Name(s)

Arhana Aatresh

Project Number

J0101

Project Title

Over the Wing: Effect of Wind Speed, Temperature, and Wing Angle on an Electrically Propelled Blown Wing's Performance

Abstract

Objectives

My experiment's goal was to model a blown wing concept, which increases wind velocity around the wing by having propellers lined along its leading edge, with varied wind speed, propeller speed, wing angle of attack, and wind temperature.

Methods

A virtual plane on X-Plane 11 (software from Laminar Research) was flown with different intensity thermals to model the blown wing effect, at different angles of attack, in different temperatures, for two minutes; the difference in elevation was recorded. As for the model, a box fan was set on the ground, and a styrofoam wing on a weighing scale was placed in front of it. A tower fan was horizontally placed between the box fan and wing setup to model the blown wing effect. An anemometer measured average wind speed across the wing. The difference between the initial scale reading (no fans running) and reading after the variable changes was recorded.

Results

The higher the difference in elevation, the less efficient the experimental group was. The most efficient conditions of the simulation was the stronger thermal, with the wing at 0 degrees at 55 degrees C. The least efficient was no thermals with the wing at -1.8 degrees at 55 degrees C. Higher differences in scale readings indicated increased efficiency. The most efficient condition of the physical model was the high-speed tower fan with a high-speed general airflow from the box fan, and the least efficient condition was no tower fan with a medium speed general airflow from the box fan.

Conclusions

In the simulation, the hypothesis was partially supported, with data indicating an increase in efficiency with more intense thermals and higher angles of attack, but a lack of trend in temperature (perhaps due to a minor effect or the software s possible incapability to model changes). As for the physical model, my hypothesis was fully supported, with data indicating increased lift with increased "propeller" and wind speed. Both experiments support the concept that blown wings provide more lift than standard wings, increasing efficiency.

Summary Statement

This project served to determine factors contributing to flight efficiency by flying a virtual plane and creating a physical model, varying wind speed, the blown wing affect, wind temperature, and wing angle of attack.

Help Received

My father assisted me in operating the controls to fly the plane with X-Plane. After reading papers published by Joby Aviation and NASA (the companies whose study on the blown wing inspired my project), I created my physical model.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Natalie Araujo; Fredy Centeno; Melissa Perez

Project Number

J0102

Project Title

Blade Power

Abstract

Objectives

The objective for the Blade Power experiment was to design four different shapes of wind turbine blades: Blade A-rectangular, Blade B-paddle, Blade C-curved, and Blade D-triangular. The collected data determined which blade shape will have the the highest power output measured with a multitester.

Methods

Window blinds polyvinyl chloride(PVC) materials, wooden dowels glued onto the blades, duct tape was used to cover the blades, Kidwind gearbox on the wind turbine, wind tunnel machine, and a multitester attached to the gear system measured the voltage for each trial.

Results

A total of 800 trials were completed. Each of the four blade shapes were tested 200 times, using the same generator, the base, length, and gearbox. Blade C, which is a curved airfoil-shaped blade, had the greatest power output with an average of 4.07 volts. Blade C had more stability and produced higher volts after 200 trials because the shape of the blade was able to draw the most wind density and did not have as much drag as Blade, A, B, and D. Then Blade B, the paddle blade, produced an average of 3.4 volts, the second highest voltage. Blade A, the rectangular blade, had a total of 2.9 volts.

Conclusions

Blade C, the curved airfoil-shaped blade, had the greatest power output, compared to the other three blade shapes. Blade C was shaped with a sharp tip and flat closed base towards the hub leaving no hole space for drawn wind to escape, therefore allowing the maximum density of wind to travel through the blades from the hub s base to the tip, thereby making the blades spin faster. The faster blade spin caused a faster spin of the attached gear system, resulting in higher voltage generated and therefore higher power output. The higher kinetic energy resulted to a higher available wind energy which in turn maximized the mechanical energy that resulted to higher electrical output. This is helpful using more renewable energies, reducing fossil fuels and helping the atmosphere.

Summary Statement

Our project is about finding more efficient blade designs to maximize wind turbine output, so that more renewable energy can be used in the world, thus decreasing the usage of fossil fuels and carbon emission in the atmosphere.

