Greater San Diego Science and Engineering Fair
2015 PROJECT SUMMARY

Name: Nicholas Hern **Grade**: 9 **School:** Scripps Ranch High School **Teacher:** Elaine GIllum

Project Title: Treads or Wheels? The More Efficient Option/ Year 2

Abstract

Objectives/Goals The goal of this project is to find the most energy and time efficient means of robot transportation between two different robot models utilizing various types of tank treads and tire designs.

Hypothesis: Based on previous research, wider plastic treads will use 5-10% more energy and will be 5% slower on rugged terrain than rubber treads. However, on smooth flat terrain wider plastic treads will use 5-10% less energy and will be 5% faster. Wider curvilinear wheels, when used on rugged terrain, will use 10-15% less energy and will be 5% faster. On smooth terrain, wider curvilinear wheels, will use 2-5% less energy and will be 2-5% faster.

Methods/Materials The LEGO Mindstorms EV3 robot was built into two configurations, the TRACK3R and the BOX3R using Eneloop Ni-MH batteries. Both TRACK3R and BOX3R were outfitted with and tested on rubber treads, linked smooth plastic treads, flat rubber wheels, and curvilinear rubber wheels. Each configuration was tested five times on concrete, asphalt, grass, dirt, and sand terrains three meters long. The energy usage and time of completion was measured by a Fluke Ohmmeter/multimeter in milliamps and seconds.

Results Curvilinear wheels were found to be 2-33% slower than flat-topped wheels on hard terrain such as concrete, asphalt and dirt/rock. This finding was due to this tire's low friction and therefore low acceleration. Plastic treads were found to be 11-34% faster on soft terrain, in comparison to rubber treads, when weight is distributed evenly. However, plastic treads are 10-18% faster on rough terrains when the weight is directly above the drive wheels. In comparison, when most of the weight is above the wheels themselves, flat-topped wheels are faster by 23-29% in all terrains except soft terrains such as sand. Flat-topped wheels are also the most energy efficient in those same terrains by 35-47% with the weight over all wheels. Wide, plastic-linking treads are most energy efficient in soft terrains such as grass and sand by 10-28% when there is an even weight distribution along the entire base.

Conclusions/Discussion These results not only supported the hypothesis but actually exceeded expectations. Plastic treads were more than 5% slower on rugged terrain and used almost 20% more energy in some tests. This was also found to be true with the curvilinear wheels. They are slower on smooth terrain and use more energy. The results also show how the design of the robot not only affects the amount of energy used but the overall effectiveness of each configuration.

Summary Statement This project's focus is to improve mobility and longevity of robots used by first responders out in the field.

Help Received Testing help and data recording from my mom and dad, proofreading and support from my mom and teacher Mrs. Gillum.