Discussion
In conclusion, my hypothesis was proven false, but i did learn a lot from doing this project. Not only did I learn from my experiment about the angles of the windmill, but also I still love science. The windmills probably reacted like this because air needs to be supplied undrneath the windmills and not enough was between the windmill with fiffteen blades. For example, our windmills have three blades wich is probably a good idea since the windmill with three blades was also high. I hope to cotinue on with sience and do hard work on every science project at me, but until then I will work on windmills and sience.

Summary Statement
I am testing to see if windmill designs will change the speed.

Help Received
Linda helped editing, and robrt helped getting the material.

Name(s)

Stephen T. Michal

Project Number

S0222

Project Title

Reducing the Effects of Geoseismic Instability

Abstract

Objectives/Goals

The purpose of this experiment was to test the efficiency of earthquake resistant foundations. The hypothesis was that the base isolators would reduce the damage to the building, which was measured by the flex and movement of the building, and the rolling foundation would perform better than the dampened fluid foundation.

Methods/Materials

A building and the three test foundations were constructed. The slab-on-grade consisted of a direct attachment to the test table. The rolling-type base-isolation foundation consisted of four marbles, each in a box constructed of foam rubber boundaries. The simulated rubber base-isolation foundation was made up of five footings, each with four water-filled balloons. I connected the building to a table, which was subjected to repeated oscillations. The lesser degree of flex observed, the less damage the building took.

Results

Results of the test process demonstrated that the rolling-type base-isolation foundation reduces the flex and movement the most. While not as dramatic, the simulated rubber base-isolation still reduced flex and movement better than the slab-on-grade foundation.

Conclusions/Discussion

The type of building foundation can significantly reduce the integral damage of the building in the event of geoseismic activity. The base-isolated foundation satisfies this objective by absorbing, instead of transferring, most of the earth's movement and energy.

Summary Statement

The purpose of this expirement is to determine whether two commonly used seismic base-isolation foundations decrease the integral damage exerted on a building by an earthquake in comparison to the slab-on-grade technique.

Help Received

Father helped with construction of building and earthquake generator. Parents provided extra hands needed during execution of experiment by starting and stopping equipment.

Name(s)
Peter A.J. Mortimer

Project Number
S0223

Project Title
Straighten Up and Fly Right: Variable Geometry Wing Analysis on a Model Airplane

Abstract

Objectives/Goals
I believe that a variable geometry wing design will decrease drag and increase speed on a model airplane. The variable in this experiment is the angle between the wing's lateral axis and the relative wind. Whichever angle produces the highest airspeed,will indicate best performance. I am going to repeat this experiment at least three times, unless in-flight failure occurs. The control group is as follows: all of the wing angles can be compared to the straight wing configuration with the lateral axis at 90 degrees to the relative wind.

Methods/Materials
EXPERIMENTAL PROCEDURE: 1. Build a model airplane with variable geometry wing design. 2. Fly model with wing at different angles. The wing will change angles at five degree increments and airspeed will be recorded at each increment. 3. Download data from the air speed telemetry device. 4. Measure and record air speed at different angles and graph results. 5. Determine what kind of performance gains we can see with this geometry wing and model airplane.

MATERIALS LIST: SIG LT-40 Model Airplane Kit; Balsa Wood Sticks, Various Sizes; Balsa Wood Sheeting; ½ inch x 3/8 inch Aluminum Bar; Monokote Top Flite 6#; Exacto Knife; Two-Part Epoxy Glue; Water Based Glue; Cyanoacrylate Adhesive; Hobby Saw; 12# Plastic Mitre Box; Heat Gun; Handheld Iron; (4) DC Electric Servo Motors - Model HS-311 Standard Hitec Servo; Pitot Airspeed Telemetric Device (Winged Shadow Device); Hitec Digital Servo Programmer; PN 57351S Extension Wire; 5 Channel RC Radio Control Box; .40 Two Stroke Engine; Propeller; Rubber Bands; Light Weight Wood Filler; 4 oz. of Fuel-Proof Paint.