Help Received

We were able to use the wind tunnel and test our turbine in our robotics class. Our mentor, Mrs. Mahoney, helped us print our photos and arranged for a wind farm tour which allowed us to interview, observe, and inquire about actual wind turbine blade designs.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Ali Badawi

Project Number

J0103

Project Title

AnyFIN Is Possible! Testing Various Flyfishing Structures to Determine Which Fly Structure Has the Best Surface Tension

Abstract

Objectives

In brief, this project is to learn which of the three main "fly" designs used in targeting top-water fish in fly fishing will have the highest level of stickiness to the water s surface tension while being slowly pulled out of the water.

Methods

To test this I made three models of "flies", which are hand-tied artificial lures imitating natural insects or bait to entice fish, each composed of a plastic toothpick, modeling clay and eight needles. I also built a balance made of household items. I laid the "model fly," which was attached to one end of the balance by string, onto the water's surface then added grains of rice to a container attached to the other end of the balance until the "model fly" came out of the water. I then recorded the weight of the grains of rice in grams, and compared the results of the three "model flies" I was testing.

Results

The result was that the "model" of an imitation insect called a "parachute fly," with it's even spacing of needles that lay flat on the water's surface, held to the water's surface tension the best.

Conclusions

In conclusion, the results matched my hypothesis. This knowledge will help fly-fishermen decide which "fly" to use when targeting top-water fish like trout or bass, because they will know which "fly" has the highest probability of staying on the water's surface.

Summary Statement

This project is to learn which of the three main fly-fishing lure designs used in targeting top-water fish will have the highest level of stickiness to the water's surface tension while being slowly pulled out of the water.

Help Received

None, this project was entirely done by me.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Emily Bell

Project Number

J0104

Project Title

Fin Shape's Effect on Altitude

Abstract

Objectives

The objective of my experiment is to explore the effects of fin shapes on the altitude a rocket achieves.

Methods

Rocket made with interchangeable fins/ Altimeter/Accelerometer /Launching Equipment / Fins. Launched rockets with different fin shapes and recorded the altitudes they achieved along with other statistics.

Results

Rockets were launched changing out the fins every time. Three trials were run to see how the rocket reacted to the different fin shapes. The fins with higher drag ended up going the highest out of all of them.

Conclusions

The fins with the highest drag ended up going the highest. This is because the higher drag fins helped the rocket stay in a straight path by reacting to induced drag the fastest; turning the rocket faster off of any divergence.

Summary Statement

I found that fins with higher drag increase the efficiency of a rocket.

Help Received

I required assistance in launching and retrieving rockets.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)	Project Number
Jacob Cho	J0105

Project Title

Golf Ball Aerodynamics

Abstract

Objectives

The objective was to find if the difference in dimple pattern of a golf ball affects the spin rate, distance, and ball speed of the golf ball.

Methods

Three different golf balls, launch monitor, and golf club. Launch monitor recorded data from ball that was hit by club.

Results

When doing my experiment, I found that the ball with the most dimples had the most spin rate. The ball with the least spin rate had the least dimples.

Conclusions

In conclusion, my hypothesis was partially correct. It was incorrect because I found no correlation between the dimple pattern of a golf ball and the distance of the golf ball. I also did not find any correlation between the dimple pat- tern and ball speed of the golfball. However, There was a significant correlation be- tween the number of dimples on a golf ball, and the spin rate of the golf ball. Through my testing, I did find that the ball with the most dimples had the most spin rate. Additionally, the ball with the least spin rate had the least spin rate. There was a significant difference of spin rate be- tween the three balls ranging from 4000 to 1000 rotations per minute.

Summary Statement

In my project I did a study on the dimples on a golf ball and how it affects the spin rate of the ball.

Help Received

I designed my experiment by myself, but used a machine made by flightscope.

Name(s)

Warren Dao

Project Number

J0106

Project Title

Which Nose Cone Is the Best when Flown?

Abstract

Objectives

The objective of this study was to evaluate which nose cone design would be the most efficient for a slow moving projectile. I predict that the nose cone in an elliptical shape will be the most efficient for a slow moving rocket because it will allow fluids to flow around the body and used to their advantage rather than reflecting fluids which will consume a lot of energy.

