



**CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY**

Name(s) Roy D. Gross	Project Number J1011
Project Title Radiocartography: Mapping the Unseen World of Radio	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My project goal is to create a system that will map radio propagation across a city, allowing the user to visualize the abilities and limitations of their radio system.</p> <p>Methods/Materials To construct the signal generated map I created a transmitting unit and a receiving unit. The transmitting unit included a transceiver that transmitted a mostly continuous radio signal onto the air through an antenna. To avoid overheating and meet FCC requirements, I wrote an Arduino program running on an Arduino Uno to activate a relay that would stay on for 20 seconds and off for 2. This relay was connected electrically to the push-to-talk pin and ground pins so it would activate the transceiver when it was on. The receiving portion consisted of an antenna hooked up to an SDR receiver that was interfaced with a computer program. Every second the program recorded the time and signal strength coming into the receiver. An Android phone logged GPS data and recorded the position and time every second. The GPS, the logging system, the receiver, and its computer logging system were loaded in a car and the transmitter started transmitting. To conduct the experiment, the car was driven around on roads that were picked systematically to be spread slightly apart. Once enough signal and GPS data had been gathered, the components were all stopped and the data was uploaded to a spreadsheet on a computer. The data was analyzed by matching time stamps and the signal strength with the location. Finally the locations and corresponding signal strength were loaded onto Google Earth and averaging software (GNUPlot) was used to make the radio propagation map complete.</p> <p>Results My system generated a signal strength map showing radio propagation around Palo Alto. The map showed propagation decreasing with distance and terrain loss. I compared my map with professional software radio modeling (SPLAT!) and I found that SPLAT was similar but had lower resolution and details. After looking at the outcome, I repeated the experiment using a handmade directional antenna. This antenna showed much worse propagation, despite using the same power, location and transmitter.</p> <p>Conclusions/Discussion My system is a low-cost way of generating a radio propagation map. However, it takes a long amount of time.</p>	
Summary Statement Designing and testing a system for mapping radio propagation.	
Help Received I designed and built all the parts of the mapping system. My parents drove me around the city to collect signal data.	