CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Daniel Au

Project Number

J0101

Project Title

The Effect of Air Temperature on Aircraft Propellers

Abstract

Objectives/Goals

The purpose of my experiment is to see if air temperature affects the speed of a spinning aircraft propeller. This experiment can help pilots and people understand more about airplanes.

Methods/Materials

Materials: clothes dryer heating element, power controller for heat, R/C airplane motor and propeller, R/C motor throttle, digital thermometer, digital tachometer. Method: hold the power to motor constant by choosing a throttle setting, then vary the air temperature by changing the temperature control, take samples of both air temperature and the propeller RPM for each variation in air temperature. Data collected is then plotted on a graph, and a computer fitted trend line is then displayed over the data points.

Results

On the first run (high throttle/torque setting) there was barely any change in the propeller RPM. On the second run, I used a medium throttle/torque setting. This reduced the airflow through the heating element and allowed hotter air to the propeller. This changed the results significantly and a relationship between heat and rpm could be seen. On the third run, I used a low throttle setting. The relationship between heat and rpm became even clearer.

Conclusions/Discussion

My hypothesis was partially correct, and partially incorrect. I thought that air temperature would not affect the speed of a spinning aircraft propeller. In the first run, there was no noticeable relationship between propeller RPM and air temperature. However, when I lowered the throttle setting in runs two and three, there was a clear relationship between propeller RPM vs. air temperature. I thought that the torque of the motor would keep the propeller speed constant even with air density changes due to the air being heated or cooled. I think it was because the higher airflow (caused by higher propeller RPM) did not allow the heating element to heat up as much, and the high throttle setting also means the torque produced by the motor is higher too. In the runs two and three, I think that it was more difficult for the motor to drag the propeller through the cooler and denser air and this caused the RPM to be lower when the air was cool. When the air was heated and less dense, it became easier for the motor to drag the propeller through the air and allowed it to speed up.

Summary Statement

I tested the effects of air temperature and density, on an aircraft propeller.

Help Received

Ukiah Aviation Flight School (John Eisenzopf) for basic aerodynamic principles and aircraft performance changes due to air temperature, my father (Derek Au) who helped me with selecting the materials, equipment and cutting the materials, and for discussion about the experiment's principles.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Ansel R. Austin

Project Number

J0102

Project Title

Silent Rotor Blades: Reducing Noise Output of Rotor Blades by Incorporating Noise-Dampening Features of an Owl's Feather

Abstract

Objectives/Goals

Rotor blades used in many home appliances, electronic equipment, and aircraft contribute to significant amounts of noise pollution, which negatively affects people's quality of life can be costly to mitigate. My goal was to design a rotor blade that is quieter than a conventional blade by incorporating noise-dampening morphological features of an owl#s flight feather into the blade design.

Methods/Materials

After doing background research, I borrowed several owl flight feathers from Santa Clara Valley Audubon Society and took photos of their special features under a microscope. Using a laptop computer and Maya 2016 software, I designed a control blade and two modified blades: one with serrated attachments on the leading and trailing edges, the other - with attachments and a fabric blade covering. I then 3-D printed the three blades and set up a testing station, which included a foam stand, an electric motor, two alligator clips, an iPhone with a decibel meter app, and a 12V battery. I controlled for background noise, then measured noise output of the motor w/out a blade, with the control blade, with modified blade #1, and with modified blade #2. I documented my research by taking photos and recording the data in my project notebook. NOTE: I am currently working on a set of modified blades for a quadcopter (FAA registered). I plan on testing their in-flight performance and including the results in my project.

Results

Modified blade #1, which incorporated two noise-dampening features of an owl flight feather (leading edge serrations and a trailing edge fringe) was on average 71% quieter than the control blade.
Modified blade #2, which incorporated three noise-dampening features of an owl flight feather (leading edge serrations, a trailing edge fringe, and a soft covering) was on average 100% quieter - virtually silent!

Conclusions/Discussion

The silent rotor blade modeled after an owl#s flight feather has potential for being widely used in civil and military engineering:

1.Reducing ambient and environmental noise from axial fans in home appliances and electronics, AC, and whole house fans.
2.Reducing noise pollution from aircraft and inside of aircraft cabins.
3. Military applications could include increasing the stealth of manned and unmanned aircraft.

Further research is needed in order to identify materials suitable for producing the modified blades.

Summary Statement

I was able to design rotor blades that are virtually silent by incorporating noise-dampening features of an owl's flight feather into their design.

Help Received

Mrs. Nancy Franklin, VCJH Technology Department Chair - making the school's 3D printer available for me to print and re-print the blades; Santa Clara Valley Audubon Society - lending owl flight feathers (with permit);my mom and dad -getting the necessary supplies and supporting me

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Sanskriti Balaji; Harshikasai Kellampalli

Project Number

J0103

Project Title

Riding On Air: How a Hovercraft Hovers

Abstract

Objectives/Goals

Our objective/goals was, if a certain amount of air (depending on the weight of the objects being placed on it) is let into the hovercraft then the hovercraft will hover.

Methods/Materials

We followed the instructions on Science Buddies to build our hovercraft. The three most important variables in this engineering/aerodynamic project would be the wood base, plastic sheet, and the leaf blower.

Results

If a certain amount of air is not let into the hovercraft, the hovercraft will not be able to rise or hover. Air is fluctuating inside the hovercraft at all times for it to be in motion. Also, the hovercraft speed (measured in cubic feet per minute) depends on the amount of weight the person sitting on it is.