Methods

Produced a waterproof ramp made of gutter splash guards and cardboard and a container with straws that would produce laminar flow. The fluid with reduced turbulence would come out of the container onto the ramp where it would come into contact with one of the eight foam nose cone designs and a rocket body. There, I could visualize how much fluid displacement was caused by the nosecone designs in centimeters. Also, get mass of the nose cones and the distance of its outer mold line.

Results

The predicted most efficient elliptical nose cone had an average fluid displacement of 1 centimeter on each side and weighed 1.5 grams. The nose cone design with the least mass was the spire cone weighing 0.5 grams but having an average fluid displacement of 1.25 centimeters on each side. The true most efficient nose cone design was the conical nose cone which has a mass of only 0.9 grams and an average fluid displacement of 1 centimeter on each side.

Conclusions

In conclusion, my hypothesis was incorrect, and the nose cone in a conical shape had the least average fluid displacement for the least mass which proved the conical design to be the most efficient for slow-moving projectiles. I discovered that for slow-moving projectiles, even though the nose cone may be able to use the moving fluids around to its advantage, the best nose cone is one that can separate the flow by being in a cone shape. This is important since it can expand a students knowledge in school activities like building the most aerodynamic bottle rockets.

Summary Statement

I measured fluid displacement and mass of different nose cone designs to observe which nose cone design was the most efficient for slow-moving projectiles.

Help Received

I designed a safer, more compact way to test and observe the properties of fluid dynamics when in contact with different objects in a two-dimensional form. I received verbal support from my parents throughout the journey of my project.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)	Project Number
Jennifer Dick-Peddie	J0107

Project Title

Designing an Autogyro to Accurately Deliver a Payload to a Designated Landing Zone with the Slowest Descent Rate

Abstract

Objectives

The goal is to build an auto rotation device that can achieve the slowest rate of descent and an accurate landing zone to deliver emergency supplies to firefighters in areas that would be too difficult to land helicopters or airplanes. The project will compare variations of auto rotation blade designs, including different shapes, materials, pitch angles, and quantities.

Methods

Fixed straw, Flexible Straws, Wood Disk, Dixie Cup, Foam Cylinder, Pointed Stick, Wood Fan Blade, Glue. Tested which blade assembly configuration achieved the slowest descent rate and most accurate landing zone.

Results

The best autogyro design, with the slowest descent rate and most accurate landing zone was the device with the large, foam blades that had an 18.5 degree pitch angle. A pitch angle of 45 degrees caused the device to drop too fast and not land intact. A pitch angle of 10 degrees was too shallow and caused the blade spin to stall, and the device drifted and did not accurately land in a repeatable location. Of all the independent variables tested, blade pitch angle had the greatest impact on descent rate and landing zone accuracy performance.

Conclusions

I learned from research and early prototypes that the shape of the blade, and pitch, impacts how much lift and spin is produced. Rectangular shaped blades had too much drag at the tips, resulting in slow spinning or no rotation. Rounded ends produce good results.

The autogyro device with 4 large, flat foam blades, rounded at the ends, and mounted at an 18.5 degree pitch angle, achieved a steady spinning performance that allowed the 28 gram payload to be delivered in a smooth vertical descent, at a rate of 2.11 meters/second, repeatedly in the landing zone. This exceeds all design constraints and achieves the desired landing zone accuracy required of a device that would be needed to quickly deliver supplies to firefighters in areas that cannot easily be reached.

Summary Statement

I designed an autogyro device to safely and accurately deliver a payload to a landing zone with with the slowest descent rate.

Help Received

I designed, tested, and improved my design, following discoveries from earlier prototypes. I received assistance from my parents, when operating some power tools during device construction, and to take videos during the device configuration testing.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Lila Ekholdt

Project Number

J0108

Project Title

Panel Potential

Abstract

Objectives

The objective of my project was to determine if different panel structure/designs on a soccer ball had an effect on the distance the ball traveled in the air. My hypothesis was that the 6 panel ball with the newest design would travel the farthest out of the 4 balls I tested, (6, 8, 18, and 32 panel balls).

