



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Zachary R. Schmidt	Project Number J0134
Project Title Pitch Control: An Analysis of Pitch	
Abstract Objectives/Goals In this project I will attempt to find the right combination of variables to generate electrical power at low wind speeds without having too much force exerted on the wind turbine at high wind speeds. Methods/Materials I used 14 inch model airplane propellers for the wind turbine blades and a small, 3 VDC hobby motor as the generator. I also soldered a network of 5 electrical switches and 5 ohm resistors so that as more resistors were switched on, the resistance decreased, which put more load on the generator. A gear box was also added to increase the speed of the generator, since it was designed to spin at 11,000 RPM. To measure the force, I mounted the turbine on a stand in the wind tunnel that pivoted away from the wind as more force was applied. When the stand moved due to the force, I measured it with a yardstick and recorded it in my notebook. Results The 16:1 gear ratio produced the most power with the 4-blade design. The 4-blade design produced 3X more power than the 25:1 at all 3 wind speeds. The 2-blade design produced 4X more at the highest wind speed and 1.5X more at the lowest wind speed. Conclusions/Discussion According to my results, I conclude that as the pitch angle increased, the force increased. This is because the blades become more efficient at extracting power from the wind from a higher TSR. Wind turbine blades take power from the wind by slowing it down. This is done by applying a force to the wind and the wind applies that same force to the blades. My data also shows that as the force increased, the electrical power increased. Force can be defined as mechanical power, therefore, as the mechanical power from the wind increases, the electrical power increases. The key to a good wind turbine design is one that will generate the most amount of electrical power with the least amount of force. The best combination of blades, gear ratio and pitch angle is 4 blades, 16:1 gear ratio and 60 degree pitch angle. This is because the 4 blade can generate enough torque to prevent stall conditions, and at 16:1 gear ratio, the 4 blade produced the most electricity. Also, at 60 degree pitch angle, the 4 blade produced a lot of electricity with a medium amount of force.	
Summary Statement My project is about finding the right combination of variables to generate the most power with the least amount of force on the wind turbine.	
Help Received Dad financed this project and helped me build the wind tunnel. Mom corrected the grammar in the report. Nicholas donated piece needed for the experiment.	