Conclusions/Discussion

Our hypothesis was true. There needed to be a certain amount of air measured in cubic feet per minute for it to be hovering. Also, we learned that if there is too much air pressure in the hovercraft, it will burst and tear the plastic. We met our design criteria, which was that the hovercraft needed to hold a person that weighed at least 112 pounds.

Summary Statement

We are testing how a hovercraft hovers with a certain amount of weight, and how many cubic feet it can travel.

Help Received

Our dads helped us build the hovercraft.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Akhilesh V. Balasingam

Project Number

J0104

Project Title

Galloping Prisms: On the Optimal Design of a Novel Aeroelastic Energy Harvester for Remote Sensing

Abstract

Objectives/Goals

My research focuses on the design and optimization of a novel small-scale generator which extracts energy from flowing air. This work responds to the growing interest in monitoring the built and natural environments using self-powered wireless sensors. State-of-the-art sensors, operated sporadically can be sustained with only about 0.1 mW of power. Alternatives to solar power are needed to support such sensing applications indoors, in the shade and at night. Though airflow and wind are ubiquitous, research on efficient flow-based milliwatt-scale generators has just begun.

Methods/Materials

After a survey of existing devices, I prototyped a family of novel, inexpensive, low-maintenance flow energy generators based on principles of aeroelastic flutter. My device consists of a flexible metallic beam cantilevered at one end and fitted with a lightweight prism at its free end. The flow-induced periodic flexure of the beam generates AC power via a piezoelectric transducer (PZT) affixed to it.

The shape, orientation and dimensions of the prismatic attachment, beam length, flow speed and load resistance are the major design and operating parameters that determine the performance of my device. I designed and executed a matrix of experiments in which I varied each parameter individually while controlling the others. In addition to electrical data, I obtained mechanical data and flow visualization videos to optimize prism shapes for increased flow separation effects and flutter.

Results

With increasing beam length the power delivered by the PZT increased and then decreased, revealing the existence of an optimal design point. Similarly, the increased flow interception capability of bigger prisms is offset by their larger mass. In my experiments, I observed well over a 1,000 operating conditions, characterized competing effects and empirically narrowed the parameter ranges corresponding to superior designs. I show for instance that about 0.4 milliwatts of average power can be obtained on a sustained basis with a 14.7cm beam and a prism with a 10cmx6.5cm face. Several LEDs connected in series could be lit showing instantaneous power delivery in the several milliwatt range.

Conclusions/Discussion

I designed, built and tested a novel family of flexure-enhanced energy harvesters which can deliver sufficient power under modest wind conditions (< 5 m/s) to emerging low-power remote sensor nodes.

Summary Statement

Using inexpensive, easy-to-obtain materials I have demonstrated a novel family of miniature (volume ~ 0.0005 m^3) aeroelastic energy harvesters, which can power remote sensor nodes, without batteries and wired power, at modest wind speeds.

Help Received

I would like to thank my science teacher Mrs. H. Mackewicz for her helpful discussions, and my brother for explaining energy conversion concepts. I would like to thank my dad for his encouragement throughout the course of this experiment, and my mom for purchasing the necessary materials.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Jeanie C. Benedict

Project Number

J0105

Project Title

The Effect of Winglet Cant Angle on the Speed of a Windmill

Abstract

Objectives/Goals

Winglets are used on airplanes to reduce the wingtip vortex and associated drag, thereby improving performance. I wanted to see whether a green energy-producing windmill would also be more productive by adding winglets, therefore creating more energy at a faster pace. My objective was to discover the cant angle on a windmill blade that allows optimum performance. A cant angle is an inclination from the horizontal plane. I hypothesized that the 35 degree cant angle winglet would perform best because it would balance out the loss of surface area of the blades with decreasing the vortices which cause drag.

Methods/Materials

I made a model windmill using a box fan and attached metal winglets to the blades. I used two more box fans to simulate wind and created a wind tunnel out of paper tubes to straighten out the airflow. The assembly was placed behind the windmill. The cant angles were 20 degrees, 35 degrees, 65 degrees, and 90 degrees; the control was 0 degrees. I used a digital photo tachometer to measure the revolutions per minute (RPM) of the blades. Three trials of ten measurements per angle were conducted. Between trials, the wind-producing fans were turned off, and everything was allowed to fully stop before starting the next one.

Results

The test results showed there are benefits to adding winglets to windmills. For the cant angles tested, there was a maximum one at which the windmill rotated the fastest and any angle higher or lower resulted in slower speeds. More specifically, the 35 degree cant angle winglet was the optimum angle and thus validated my hypothesis. The difference in the average RPM between the winglet with the 35 degree cant angle and the average of the control was 6.8 RPM.

Conclusions/Discussion

My objectives of discovering whether winglets would improve the performance of windmills and finding the optimum cant angle of that winglet were fulfilled. After creating a simulated windmill and wind source, I found that the 35 degree cant angle winglet allowed the fan blades to spin at the highest speed. In future work, I would test more cant angles to determine whether there might be an even better winglet cant angle to use. This work could be applicable to commercial windmills to produce more green energy quicker.

Summary Statement

In my project, I studied the effect of different cant angles of winglets on the speed of a windmill.

Help Received

I built and tested my project by myself. My dad helped me to understand the forces acting on the blades and winglets.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Madisen F. Berube

Project Number
J0106

Project Title
The Effect of Textures on Rocket Shuttle Drag

Abstract

Objectives/Goals
The objective of this study was to find out which surface texture reduces drag the most on rocket shuttles.