Methods

I constructed a catapult with various lengths and sizes of wood and I attached a slingshot to the structure to form the catapult. I also modified a saw horse to form a launch pad to ensure that the tension of the catapult would be consistent every time (angle and length). All four balls were the same size, same air pressure, and any soil and grass would be wiped off before every launch to keep the same variables. I did 4 trials each trial having 100 launches and each ball having 25 launches per trial, (balls were randomly chosen to be launched). I recorded each launch using a 100-foot measuring tape laid out and a stake placed at the exact first bounce. All trials took place in the same location, (wide open field in backyard).

Results

The 32 panel ball traveled an average of 60.62 feet and traveled the farthest average. The 6 panel ball traveled an average of 57.90 feet. The 18 panel ball traveled an average of 56.18 feet. The 8 panel ball traveled an average of 55.98 feet and traveled the least average distance. The 18 panel ball and the 8 panel ball are virtually identical in average distance, separated by 2 tenths of a foot.

Conclusions

My project helped me discover the elements of aerodynamics and how the properties of an object have a big impact on its flight. My project made me look at a ball completely differently. It showed how panel number and design can make a big difference on the ball s flight and aerodynamics. Many people such as referees, soccer players, coaches, and maybe even brands may be interested in the fact that a different ball could mean different flight.

Summary Statement

Using a catapult and 4 different paneled soccer balls (6, 8, 18, and 32 paneled balls) I showed that aerodynamics including drag and lift are found within the ball's panels.

Help Received

I received help from my dad when using heavy cutting tools, designing/constructing the catapult, and he assisted me with launching the balls.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Eoghan Gloster

Project Number

J0109

Project Title

Impact of the Depth of the Dagger Board during Different Points of Sailing

Abstract

Objectives

The objectives of this study was to measure the effect of the depth of the dagger board (sail boat) in the water and how varying the depth impacted sailing at different points of sailing (closer or further away from where the wind came from): direction of the boat (measured by the drift from the original course) and speed. It explains how the forces are applied to the boat: center of effort (wind on the sail) and center of resistance (water on the dagger board). The hypothesis was that I could control the boat better if the dagger board was deeper, in particular when sailing closed hauled.

Methods

I used a single handed sailing boat (9 feet long) with a removable dagger board. I used floating buoys (to go back to the same point for each run), Garmin watch that recorded my GPS coordinates over time when sailing.

Results

I repeated each run several times. I tested 3 depths of the dagger board (fully down, 1/2 way up and fully up) at 3 different points of sailing: close hauled (when you sail close to the wind and the sail is pulled in), beam reach (when you sail at 90 degrees angle from the wind and the sail is 1/2 way out) and running or downwind (when the wind comes from the back of the boat and the sail is fully opened). Results confirmed my hypothesis. When sailing closed hauled, I absolutely needed to have my dagger board fully down to control the direction and speed of the boat. If I lifted the dagger board even only 1/2 way up, I drifted more than 135 and 127 degrees away from my normal course. When going beam reach, the dagger board was also important, but it could be lifted with only a relatively small impact (17 degrees drift if 1/2 way up and 31 degrees if fully up). And when going down wind, with the wind coming from the back of the boat, the dagger board was not necessary. The dagger board can be fully up and I could still control the direction of my boat. I only drifted 7 degrees and that's probably part of the variability from run to run. Also, the depth of the dagger board did not impact the speed significantly. It appeared that when drifting (close hauled when lifting the dagger board), my boat speed slowed down from 6.4 km/hr to 5.8 km/hr.

Conclusions

My experiments confirmed my hypothesis. I am a sailor and I already knew when I am supposed to lift my dagger board when sailing and when not doing so. I did not know why and this research taught me about the forces at play and how several forces contribute to the final direction and speed of the boat. I was also able to quantify the criticality and importance of the dagger board at different points of sailing. It also showed

Summary Statement

On a small sail boat, lifting fully the dagger board has no impact when sailing downwind (wind from the back of the boat), but it is essential to keep the dagger board fully down when sailing close hauled to control the boat's direction.

Help Received

My father was on a small motorboat to provide safety during my experimental runs. I learned how to use Excel to calculate angles from GPS data. I did an internet search to find the equations to convert GPS bearings into angles and distance. I used my own sail boat.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Maxwell Gross

Project Number

J0110

Project Title

How Proximity to a Surface Affects the Lift of an Aircraft

Abstract

Objectives

The objective of this project is to determine the effects of proximity to a surface on aircraft wings.