Results
The variable geometry wing was heavier, had less lift, and was less controllable. The real problem, however, was the weight imbalance. This occurred whenever the wings were swept beyond fifteen degrees.

Conclusions/Discussion
OVERWEIGHT, OVER BUDGET AND OVERRATED
Testing quickly revealed that slightly sweeping the wings back decreased our speed. Sweeping the wings back more than fifteen degrees made the model uncontrollable due to insufficient elevator authority. When the wings were swept back, the model's center of gravity moved aft. When the center of gravity moved aft, more elevator down deflection was needed to maintain level flight. This elevator deflection

Summary Statement
The central focus of my project is to determine how variable geometry wing design affects model airplane airspeed.

Help Received
I would like to thank my Mom for her excellent. typing skills. I would especially like to thank my Dad, for all the countless hours we spent at his shop, La Quinta Aviation, in Thermal, California.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Bradley E. Perek

Project Number
S0225

Project Title
Ballistics of Materials for Armor Applications

Abstract

Objectives/Goals
This project, Ballistics of Materials for Armor Applications, was initiated to test and improve the ballistic performance of certain specialty and everyday materials.

Methods/Materials
The materials include: Polyetheretherkeytone (PEEK), Carbon Fiber Pre-preg, Vltem 7201, Kevlar, Lexan, and fiberglass cloth. These materials, with the exception of Kevlar and fiberglass cloth, were cut into 4-by-6 inch sections, mounted on a cardboard sheet, and tested using a Ruger 10/22 .22-caliber (5.6) rifle. Of the aforementioned materials, the fiberglass cloth and Kevlar were previously known to fail in ballistic testing when used independently. After the initial series of tests on the materials, the samples were examined and certain measurements and characteristics were recorded, including entry hole diameter, exit hole diameter, spall, and key hole effects. With the exception of entry/exit hole diameters, the effects were determined by examining the witness plate, a piece of cardboard mounted behind the sample during testing to show the presence of penetration, spalling, or key-holing. Using available reference material, prior knowledge, and outside opinions--namely the opinions of a police sergeant and a materials engineer--, two final samples of armor were created to test the concepts determined from the initial test results. The foci of the final test included the use of a hard frontal plate to dissipate energy, the use of carbon fiber and other materials to provide stiffness and rigidity, and the use of layers to capture any fragments or shrapnel. The first sample used PEEK, Lexan, fiberglass, carbon fiber, Vltem 7201, and Kevlar in that specific order. The second sample used the same order of materials with the exception of Vltem 7201 as the frontal material instead of PEEK. The second sample also differed in its composition of 4-ply carbon fiber pre-preg versus the 2-ply carbon fiber of the first sample. The two samples were then tested and examined in the same manner as the previous test samples.

Results
Both samples were successful in preventing complete penetration of the projectile. The partial penetration that occurred was expected based on the prior information gained from references and tests.

Conclusions/Discussion
The hypothesis was correct in that the PEEK plate stopped the projectile, but was incorrect because the second sample also stopped the projectile.

Summary Statement
This project was designed to test the ballistic ability of different materials when shot with a firearm.

Help Received
Folsom Police Department Sgt. John Landahl conducted the ballistic testing. John Perek provided material samples.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Yonatan Rafael

Project Number

S0226

Project Title

The Effect of Time and Temperature on the Strength of a Seal on a Plastic Packaging Bag

Abstract

Objectives/Goals

The objective of this study was to determine the optimal temperature and time to seal a bag and achieve the maximum strength.

Methods/Materials

This experiment tests different temperatures (210-350 degree Fahrenheit) and times (1-9 seconds) to find the ideal conditions in which a perfect seal on a packaging ba was made. I used a Vertrod Packaging Machine to make 10 trials of each seal, the more washers each seal held in my measuring device, the stronger the seal.