Methods/Materials
The project required the use of 4 foam cones (3.88in x 8.88in) with different textures (one smooth and 3 textured using heat to create dimpled, zig zag, and lined cones), a fixed wind tunnel approximately 8in wide and 12in tall, fan, and a spring scale (g). The spring scale measured the difference in weight for 50 trials on each cone when the fan (wind) was on versus off to determine the drag.

Results
The zig zag textured cone had the least difference of 2.90g on average which meant there was less drag and therefore greater drag reduction. The dimpled cone had the least amount of drag reduction with an average of 5.60g difference in weight measure.

Conclusions/Discussion
The results of the rocket cone model shows that surface texture does affect the drag. Reduction of drag is important to save fuel in order to make launching a space shuttle more cost efficient and environmental.

Summary Statement
I tested different textures on foam rocket cones using a homemade wind tunnel to find which texture reduced drag the most.

Help Received
I did not receive any help while doing this project. I built and preformed this experiment by myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Chloe Brandon

Project Number

J0107

Project Title

Bio-Inspired Wind Power: Can a Whale Help Us Design Better Wind Turbines?

Abstract

Objectives/Goals

The objective of this task was to determine if the power output of a three blade horizontal axis wind turbine could be improved by incorporating simple whale tubercles into the leading edge of the blades. Tubercles are bumps found on the fins of whales, and have been shown to reduce drag as the whale moves through water.

Methods/Materials

Balsa wood turbine blades were attached with bamboo skewers to a compact disk. This assembly was then attached to a DC motor and placed in front of a box fan. The power output from the DC motor was determined using a multi-meter, as the turbine rotated from the wind generated by the fan.

Results

Measurements of power output were performed on modified turbines and control turbines at different fan speed settings. At all speeds, the tubercle modified blade design resulted in improved power output. The increase was greatest at the highest fan speed setting.

Conclusions/Discussion

The project demonstrated that the power output of a horizontal axis wind turbine can be improved using a simple tubercle design added to the leading edge of the blades. This was verified using a model three blade turbine constructed from balsa wood.

Summary Statement

I demonstrated that the power output of a simple wind turbine can be improved if whale tubercles are incorporated into the leading edges of the blades.

Help Received

I came up with the idea for this project after investigating ways to improve wind turbine performance. I designed and assembled the wind turbines and blades. My father taught me how to use a multi-meter to measure voltage and from the motor, and convert it to power.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Ivy A. Brott

Project Number

J0108

Project Title

Paddling for Power

Abstract

Objectives/Goals

The purpose of this project was to test hydroelectric water turbine efficiency.

Methods/Materials

Many materials were used throughout the project but the turbine itself is mainly constructed of PVC pipe, wood and plexiglass.

Results

After multiple tests, it was concluded that the paddles with the 45 degree angle to the axle were able to produce the most electrical current.

Conclusions/Discussion

The results of the experiment, proved the hypothesis wrong. After much thought where there might have been error(s) or unforseen variables, it was concluded that there were small possible errors or variables but not that could greatly impact the outcome. Ultimately, the 45 degree paddles were the most efficient source of hydroelectric power, therefore, if I were to build a large water turbine to produce electricity, I would use that type of paddle.

Summary Statement

This project was used to test the efficiency and production of green energy using different paddle shapes on a hydroelectric water turbine.

Help Received

Name(s)

Sophia G. Cotman

Project Number

J0109

Project Title

Swim Caps: Do They Really Make You Faster?

Abstract

Objectives/Goals

This project was designed to determine if wearing a swim cap while swimming increases your speed. My hypothesis was that using a swim cap would help increase your speed significantly.

Methods/Materials

I purchased two Barbie dolls for this experiment. I shaved the hair off of one of the dolls and left the long hair as-is on the other doll. I then placed weights inside the dolls# heads to give them equal weight. After that, I dropped both dolls into a pool and timed their underwater descent to see if the difference was significant. Immediately thereafter, I placed tape on the head of the doll with long hair to create a "swim cap" on its head and the process was repeated.

Results

The doll with no hair traveled the fastest, and the doll with the "swim cap" traveled slower then the bald doll, but faster than it did with its full head of hair. The doll with hair was the slowest of them all.

Conclusions/Discussion

My conclusion is that swimmers who want to swim faster should definitely wear swim caps and, if they are Olympic swimmers going for the gold, they should shave their heads and be bald

Summary Statement

I showed that using a swim cap makes swimmers a lot faster by dropping two dolls (one with hair and one without) underwater and timing their underwater descent.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Gil T. Dominguez-Letelier

Project Number

J0110

Project Title

Parachutes and Drag

Abstract

Objectives/Goals

The goal of this project was to find out what really is the best material for parachuting by calculating its drag. This project involved 8 trials in which a Polyester, Silk, Cotton, and two nylon parachutes were dropped. The drag of it was calculated by timing the drops, finding the velocity, then using the drag equation. All tests were controlled except the variable of weather.

Methods/Materials

In this experiment, I used 5 varieties of cloth, Sewing machine, Strap material, A tall building, 50g weights, Duct tape, Altimeter, and a Stop watch.

Procedure

First, I gathered the materials and made 5 different parachutes. I acquired a cotton parachute, silk parachute, polyester parachute, and got 2 premade parachutes made out of nylon.

After the prep, I figured out all the equations needed for the experiment. Which were the Drag Equation, Tangent equation for height, Velocity equation, Coefficient of Drag Equation, and the Surface area of a circle equation.