Methods

Wind tunnel, variable-height wing, force sensor. Tested upwards force on wing while changing the height of this wing.

Results

The lift of the wing was independent of height of the wing.

Conclusions

Through repeated trials, the lift of the wing was determined to be independent of the height of the wing. There was some deviation in the lift from this trend, which leads me to believe that friction with the edges of the wind tunnel slowed down the air moving under the wing.

Summary Statement

As measured by a wind tunnel, there is no difference in lift for a varying distance from a surface.

Help Received

I based the design of my wind tunnel off of one that I found on the internet. Otherwise I build and performed the experiment myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Charles Huang

Project Number

J0111

Project Title

Dual-Purpose Boba Straw: Design and Implementation of a Novel Straw for Choke-Free and Pleasant Drinking Experiences

Abstract

Objectives

People want to drink and suck boba separately, but the simple wide straw has tea and boba together. This not only makes the customer unsatisfied, but it also causes issues with choking on the boba when trying to suck tea. This project addresses this problem by creating new models of straws, testing the effectiveness, and comparing them from several aspects.

Methods

The first part of the project was to brainstorm designs for the straws. The materials used were a measuring cup, 10 regular straws, 10 boba straws, tape, glue, a toothpick, a stainless steel nail, and 3 cups of boba tea. Five models of designs with the materials above (excluding the measuring cup and the 3 cups of boba tea) were then built. The five models were tested with the three cups of boba tea and the measuring cup through three phases: testing for the design constraints, testing for tea sucking efficiency, and testing for boba sucking efficiency.

Results

In the end, two out of the five models were successful. Out of the two models, one of them was superior on the perspective of cost, usability, and effectiveness. The model cost three cents less and was effective in all the trials.

Conclusions

The goal of creating a successful straw model that could separate boba and tea was reached. The ideal model is not too expensive compared to regular boba straws, can function well, and is easy to use. The project shows that the problem of choking and inconvenience with boba straws can be solved. The results of this project is important because it helps boba shops keep their customers satisfied.

Summary Statement

My project is about the design and implementation of a novel straw for pleasant and choke-free bubble tea drinking experiences.

Help Received

My parents provided me with supplies and a place to perform the project. I performed the project and made the board on my own. My science teacher invited me to the science fair and reminded me about deadlines.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Iamanni Jackson

Project Number

J0112

Project Title

The Coanda Effect: Does Temperature Influence Its Power?

Abstract

Objectives

The objective of this experiment is to determine if temperature affects how high a ping pong ball will go in a direct airstream.

Methods

Yardstick, ping pong ball, hair dryer. Placed the ball into the hair dryers airstream to see how high it would be propelled on different temperature settings.

Results

A ping pong ball was placed in a direct airstream. Multiple trials were done, determining which temperature of air propelled the ball highest. The difference between the results was that, the colder air made the ball go higher than the others.

Conclusions

Repeated trials were run to determine if different temperatures would propel a ping pong ball higher. They concluded that colder air makes a ball go highest in a direct airstream.

Summary Statement

After measuring the different heights of the ball in the airstream, I determined that colder air made the ping pong ball go highest.

Help Received

My mother and sister assisted me with the experiment, and my science teacher helped me develop my question.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Aidan Land

Project Number

J0113

Project Title

Wingin' It: Design and Construction of a Modular Model Aircraft for Wing Studies

Abstract

Objectives

Design and construct a modular control-line model aircraft to allow a range of wings to be easily swapped at the flying field to evaluate aerobatic performance.
The design would allow wings with different airfoil section thicknesses (13% to 26%, symmetric) and different planforms to be evaluated.

Methods

Using a full length carbon fiber tube spar for strength and a secondary stub spar for alignment, gave a strong, accurate and reproducible system. Wings were hotwire cut from insulating foam using airfoil templates printed from Profili software. Wings were flight tested to measure their lift and drag characteristics. Drag of the wings was measured by timing sets of level laps. For lift, photogrammetry was used to measure the angle of attack for level flight, and aerobatic loop radius.