Results

After conducting all the tests, the optimal temperature and time was 270 degrees Fahrenheit and 8 seconds. It produced seal strength of 23.33 washers. This temperature was the strongest, because the perfect amount of heat, not too little and not too much, was applied on the plastic bag, while the machine pressed. My results showed me that time was a non-factor as an independent variable.

Conclusions/Discussion

In conclusion, the optimal temperaure was 270 degrees Fahrenheit. This temperature makes the strongest seal. Time is not a factor to achieve the maximum strength.

Summary Statement

This project tests different temperatures and times in order to find the optimal conditions to make the strongest seal on a plastic packaging bag.

Help Received

Serge Berguig assisted in supplying me with the tools I needed, and the facility I worked at. He helped assemble my tests, and supervised my accuracy.

Name(s)

Riley D. Schofield

Project Number

S0227

Project Title

Acoustical Comparison of Wall Materials

Abstract

Objectives/Goals

I am trying to figure out which type of wall material reflects sound the least.

Methods/Materials

We used three different sized rooms, a tape measure, a sound reader, drywall, Mahogany plywood, sound board, particle board, plaster wall and a CD player with a CD. We measured the sound of different boards at six, twelve and eighteen inches in three different rooms.

Results

The drywall was the board that reflected the least amount of sound.

Conclusions/Discussion

I found that the drywall was the board that actually reflected the least amount of sound. I will probably go around to different buildings that have different wall materials instead of using three different rooms that are all built of the same wall material.

Summary Statement

I'm am testing what type of wall material reflects sound the least.

Help Received

I used my school's sound reader.

Name(s)
Sarah E. Seko

Project Number
S0228

Project Title
The Effect of Shape on Aerodynamic Drag

Abstract

Objectives/Goals
The objective is to determine the effect of shape on aerodynamic drag as measured in a homemade wind tunnel. After completing the first two years of work on the experiment (Phase I), the experiment was continued (Phase II) in order to accomplish the following objectives: 1) to improve the wind tunnel design, specifically to increase air velocity, 2) to devise a new method of measuring drag, 3) to calculate the drag coefficient, and 4) to gain a better understanding of the flow patterns around each object.

Methods/Materials
An eight foot long wind tunnel was constructed out of pine and plywood and powered by two box fans. Eight balsa wood objects, each with the same cross sectional area were formed. The amount of drag produced by each object was individually tested in the wind tunnel. The Drag Coefficient of each object was then calculated.

Results
The test objects ranged from a drag coefficient of 0.38 to 1.22, which represents a 31% drop in drag produced. In order from least to greatest drag produced, the objects are as follows: sphere, teardrop, sloped-diamond, sloped wedge, mini-van, wedge, diamond, and rectangular prism.

Conclusions/Discussion
The substantial difference in the amount of drag produced supports the hypothesis that if an object is designed to be streamlined, then it will produce less drag.

Summary Statement
Eight differently shaped objects were tested in a homemade wind tunnel to determine the effect of shape on the drag coefficient.

Help Received
My father aided in the construction of the wind tunnel, specifically in the use of power tools.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Kevin Shih

Project Number

S0229

Project Title

The Effect of Solutes on Drag

Abstract

Objectives/Goals

The purpose of this project was to find the effect of solutes on drag in an aqueous solution.

Methods/Materials

Materials used include: 5.0L of 0.5M Sucrose solution, 0.5M Sodium chloride solution, 0.5 M Sodium bicarbonate solution, 0.5 M Sodium carbonate monohydrate solution, and water; 2.43 m long 50.8mm black PVC pipe, Digital Scales, 37.4g 25.4mm magnetic ball, Ferrite ring magnet, 2 50.8mm plastic pipe fittings, 4 1L plastic bags, 2 magnetic reed switches, 4 copper wires, AA battery holder, Line-in input wire, 5 10L buckets, and one 500mL beaker. The PVC pipe was filled with solution and the magnet was dropped into the solution. The magnet caused each switch on the parallel circuit to close, generating two pulses of electric current. The time elapsed between the two pulses was measured using an audio recording program and line-in, which allowed the drag coefficient of the solution to be calculated (using the drag equation).