Then I chose and measured a building by taking the angle from where we would observe the drops and applying the tangent equation of height . The height was 20.7 m

I then timed and took pictures of dropping the parachute with five trials for each type

I then analyzed the times applied the data I had into the previously mentioned equations to calculate drag.

Results

The results of the experiment turned out well. The polyester parachute was bottom with worst time, velocity, and drag. The Nylon Blue and yellow and the cotton parachutes were in the middle, and the silk and nylon black and white parachute topped. Timings went smoothly as no wind had been encountered during most of trials. As expected however, silk was dominant.

Conclusions/Discussion

According to the data, the silk and nylon proved to be the most efficient. The silk had not only had the most hang time, but drag was not as present as say polyester which had the most drag. Nylon was very close to silk with .01 seconds different from the silk. In conclusion, my data proved the silk and nylon are the best material out of the five. Even centuries ago, people used silk for parachutes not even mathematically knowing its advantage, yet for them just felt effective, which it is.

Summary Statement

This project is figuring out the best material for parachutes by calculating its drag

Help Received

I had help from my science teacher Mr. Shirjian. He helped me develop my theory for this project. I also had help from a university graduate Levon who helped me correct my calculations.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

James D. Fagan

Project Number

J0111

Project Title

A Wind Tunnel to Examine Subsonic Aerodynamic Effects on Airfoils for Future Flight on Mars

Abstract

Objectives/Goals

My objective was to gain an understanding of aerodynamic principles that I could then apply to my design of an observation drone aircraft for Mars exploration.

Methods/Materials

I designed and built 2 closed circuit wind tunnels, 1 to measure lift force, and another to measure the drag force on several different airfoils that I also built. I used a vacuum cleaner for my air source. Forces were measured on a balance scale. I conducted over 500 individual tests to see how each airfoil would respond to different air speeds and different angles of attack. I made string probes to allow me to visualize the airflow around my airfoils while being tested.

Results

1. I found as airspeed increased, so did lift-and drag. Also, as angle of attack increased, so did lift and drag- But only to a point, when, depending on the airfoil, as angle of attack was increased above approximately 15-20 degrees lift would become unstable, or decrease, while drag would continue to increase. This was due to a condition known in aviation as a "stall", where airflow "detaches" from the upper surface of the airfoil.
2. I was able to demonstrate that the "equal transit time" theory of lift generation is incorrect.
3. I believe I was able to demonstrate that "Coanda Effect" increased lift on an airfoil, through an experiment of my own design.

Conclusions/Discussion

Based on my experiments so far, I think that an airfoil with a high camber wing and "built-in" angle of attack of 10-12 degrees would provide the best lift characteristics for a Mars observation drone, due to the Martian atmosphere being only 1/100 that of Earths.

Through my own experimentation, it is clear to me that the application of Bernoulli's principle to "Equal transit-time" theory of lift generation is untrue. Pressure above an airfoil is not reduced due to fast moving air, but fast moving air is produced because of the creation of a region of lower pressure. The "cause and effect" are reversed. This seems important to me because it does not seem possible to design the most efficient Martian airfoil without understanding the basic principles involved. I also learned and experimented with several other forces at work to create lift(and drag)such as "Entrainment", Newtons 3rd law, and Coanda effect.

Summary Statement

Research and wind tunnel experimentation to gain an understanding of aerodynamics that I can apply to the design of a Martian observation drone.

Help Received

Mr. Thomas Smid (M.S.C. Physics, Ph.d. Astronomy) His paper on areodynamics helped me to understand the effects of airflow on an airfoil at the molecular level. It also inspired me to build my triangular airfoils. My father supervised me at all times when I used power tools (jig saw and belt sander).

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

James A. Gow, Jr.

Project Number

J0112

Project Title

Are Angle and Size of the Buckets Keys for a Successful Pelton Water Turbine?

Abstract

Objectives/Goals

To determine if any physical characteristic of a Pelton Turbine may affect its efficiency.

Methods/Materials

Used Cura and 123D Design software to design various Pelton water turbines with 4 different tilt angles of the buckets and 2 different bucket sizes. The device was built with water jug, rare earth magnets, enameled magnet wire, foam board, wooden dowels, vinyl tubing, and brass paper fasteners. The 3D printed rotors were printed by Airwolf 3D AXIOM 3D Printer.

Results

The angle of the buckets and size of a water turbine rotor do affect the total conversion of kinetic energy into electricity (voltage measured). The turbines with 15 degrees and 45 degrees bucket angles gave a higher average voltage.

Conclusions/Discussion

The results from the data, observations, and graphs did not support the hypothesis completely. First, the 1.5 times larger rotor/buckets did not produce 1.5 times more electricity when compared with the control. Bigger is not always better. The rotors with buckets angled to 15 degrees and 45 degrees produced the most electricity and they support the hypothesis that titling angle may affect the electricity output.

Summary Statement

I showed that Pelton water turbines rotors buckets angled at 15 and 45 degrees generated the most electricity and 1.5 times larger buckets produced the least electricity.

Help Received

I built the water turbine device using 3D printing technology. Ms. Ricart (STEM teacher) taught me how to use the software, 3D printing, and laser cutting. Dr. Ross-Viola and Mr. Harrington (science teachers) provided guidance and feedback in reviewing my work.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Daniel Gushchyan

Project Number

J0113

Project Title

How Do the Temperature and the Length of the Tube Affect the Speed of the Wind Produced?

Abstract

Objectives/Goals

My project investigated the relation between different temperatures of PVC pipes and the speed of wind going through them, as well as the length of the heated PVC pipes and the speed of wind going through them.

