CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

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Project Number

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.