Results

The drag coefficients of the solutions were found to be as follows: Sodium Chloride: 19.05, Water: 19.33, Sodium Carbonate: 20.96, Sucrose: 21.25, Sodium Bicarbonate: 22.15. Using graphs and linear regression of the data, it was found that there was a moderate positive linear correlation between the molar mass of the solute and coefficient of drag. A strong negative correlation was found between solubility and coefficient of drag.

Conclusions/Discussion

Based on the data, the first part of the hypothesis, that molar mass of a solute will have a positive correlation with the coefficient of drag of the resulting solution is supported. However, the second part of the hypothesis, that the solubility of a solute will have a positive correlation with the coefficient of drag is not supported.

Summary Statement

The central focus of this project is to find the relationship between solute properties and drag of the resulting solution.

Help Received

Father helped with setting up the experiment and bought some materials used in the experiment.

Name(s)

Jacqueline R. Sly

Project Number

S0230

Project Title

The Efficiency of Fin Shapes of Members of the Scombroidei Sub-Order as Modeled by Mechanical Analogs

Abstract

Objectives/Goals

The purpose of this project was to determine the effect of fin shape on the speed of members of the Scombroidei sub-order This project explored the application of fin shape in underwater locomotion as well as the mechanical aspects required. It was believed that the fin shape modeled after the Thunnus thynuus would be the most efficient in consideration to speed. This fin shape is the most streamlined of the three fin types. It was believed that this streamline fin design would be the deciding factor in the overall speed of the mechanical analog.

Methods/Materials

A mechanical analog representative of all three species was designed and constructed. The analog can be divided into three parts: the circuit board, the motors and the body shell. The mechanical analog was outfitted with plastic fins modeled after the fins of each of the three species. The manipulated variable was to be dorsal fin shape, while the responding variable was efficiency in consideration to speed. Ideally, the time trials would have been run and speeds would have been recorded. However, the mechanical analogs suffered a number of failures and malfunctions that prevented the trials from being completed.

Results

The mechanical analog suffered various failures and malfunctions, both in and out of the water, and the timed trials were unable to be completed. Instead, an in-depth study of the failures and malfunctions was completed to determine the reasons that the mechanical analog failed. Several conclusions were drawn at the end of this investigation process.

Conclusions/Discussion

The data collected did not support my original hypothesis, nor did it oppose my original hypothesis. Due to irreparable malfunctions, the data collected was not based on the speed of mechanical analogs outfitted with various fin shapes. Instead the data collected was based on those malfunctions. Overall, the mechanical model was unable to create enough momentum to move forward and the stiff, hard plastic created a choppy motion that did not resemble the fluid motion of a fish. A successful mechanical analog would need stronger servos and a new design that utilized flexible materials such as rubber and thin silicon tubing.

Summary Statement

My project explored the application of fin shape in underwater locomotion as well as the mechanical aspects required for such underwater locomotion through the design and construction of a robotic fish.

Help Received

Father helped with circuit board debugging process and mother helped with grammar/spelling corrections.

Name(s)

Anshu Vaish

Project Number

S0232

Project Title

Magnetorheological Fluid Based Links in Morphing Aircraft Structure

Abstract

Objectives/Goals

The project aims to create an active hinge link to move the internal load carrying structure of the morphing aircraft wing based on magnetorheological principles. The research estimates the level of resistance (rotational shear stress) of magnetorheological fluid as a function of a varying strength external magnetic field and amount of fluid.

Methods/Materials

Rotational shear stress was determined by attaching a plastic spindle to the electromagnet. Wooden dowels of varying diameters (1.0 cm, 1.5 cm, and 2.0 cm) were obtained to vary the amounts of magnetorheological fluid and test the subsequent effect on the fluid's rotational shear stress. Each dowel was cut in two pieces with one piece attached horizontally to the other vertical piece and strings were attached to the horizontal pieces. An external dual pulley system was also erected. The dowel was then inserted into the spindle and the gap between the spindle and dowel was filled with magnetorheological fluid. For each dowel tested the electromagnet had varying voltages in 5.0 V increments up to 30.0 V run through it and identical masses were attached to each pulley until the dowel rotated five degrees. This procedure was repeated for each different diameter dowel and the masses were recorded.