Methods/Materials

My project was split into two experiments, so I will be stating a paragraph for each one.

The first experiment the relationship between different temperatures of a PVC pipe and the speed of the wind going through it. A 40 cm length of PVC pipe was heated to 93, 110, and 127 degrees Celsius in an oven. A hair dryer was used to blow wind through an additional cold PVC pipe connected to the heated ones. Each increase of temperature was tested 10 times. The wind speed was measured with an anemometer in kilometers per hour (km/h). In this experiment, as the temperature of the PVC pipe increased, the speed of the wind going through it increased.

This project investigates the relationship between the length of a heated PVC pipe and the speed of wind going through it. Different lengths of PVC pipe were heated to 93 degrees Celsius in an oven. Using a hair dryer, wind was blown through an additional cold PVC pipe that was connected to the heated pipes. Each length of PVC pipe was tested 10 times. The wind speed was measured by an anemometer in kilometers per hour (km/h).

Results

In the first experiment, as the temperature of the PVC pipe increased, the speed of the wind going through it increased.

In the second experiment, as the length of the heated PVC pipe increased, the speed of the wind going through it varied. At the second level it increased, then slightly decreased when at the third level.

Conclusions/Discussion

With my experiments I wanted to explore the possibility of making wind-based energy more efficient, by attempting to speed up the wind that is used to make the energy, thus increasing energy creation. Seeing how without tubes the hair dryer output 27.5 km/h speeds, and the speeds I was getting averaged to about 33 km/h (roughly), the increase margins were not probably enough to be efficient. More energy was probably used in the heating and cooling of the the PVC than the extra created. However new experiments that test the materials, shapes of pipes, and methods of heating/cooling may suggest the usage of the idea.

Summary Statement

I tried to increase the speed of wind going through PVC pipes that were heated to different temperatures and cut to different lengths.

Help Received

My brother and father helped me form the question of the project from an idea that I had. My brother found examples in innovations (such as the Bladeless Fan), which proved the possibility of the idea.

Name(s)

Jonah S. Henry

Project Number

J0114

Project Title

Tabletop Hurricanes: A Study of Vortex Stability in a Rotating Fluid

Abstract

Objectives/Goals

The objective of this experiment was to determine which factor most impacts the stability of a vortex in a rotating fluid.

Methods/Materials

Multi-speed turntable, basin, water, food coloring, stopwatch. Measured the amount of time a stable vortex lasted when subjected to different factors (High and low heat, low rotational speed, and a physical disturbance).

Results

Vortices were subjected to the different factors, with 3 trials per factor. The control vortices lasted an average of 40 minutes, the low heat vortices 61 minutes, the high heat 6 minutes, the low rotational speed 35 minutes, and the physical disturbance 31 minutes.

Conclusions/Discussion

Vortices were subjected to different factors multiple times, which revealed that the factor with the greatest impact is the heat of the fluid surrounding the vortex, not the physical disturbance as hypothesized. Thus, the most plausible cause for a considerable change in the stability of a vortex is a change in temperature.

Summary Statement

I found that the temperature of the fluid surrounding a vortex is the factor that most impacts the stability of a vortex.

Help Received

A demonstration performed by Dr. Johnathon Aurnou from UCLA's SPINLab inspired me to conduct this experiment.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Isaiah M. Hessler

Project Number

J0115

Project Title

Need for Speed: A Study of Drag Reduction Methods in Vehicles

Abstract

Objectives/Goals

The objective of this study is to reduce drag in vehicles via the use of various aerodynamic attributes.

Methods/Materials

Fabricated wind-tunnel, test vehicle, scale, shop vacuum, stopwatch, rope, pulley. Tested vehicle in wind tunnel connected to scale via rope and pulley. Measured differences in vehicle drag corresponding to different aerodynamic attributes.

Results

Applied wind caused the vehicle to pull on the scale. The scale reading for each aerodynamic attribute indicated varying negative readings. The attribute with the smallest average scale reading was the top cover with .77 ounces.

Conclusions/Discussion

The best of the four tests was the top cover with an improvement of 42% over the stock body. I believe this was because the attribute made the car more aerodynamic by reducing turbulence and converting it into a wing shape with airfoil characteristics. The body shape improved the car#s aerodynamic efficiency, and likely improved fuel efficiency.

Summary Statement

Using a wind-tunnel to test various aerodynamic attributes on a vehicle, I was able to identify one attribute that reduced drag by 42% over the stock body.

Help Received

I ran the experiments and and completed the project by myself. My dad helped me set up the wind tunnel.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Daniel Z. Izmirian

Project Number

J0116

Project Title

Wicked Wave Walls: The Effect of Different Types of Walls on the Distance a Wave Will Travel

Abstract

Objectives/Goals

The objective of this experiment was to test the effectiveness of various wall designs on shortening the distance a standard size wave would travel.

Methods/Materials

Wood, pulleys, water, box, brick, string. I created a pulley system that would lift a piece of wood out of a box containing water to create a standard sized wave. Using three different wall designs that I created, I was able to tell what type of wall worked the best at preventing a wave from propagating the farthest.

Results

My results proved my hypothesis to be correct. For example, the vertical wall was nearly equivalent to having no wall at all. Also, the vertical wall with holes worked a little bit better, and the vertical wall with a board at a 90 degree angle on top worked the best at stopping the wave.

Conclusions/Discussion

The vertical wall with a board at a 90 degree angle on top, worked the best at stopping a wave. If a community wanted to protect itself from large waves, the city could build this type of wall because my experiment showed that it was the most effective at stopping waves from traveling the farthest.