Results

Reasonable agreement with basic drag theory was found when multiple sources of drag, including the control lines, were allowed for. Wing lift was first evaluated by measuring the angle of attack for level flight using graphic measurement of video recordings. Observed values for angle of attack ranged from 1.3 deg. for the 16% high aspect ratio wing (close to theory), to 4.3 deg. for the 26% rectangular planform. Lift was evaluated at high angles of attack by flying the plane through figure-8 maneuvers. From videos, composite images capturing the path of the model through the maneuvers were created using Microsoft ICE software. This allowed the loop radius to be determined and from these the centripetal acceleration and coefficient of lift (CL) were calculated. The model pulls more than 9g though figure-8 maneuvers. The measured CL values agreed well with the basic theory.

Conclusions

The design has proven to be very rugged, surviving more than 100 test flights, with three major and two moderate crashes. Flight performance was both good and consistent between test sessions, showing that wing alignment is accurate and reproducible. The small changes in level flight lap times (<0.2 sec/lap) highlighted the relatively small contribution of airfoil section drag to total drag for a small, low aspect ratio model of this type. The expected ability of thicker sections to turn tighter was confirmed, but the increased drag led to almost no difference in time for the figure-8 maneuvers. The only data which showed a significant difference for the high aspect ratio wing was angle of attack in level flight.

Summary Statement

I designed and built a modular control line model aircraft which allowed me to evaluate a range of wings for the best performance, measuring lift and drag for a range of both airfoil section thicknesses and wing planforms.

Help Received

My dad helped with the foam wing hot-wire cutting, pitman duties and poster graphics.

Name(s)

Megan Maggiora

Project Number

J0114

Project Title

The Effect of Blade Variables on Wind Turbines

Abstract

Objectives

The objective of this study is to determine if the weight and number of blades on wind turbines effect the voltage output it generates. This could help us generate better energy with wind turbines.

Methods

Make 1 wind turbine stand, use hairdryer to spin wind turbine, attach hair pins to blades to test weight variable, use different amounts of blades to test number of blades variable, use a voltage meter to measure how many DC volts per minute the wind turbine generates.

Results

As a result, when testing the voltage outputs of each different variable, I found that the 2 bladed, unweighted wind turbine had an average of 2.009DC volts, and the 2 bladed, weighted one had an average of 2.002DC volts. The 4 bladed, unweighted wind turbine had an average of 2.099DC volts, and the weighted one had an average of 2.082DC volts. The 8 bladed, unweighted wind turbine had an average of 2.102DC volts, and the weighted one had an average of 2.117DC volts.

Conclusions

In conclusion, there was no drastic change between the different weights and number of blades. Despite this, the weighted wind turbine with 8 blades generated the most energy. My hypothesis was incorrect because I thought the wind turbine with the most voltage output would be the smallest and lightest one.

Summary Statement

My hypothesis was that the lightest blades would produce better energy, but I was incorrect because the wind turbine with 8 blades did.

Help Received

My teacher Ms. Talavera, my parents Mike and Brenda Maggiora, and Darla

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Gracyn Manley

Project Number

J0115

Project Title

The Power of Wind: What Effect Does Blade Angle Have on the Voltage Output of a Wind Turbine?

Abstract

Objectives

As demand increases for energy, wind turbines have become an intriguing source of electricity around the world. However, wind turbines face many challenges including wind speeds in particular locations and cost values. The purpose of this project is to determine if the angle of blades on a wind turbine effects the amount of energy generated. If the amount of energy harnessed by wind turbines can be optimized, then the cost value will be high enough to benefit people around the world with the ability to leverage the power of wind. The hypothesis of my project is that the blades with a 30 degree angle will produce the most voltage because research suggests that a blade with a tilt at about 30 degrees will accurately lift and spin at a higher revolution per minute than other blade angles.

Methods

I constructed a wind turbine out of PVC pipe attached to a wood base. Four propellers were made out of cardboard with blades at varying angles, including 0 degrees, 10 degrees, 30 degrees, and 50 degrees. I used a standard blow dryer as my source of wind, which was held 30 cm away from the hub of the turbine, and ran for 30 seconds during each trial. The blades were attached to an electric motor which was connected to a digital multimeter using alligator clips. The voltage output was recorded from the digital multimeter.