Results

The rotational shear stress of the fluid stayed constant to the 20.0 V mark (10.0 g mass was needed on each pulley) and then increased to 20.0 g where it stayed constant to the final 30.0 V mark. This was true in each of the different diameter dowel experiments. Because of identical results in all three different diameter dowel experiments, it was found that rotational shear stress was not affected by the amount of magnetorheological fluid.

Conclusions/Discussion

Since rotational shear stress did eventually increase, the fluid's application in an active hinge link in aeronautics is viable. Future research would involve developing a morphing wing based on a bird's wing. This wing would contain active hinge links with magnetorheological fluid each link's rotational axis. The magnetorheological fluid would be the agent which locks the hinge in different angles. The hinge angles would be controlled by onboard computers and would change to best suit external flight conditions. By changing these angles, the overall internal structure of the wing can be morphed.

Summary Statement

The project aims to create active hinge links based on magnetorheological principles to morph airplane wings.

Help Received

Dr. Shiv P. Joshi helped me in designing the project

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Jarrod P. Wilbur

Project Number
S0233

Project Title
Wind Power

Abstract

Objectives/Goals
The purpose of the report is to find the best combination of blade length, number of blades, and angles of the blades needed to create the optimal fan settings to produce the maximum voltage while using an electric generator.

Methods/Materials
First, I needed to find my variables. I decided to find the best length, number, and angle for blades on a windmill. I decided to make the body out of PVC piping, the blades out of Balsa wood, and I received my hub and generator from an online windmill source called http://www.kidwind.org/. The wire was connected to a voltage test meter with a digital screen to give specific measurements. The balsa wood fins were eighteen inch long fins. I then used dowels that would attach to the fins so they could fit into the hub. The hub attached to the generator so that it could generate the voltage. I then started my testing. I joined the wires that were connected to the generator to the voltage indicator. To make my wind go at a constant speed, I used a heavy duty house fan. I then made a chart that would be easy to write down the results of my tests. In order to ensure my variables were tested correctly, I did each measurement eight times to keep the tests constant. The next step was to test my windmill in order to receive my results. I waited until the numbers reached their plateau, wrote the result, and turned off the fan. I then turned the fan back on and repeated the steps until I completed all eight tests. I then moved or cut the fans in order to make the new tests.

Results
In this project, I tested three different factors that affect power output in a small scaled windmill: blade length, number of blades, and angle of the blades. After testing all of the variables, I conclude that the combination of three six inch blades with at 24° angle gave the best peak of energy.

Conclusions/Discussion
I found that according to my tests six blades, not three, gave the most consistently efficient amount of energy during my tests. I also found that my two smaller angles, angles 12° and 24°, turned out much more energy then the high 36° angle. The final conclusion I found in this project was that my shortest blade, the six inch one made the most amount of energy then the other longer blades, the twelve and eighteen inch blades. I conclude from this that since the longer blades have more mass, they create more drag and therefore, less energy output.

Summary Statement
To get the best voltage from the blade length, number of blades, and angle of the blades on a horizontal wind turbine.

Help Received
Dad helped with buying material. Dad helped take pictures.

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

W. Tyler Winick

Project Number

S0234

Project Title

Wind Power: The Quadric Solution

Abstract

Objectives/Goals

This experiment was about building the windmill best suited for generating voltage. I tested the number of blades and the angle of each blade. The amounts of blades used were two, three, four, and six. The angles used were from 0° to 50°. After testing, I derived quadric formulas, predicting the outcomes for any number of blades and angles.