Summary Statement

I tested the effectiveness of different wall designs at preventing the propagation of a standard sized wave.

Help Received

I designed, built, and conducted the experiment myself, except for the wood my father helped me cut

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Joshua T. Manivone

Project Number

J0117

Project Title

Do Sail Size and Speed Affect Efficiency?

Abstract

Objectives/Goals

The objective of this project is to determine advantages of different sails in different scenarios.

Methods/Materials

Pool, Boat, 3 Triangular Sails, 3 Rectangular Sails, Large Circular Fan. Recorded the amount of time needed for the various sails to sail 3 and 6 meters.

Results

Triangular sails were faster in the 3 meter race with higher acceleration and maneuverability. Rectangular Sails were faster in the 6 meter race with a more constant speed as they moved further away from the fan. Repeated trials were conducted to determine the average speed of each sail.

Conclusions/Discussion

Repeated trials determined the advantages of various sized and shaped sails. These advantages can be translated to using different sails in different scenarios to make sailing more enjoyable.

Summary Statement

I conducted many trials with self-constructed sails and a boat which determined each sails advantages.

Help Received

I received help in constructing the boat and sails and running the trials from my dad.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Ryan T. Mikami

Project Number

J0118

Project Title

Measuring Airfoil Lift/Drag Designs

Abstract

Objectives/Goals

The objective of my project is to study six aerodynamic attributes of airfoil design and understand how they affect lift and drag forces.

Methods/Materials

Overall project materials used were balsa wood, spring, guide tracks, a wind tunnel, and power tools. Using a spring, I measured the lift and drag of different airfoil designs in a homemade micro-scale wind tunnel. The wind tunnel simulated a flight of an airfoil. Mounting the airfoil in guide tracks allowed movement in specific direction - vertical tracks for lift and horizontal tracks for drag. The airfoil displaced the spring as it moved through the tracks, and using Hooke's Law, the lift and drag were be calculated.

Results

My results had six conclusions based off of testing. As the velocity doubles, the lift and drag increase. An airfoil with a 25% maximum thickness creates more lift and drag than a 50% maximum thickness. A smooth surface texture has a higher lift/drag ratio than a rough surface texture. A rough surface texture on the trailing edge creates a higher lift/drag ratio than a rough surface texture on the leading edge. A 15 degree angle of attack has the same amount of lift yet less drag than a 23 degree angle of attack. A greater chord creates more lift and drag. A supercritical airfoil creates less lift and drag force than a normal airfoil. Supercritical airfoils cannot create any lift at low wind speeds.

Conclusions/Discussion

Some variables had greater performance impact than others. Based on my experiment, the chord had the greatest positive impact on lift while the angle of attack had the most effect on drag. However, the angle of attack had the greatest effect when comparing lift/drag ratios. Therefore, the experiment suggests that future studies should focus on controlling and maintaining angle of attack rather than other aerodynamic variables, such as chord and maximum thickness, to best improve aerodynamic performance

Summary Statement

Lift and drag forces of different airfoil designs were tested in a homemade micro-scale wind tunnel.

Help Received

My teacher helped set deadlines for the project and reviewed my notebook. My high school mentor gave input on the wind tunnel. My dad taught me how to use power tools to build airfoils and wind tunnel. My mom reviewed my research paper and helped construct the board.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Denico M. Nieves-Ellis

Project Number
J0119

Project Title
Experimenting with Ferrofluid's Magnetic Properties: Searching for Novel Applications

Abstract

Objectives/Goals
Ferrofluid is a magnetic liquid with some interesting qualities. Under the influence of a magnetic field, ferrofluid acts like a solid. It collects into one large semi# sphere that has many spikes on it. Some of the uses for ferrofluid include improved audio quality on loudspeakers, bio-medical purposes, and vacuum seals. I was inspired to experiment with ferrofluids to experience its benefits and drawbacks and try to discover more applications for ferrofluids.

Methods/Materials
To conduct my experiments, I had to first conduct research and gather my materials, which included assorted containers, ferrofluid, neodymium magnets, and vegetable oil. I conducted more than fifty tests, experimenting to find if ferrofluid could move a solid mass when exposed to a magnetic field, as well as if viscosity affected ferrofluid's magnetic abilities, and whether ferrofluid could move solid mass from one area to another effectively and efficiently. I also conducted smaller side experiments to further my knowledge and understanding of ferrofluids.

Results
My first experiments made me realize just how much I had underestimated the strength of ferrofluid while under the influence of a magnetic field. I observed through my tests that a ferrofluid can move a mass more than 20 times its own weight. My second experiment showed me that viscosity does in fact play a role in the performance of ferrofluid. My final experiments were at first unsuccessful, but when the mass being pushed was reduced and more iron oxide was added, the test weight was moved from one end of the test tube to the other.

Conclusions/Discussion
I discovered I could use ferrofluid to move or push things within a small area by simply guiding it with a magnet, I immediately thought of ways I could incorporate this finding into society. In the end, I had an idea to use ferrofluid to get rid of clogs in pipes or drains by guiding it to the blockage with a magnet. This application is very much like its already existing bio-medical application, where it is guided to a lesion and drawn up, eliminating bacteria and infections. I would recommend more research be conducted on the study of ferrofluids. There are so many ways this material can benefit us in society that we don#t yet know. Hopefully, my findings can be applied in ways to benefit many people and inspire scientists to explore further, perhaps focusing on transportational uses and conveyor systems.

Summary Statement
I sought to find novel applications for ferrofluids through various experiments and believe ferrofluids may be used for conveyor systems and even plumbing applications.

