



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Michael S. Zeng	Project Number J1024
Project Title Short and Steady Wins the Race! Exploring Antennas in RC	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals As a passionate RC hobbyist, I've consistently experienced range issues. The objective of this project is: using readily available resources around me, to create a stronger transmitter antenna of my own design which will improve range of the radio-controlled vehicle I'm building. I also want to test impact that specific factors can have on antenna performance such as material, thickness, length and shape.</p> <p>Methods/Materials Copper and steel wires, RF explorer signal generator, RF explorer spectrum analyzer, multiple SMA connectors and basic tools (wire cutters, pliers, measuring tape and soldering pen). Signal strength was tested for each antenna design from 10ft and 20ft distance with data recorded in dBm.</p> <p>Results Among the 48 different combinations of antenna design I created, not just one, but many outperform the factory-made reference antenna. Best overall performer is $\frac{1}{4}$ wavelength straight AWG 14 copper antenna - with signal strength 3dB (2 times) stronger than that of the factory-made reference antenna, which results in double the power and 42% improvement in range.</p> <p>Conclusions/Discussion I concluded that standard factory-made transmitter set does come with fairly poor quality antenna performance. With a little more thought into the design, much better performing antenna can be designed at home for RC hobbyists like me. Some of the general learning I derived from this project include: 1. Material does have an impact on antenna signal strength, copper in general outperforms steel in transmitting strength. 2. No conclusive evidence can be found that length of antenna plays any determining role in signal strength (longer is not necessarily better). 3. Shape of antenna design plays a big part: coil and double coil lead the performance, followed by straight with L-shape lagging far behind. As I move from terrain vehicles onto drones as my next step of exploration, I believe antenna design will play a much bigger role in drone performance. Further research on more complex designs, antenna placement and orientation, omnidirectional and obstacle overcoming capabilities etc. can be valuable next steps!</p>	
Summary Statement To address the range issue of standard transmitter set for RC vehicle, I tested and created my own antenna design, which produces signal strength 3dB (2 times) stronger with 42% improvement in range.	
Help Received I had help from my school science teacher in undering the basics of radio frequency. I had help from my father in learning how to use the signal generator and spectrum analyzer tool. I researched, designed and tested all the antenna performance by myself.	