Methods/Materials

To be able to test, I needed a windmill. This windmill is made of PVC pipe for the base, a PVC clip to hold the windmill, a hub, a small motor that has an LED light, six metal rods, and six blades. I was able to spin the windmill by using a shop vacuum. The vacuum was mounted on the table and was a constant factor. I used a multimeter to learn the voltage generated.

Results

After initial testing, the optimum angle for the two-bladed windmill was 25° with an output of 1.941 Volts; the optimum angle for the three-bladed windmill was 20° with an output of 2.2 Volts; the optimum angle for the four-bladed windmill was 15° with an output of 2.4 Volts; and the optimum angle for the six-bladed windmill was 20° with an output of 2.39 Volts. I then did more research and derived a quadric formula giving the predicted outcomes for any amount of blades. The second round of testing found 25° to still be the optimum angle for the two-bladed windmill, 19° was the optimum angle for the three-bladed windmill, 16° was the optimum angle for the four-bladed windmill, and 21.5° was the optimum angle for the six-bladed windmill.

Conclusions/Discussion

After much testing and researching, my first hypothesis that states four blades would be the best amount of blades for the windmill was correct. My second hypothesis that states 40° would be the best angle was very wrong. There was a different angle for each set of blades: 25, 21.5, 19, and 16. I concluded that these discrepancies were due to fact that the established formulas presumed conditions that did not include dynamics such as other air currents, slight inconsistencies, and human error. The test conditions for my experiment included all of these factors. However, using the test data, I was able to derive my own mathematical formulas that accurately predicted the outcomes in my testing environment. This could be useful for people who would like to go further and build a windmill of their own to generate their own electricity.

Summary Statement

I built a windmill to test voltage output as well as creating quadric formulas to predict any outcome.

Help Received

Teacher taught me how to figure out the formulas and a physicist gave me some deeper research

CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

Jonathan B. Yang

Project Number

S0235

Project Title

Efficiency from a New Wind Turbine Design

Abstract

Objectives/Goals

I believe that propelling relatively low wind speeds through a wind tunnel to test different self designed wind turbines that vary in blade angle and length can produce a power output (watts) in a reversed current generator as measured by a volt amp meter.

Methods/Materials

Essential materials needed were cardboard, note cards, playing cards, fan, volt amp meter, and a DC Motor. My turbines were constructed in an upright vertical postion with a 360 degree spin, allowing it to capture wind from any direction. Propellers were constructed of note cards, playing cards, and other useful materials founded around the house. By building a wind tunnel I was able to concentrate the air flow of the fan into speeds of 5 mph, 7mph, and 8 mph. However, I was able to calibrate the air speeds buy building an anemometer using a block of wood, a single nail, and a sheet of copper. By driving it through a car at intervals of 5mph and stopping at 20mph, I marked the angular displacement of the copper sheet. I used this as a reference to calibrate the air speeds of the wind tunnel. Using a volt amp meter connected to the DC motor, I was able to measure the appropriate amps and volts given off each wind turbine. With both the amps and volts I simply calculated the power output (watts) using P=IV.

Results

At the present I have constructed three different wind turbines. Out of these three I was able to observe which was the most efficient. The power output of wind turbine #2, the most efficient turbine, measured at .003 watts at 5mph, .01 watts at 7mph, and .02088 watts at 8 mph. However I do wish to construct more wind turbines so my results will vary in time.

Conclusions/Discussion

I was able to support my hypothesis by producing a power output (watts) using my vertical wind turbines. As my results pointed out, out of the three turbines that I had constructed wind turbine #2 proved to be most efficient out of the three. I wish to further my research by testing on similar designs. If built on a bigger scale, models like these may end up being more efficient than traditional wind turbines. By their sleeker design and efficient method of capturing wind, it could be built within urbanized areas as well as individual homes. This will reduce our dependence for extensive wind farms and promote the construction of urbanized wind turbines.

Summary Statement

Optimizing the wind through a vertical based wind turbine.

Help Received

Brother helped build wind tunnel; Found DC Motor in the classroom with permission of science instructor; Mother helped drive the car to calibrate wind speeds