Help Received
I would like to thank my mother, father, and science teacher for their contributions to this project. I appreciate that they have stayed with me throughout the project and supported me by providing many of my materials, as well as taking photographs and videos of my experimentations.

Name(s)
Zachary Patton

Project Number
J0120

Project Title

Squirt Power: Constructing a More Efficient Generator by Changing the Diameter of the Pipe in the Water Feed System

Abstract

Objectives/Goals

Hydroelectric power is a clean energy source, but must be made more efficient. With the drought, it is increasingly important to use the limited amount of water available in the most efficient manner.

The objective of the project is to find the increase in voltage from 3 different water channel diameters, 1/8, 1/4, and 1/2 inches. The hypothesis is, if the force of the water stream is increased by the narrowing of the opening through which the water is delivered to the turbine blades, then the turbine will produce more energy from less water.

Methods/Materials

I made a small hydroelectric generator with a voltage meter from lego pieces. 1/8, 1/4, and 1/2 inch diameter openings were used to deliver water to the waterwheel. Voltage readings were recorded and averaged for the 15 trials. I used 2 gallons of water for each test, the average amount of time to fill 2 gallons of water was also noted.

Results

In comparing the 15 trials that I did per each cap adapter, the 1/8 inch opening not only increased voltage by 248% compared to the largest opening, it used less water.
The results of my investigation on the energy output on a water wheel turbine and generator indicates that the smaller the opening for which the water is delivered to the turbine blades the more voltage output and the less water is used.
The results show that 1/2 inch diameter opening had on average 1.78 volts, 1/4 inch diameter opening had on average 3.37 volts, and the 1/8 inch diameter opening had on average 6.2 volts.
The average amount of time to fill the 2 gallon bucket showed comparable differences based on the cap opening.
The results show that there was an increase of 45% between 1/8 in. and 1/4 in. and an increase of 47% between 1/4 in. and 1/2 in. Overall there was an increase of 71% from the 1/8 in. to the 1/2 in.

Conclusions/Discussion

After completing my investigation to test if narrowing the point where water is delivered and hits the turbine of a hydroelectric generator produces more energy and uses less water, I found that my hypothesis was correct. My investigation is applicable because the turbine did increase in volts significantly as each diameter decreased in size and would serve to use less water during drought.

Summary Statement

I made a hydroelectric generator and changed the diameter of the cap size in the water feed system to learn about more efficient uses of water.

Help Received

I built the hydroelectric generator myself, but I was supervised by my grandfather to ensure safety using the voltage meter, electrical tools, and water.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Olivia G. Petty

Project Number

J0121

Project Title

Powerful Wind: Which Wind Turbine Design Is Most Efficient?

Abstract

Objectives/Goals

The objective of this investigation was to determine which wind turbine design, of four, is the most efficient.

Methods/Materials

I tested four types of wind turbines for which I built small plastic models. To build the models I used various plastic pieces such as PVC pipes, small propellers, and some parts I had 3D printed.
I conducted three trials for each of the four turbines to determine efficiency according to when they stopped turning upon decreasing wind speeds. For each trial, I had a 14" fan on its highest setting and set the turbines in front of it starting at 24 inches away. I then moved the turbines away from the fan in two foot intervals until the turbines stopped turning, recording the distances and wind speed with an anemometer at each interval .

Results

The results of the experiment data showed that design three was much more efficient than the other three designs. It stopped turning at an average of 160 inches away from the fan at 0.6 MPH wind speed. Design four was the second best design which stopped turning at an average of 141 inches and 1.4 MPH wind speed. Design two was third which stopped turning at an average of 62 inches and 4.5 MPH wind speed and design one was the least efficient type which stopped turning at an average of only 29 inches and 5.8 MPH wind speed.

Conclusions/Discussion

The wind turbine that proved to be the most efficient of the four tested was my experiment design three, the Modern HAWT (horizontal axis wind turbine) which is the three-bladed propeller-like turbine and the most commonly used. Design four was a little less efficient. Designs one and two were far less efficient than the other two but work fine with adequate wind speeds. They are easy to build yourself with common materials so would be a good option for generating electricity for those who do not have access to or cannot afford produced turbines.

Summary Statement

As measured by the wind speed at which four types of wind turbines stopped turning, I determined that the Modern HAWT is most efficient.

Help Received

My father helped me build my models based on my research, otherwise I designed and conducted the experiment myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Olivia H. Pierson

Project Number

J0122

Project Title

Can I Make Rocket Fins More Efficient?

Abstract

Objectives/Goals

Phase 1 - Would differently shaped fins affect rocket performance?
Phase 2 - Methodology improvements to validate results and improve upon standard rocket kit fins.
With surprising results from Phase 1, I need to retest my project with more launches, more apogee accuracy, and better fin precision.

Methods/Materials

Phase 1 - For my project, I measured rocket apogee as my metric for fin efficiency.
I built 24 rockets to account for duplicates, lost, and damaged rockets. I cut and shaped seven fin shapes from balsa wood, including a replica of the Estes kit cardboard trapezoid-shaped fin.
Using different fin materials (balsa vs. the rocket kit cardboard), I would need to create Baseline data as well as Control data for my project.
Standing 30 and 60 meters north and south of the launch site, my measurers observed the apogee tangent angle. I launched each shape twice, then averaged measurements for apogee.
Phase 2 - During Phase 1 I observed interesting trends, but I feel that I require more data points (launches) per fin type, more precise altitude measurements, and more precisely shaped fins.
I am now testing using rocket kits that carry a small altimeter. I will require more powerful motors to generate the speed and altitude to differentiate between fin types.