Results

I ran three trials for each blade angle, ensuring that the results of the experiment were accurate and precise. The 0 degree blade produced no voltage output, the 10 degree blade produced an average output of 2.4 mV with a standard deviation of 0.3 mV, the 30 degree blade produced an average output of 11.1 mV with a standard deviation of 0.4 mV, and the 50 degree blade produced and average output of 2.3 mV with a standard deviation of 0.2 mV.

Conclusions

The hypothesis that the blades on a wind turbine with a 30 degree angle will produce more voltage than angles at 0 degrees, 10 degrees, and 50 degrees was supported in the experiment. The 30 degree blades produced an average output of 11.1mV while the other blades produced lower amounts of voltage. This hypothesis was tested on the independent variable of the angles of the blades. However, many other variables may be tested such as the blade material or the weight of the blade. With this information, scientists may one day create an optimal wind turbine that has a high cost value and allow for many to leverage the power of wind.

Summary Statement

My project supported the hypothesis that a wind turbine with a 30 degree blade angle will produce more voltage than blades at angles of 0 degrees, 10 degrees, and 50 degrees.

Help Received

I designed and built the wind turbine using materials purchased from a local hardware store and Amazon. No outside assistance was received.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Martin Ok

Project Number

J0116

Project Title

Frisbee Aerodynamics: The Effects of Varying Weights and Angles

Abstract

Objectives

The objective of this study is to determine which frisbee weight and launch angle resulted in the furthest flight distance.

Methods

3 frisbees of varying weight (200 grams, 175 grams, and 125 grams) and a tape measure.

Results

Each frisbee was thrown multiple times at three different launch angles. The distance traveled by each frisbee was measured with the tape measure. The frisbee weighing 175 grams thrown parallel to the ground (0 degree launch angle) had the greatest average distance flown.

Conclusions

Throwing the frisbees of different weights at different angles, demonstrated that other variables are also important in determining flight distance. Environmental factors (i.e. wind, rain) and human factors (i.e. throwing strength and technique) are significant factors in determining flight distance.

Summary Statement

I showed the effects of frisbee weight and launch angle on flight distance.

Help Received

None. I performed the project and measured the results by myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Michael Okawa

Project Number

J0117

Project Title

I'm a Big Fan: Determining What Shaped Blades Most Effectively Generate Power in Wind Turbines

Abstract

Objectives

In this project the goal was to find which of three rotor designs on a windmill worked the best and spun fastest. Faster spin means more rotations per minute to create energy more effectively. The hypothesis was that the rectangular rotor blade which has the most surface area would work the best.

Methods

In this experiment a small-scale model of a wind turbine was built of, with three different rotors to test on it to find which one went fastest.

Results

Wind was simulated at a constant speed and the approximate number of turns per minute calculated per rotor type to determine effectiveness of the blade design. Repeated trials showed that the triangular blades consistently had the highest rotations per minute.

Conclusions

At the control wind speed of 7.5 miles per hour triangular rotor blades are more effective at generating spin than curved or rectangular blades.

Summary Statement

The experiment determined which of three differently shaped pairs of blades result in fastest spin to generate power most efficiently on wind turbines.

Help Received

I built, and preformed the experiments myself based on research I had conducted online. The design was modified from one I adapted off of the website sciencebuddies.com. I was supervised and instructed by my grandmother in the use of power tools.

Name(s)

Hunter Paris

Project Number

J0118

Project Title

Parachute Predicament

Abstract

Objectives

The goal of my project is to attempt to solve the problem of which shape is best for parachutes.

Methods

The way that I tried to solve the problem was that I tried to make 12 different shapes--two of which have real-world equivalents--that I then dropped five times and timed to see which shape took the longest to reach the ground. I had to cut the shapes out of a sheet of nylon fabric, then I sewed the edges to keep them from falling apart, and then I had to sew strings into the edges so I could a attach weights to them.

Results

The results showed that the Dome had the third worst time (1.308 seconds) and was the worst overall. The three best for time were the Rectangle (bottom release), the Cone, and the Square (1.616, 1.608, and 1.598 seconds, respectively).

Conclusions

My project contributes information about the effectiveness of different shapes for parachutes. Overall, the Dome is the worst shape (in small scale, at least) and the Rectangle (bottom release), Cone, and Square parachutes were the best shapes (at least, in small scale).