Results

Phase 1 - My results disproved my hypothesis that an S-shaped fin would be most efficient
The half circle balsa fin went highest of my test fins, only 1% less than the Estes cardboard fin, but far above all other test fins including my Control trapezoid balsa fin.
Though my calculations were accurate, my Santa Cruz County judges advised me to develop a more precise apogee methodology.
Phase 2 - Phase 2 rocket building is in process so no results yet.

Conclusions/Discussion

In Phase 1, my Control trapezoid balsa fin launched lowest of all fins. This leads me to believe that all fin shapes would improve if I use Estes-thickness cardboard.
However, my goal is to improve upon the standard kit fins.
Can I create a fin shape that is better than a standard kit shape or do I improve upon the standard Estes kit fin by creating an airfoil cross-section on my balsa fins?

Summary Statement

I suspect that the standard shape rocket fin that comes with rocket kits might not be the most effective; my preliminary results indicate that a half-circle fin shape could be very efficient, as measured by apogee.

Help Received

My Science teacher helped refine my scientific methods and my Math teacher introduced me to trigonometry so that I could use tangent angles for my apogee calculations.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Alec D. Vuicich

Project Number

J0123

Project Title

Wind Turbines: Vertical vs. Horizontal: Watts Up with That?

Abstract

Objectives/Goals

Wind turbines horizontal vs vertical. Watts up with that!
I was interested in learning about alternative energy when I came across two different types of wind turbines, horizontal and vertical. I wondered which style would produce the most energy. After some research my hypothesis would be that the horizontal turbine would produce more energy, due to its more commonly used design.

Methods/Materials

For my experiment, I built a horizontal wind turbine and a vertical wind turbine with the same size motors. Each turbine is calculated at the optimum size to produce the maximum amount of energy for each identical motor. I used an Anemometer to measure the wind speeds of 15 kilometers, 20 kilometers and 25 kilometers. I repeated the experiment five times

Results

The wind speed at 15 kilometers showed the horizontal turbine produced an average of 1.41 volts. The vertical turbine produced an average of 1.14 volts. At 20 kilometers the horizontal turbine produces an average of 1.47 volts and the vertical turbine produced an average of 2.1 volts. At 25 kilometers the horizontal turbine produced an average of 1.66 volts. The vertical turbine produced an average of 2.71 volts. The overall averages for the horizontal was 1.51 volts and the vertical 1.98 volts.

Conclusions/Discussion

I learned from my data the horizontal turbine produced energy more consistent in varying wind speeds; however, the vertical#s data showed that it consistently produced more energy in higher wind speeds.

Summary Statement

In comparing the vertical and horizontal wind turbines, I discovered that the vertical produced the most energy on average and preformed best in high wind speeds; however, the horizontal preformed more consistent in different wind speeds.

Help Received

I built the wind turbines from a kit from picoturbine international by myself. I conducted and designed the experiment by myself and used my dad and my teacher Mrs. Salazar for any questions I had.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Narayan K. Weibel

Project Number
J0124

Project Title
Hydropower Unleashed: Design Elements of a Small-Scale Paddle Wheel Hydroelectric System

Abstract

Objectives/Goals
The goal of this project is to design a system to generate electricity from stream flow using a paddle wheel constructed from readily available, inexpensive materials and a permanent magnet generator (PMG). The idea is that the axle on the paddle wheel turns with the flow of the stream, and through a series of pulleys connected by belts, turns the shaft in the PMG to generate electricity. The objective is to make the paddle wheel turn as fast as possible with the least amount of friction to be able to generate electricity.

Methods/Materials
The hypothesis is that paddles with a cupped design, on a paddle wheel to be attached to a PMG, will make the paddle wheel turn faster from water flow than curved, unenclosed paddles. This hypothesis was tested in the shop simulating stream flow by directing hoses onto the wheel and measuring revolutions per minute (RPM) of an attached pulley, using a strobe light iPhone application. A bicycle wheel and cut sewer pipes were the materials used for the original wheel and paddle designs.

Results
The hypothesis was correct because the wheel with the cupped paddles spun 1.5 times faster on average (620/402 rpm) than unenclosed, curved paddles. This result indicates that the weight of the water in the paddle wheel contributes to the speed of rotation. A PMG was ordered based on these results. Once the PMG was attached, the torque needed to move the system was higher than anticipated and a wheel redesign was necessary. Specifications for the redesign were based on measurements made by attaching a string with a bucket to the pulley belt and determining how much water weight it took to move the pulley. This measurement established the final size of wheel and cupped paddles needed for the PMG. The redesigned system was tested at maximum water pressure in the shop, which rotated the PMG shaft to only 200 RPM.

Conclusions/Discussion
The next phase of this two-year project will involve setting up the system near a stream and directing sufficient water flow to turn the redesigned paddle wheel fast enough to rotate the PMG shaft to 1000 RPM or more in order to generate electricity. If successful and stable, a system like this could be used to generate electricity in rural areas with stream access such as Humboldt County where this prototype was created.

Summary Statement
This project tested for the most efficient design of a paddle wheel hydroelectric system utilizing pulleys and a permanent magnet generator with the ultimate goal of producing electricity from a stream.

Help Received
Local hardware store staff provided help choosing materials and Revolution Bicycles provided used bicycle chain. WindBlue Power Company provided technical PMG information. This project would not have been possible without the help of my father who guided me through the use of shop tools.