Summary Statement

My project tests how effective different shapes are for parachutes, and its goal is to find out which shape is best (the best is the slowest for its weight).

Help Received

My grandmother cut out and sewed the parachutes, and she also dropped the parachutes off the roof of my house. My grandfather helped me figure out how to draw the net shape for the cone, and he verified that I did the calculations for the dimensions of the shapes correctly.

Name(s)

Beckett Pfahler

Project Number

J0119

Project Title

Airfoil Shape Effect on Lift

Abstract

Objectives

The objective of this experiment was to find out which airfoil shape would create the most lift.

Methods

Wind tunnel, three varying airfoil shapes, digital scale, and stand. Tested each airfoil in the wind tunnel for 20 seconds, measuring the lift each created.

Results

Five trials were conducted for each airfoil, measuring the amount of lift created. The airfoil with the most camber, NACA 6713, created the most lift in the majority of the trials.

Conclusions

The airfoil with the most camber created the most lift. The NACA 6713 and 4112 consistently created the most lift. The symmetrical airfoil, NACA 0012, consistently generated the least lift. It is concluded that airfoil shape directly influences the amount of lift generated in a wind tunnel.

Summary Statement

By testing different airfoils in a wind tunnel, I found that the airfoil with the most camber generated the most lift.

Help Received

After finding wind tunnel building plans and dimensions, my father helped me build the wind tunnel. I obtained the airfoils and printed them on the school 3D printer.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Isabelle Pinto

Project Number

J0120

Project Title

Blown Away! How Does the Camber of a Wing Affect Turbulence with a Crosswind during Takeoff?

Abstract

Objectives

My objective was to find out if the camber of a wing affects turbulence with a crosswind during takeoff. My hypothesis was that the wing with the greatest camber would have the most turbulence with a side wind.

Methods

3D printing database(found a design for a wing that had a changeable thickness and camber) found 3 NACA profiles, NACA 2412(low camber), NACA 4412(medium camber), NACA 8412(high camber), 3D printer, wind tunnel made from a foam board, front wind(3-foot tall Seville fan), crosswind(1.5-foot tall Seville fan)-that simulates rouge winds during takeoff, paper clips to hold the wing in the air and attached to a Jenga block, small scale(for weighing wing). Started the front wind fan on the highest setting and recorded the weight. Turned the crosswind on and recorded the highest, lowest, and average weight. Turned everything off and retook all the measurements two more times. Repeated entire process for all three wings.

Results

The wing with the medium amount of camber provided the best balance between lift and minimizing turbulence. The wing with the most camber provided the most lift, but the least reliability with a crosswind. The wing with the least camber provided the least lift, but the most reliability with a crosswind. On average, when I added the front wind, the weight of the wings went down, but when I added a crosswind, the weight went up.

Conclusions

I learned that my hypothesis was correct. I learned that the camber translates directly to the amount of turbulence as well as the amount of lift. The higher the camber, the higher the lift and the greater the fluctuation with a crosswind.

Summary Statement

My experiment is about how high camber wings increase turbulence in takeoff scenarios that have a crosswind.

Help Received

My dad helped me 3D print the wing profiles. I made the wind tunnel and the wing holder myself. I also took all of the measurements myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Maddox Smith

Project Number

J0121

Project Title

I'm Your Wingman: Aerodynamics of Wings and Winglets

Abstract

Objectives

To verify stability of wings with our without winglets. My goal was to verify which which type of wing is preferable from a safety versus efficiency.

Methods

Building a wind tunnel. Used a cardboard box, duct tape, clear plastic to create a viewing area, and foam board to create wing shapes. I simulate airflow by using a hairdryer in the highest setting.

Results

The average movement for the wing without winglets was 2/3 inches. The wing with winglets moved on average 1 1/4 inches. My objective was to understand the stability of wings with winglets since airlines have begun to use them to improve fuel efficiency.

Conclusions

I was interested in the project becuase of my research and family members involvement in aircraft. Also the last time I traveled on a plane I was interested in the winglets. I found winglets are used for better fuel economy, however, I wanted to know if they made the plane more stable. Further testing included more modern prototypes of winglets airlines are now using.

Summary Statement

Aerodynamic testing of the stability of wings with and without winglets.

Help Received

Parents helped in display board only.