



**CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY**

Name(s) Anthony J. Neuberger	Project Number S0107
Project Title Real Time Analysis and Optimization of Solid Fuel Rocket Engines	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Maximizing the efficiency of solid fuel rockets and controlling the flight profile requires the tailor engineering of multiple design features. Previously, I identified engine design features which had significant impact on thrust generation. However, data was collected and analyzed after the burn test. The purpose of this project is to simultaneously monitor multiple engine performance parameters, collect data on the millisecond timescale and analyze it in real time.</p> <p>Methods/Materials To achieve these goals, I designed and built a rocket engine test device with multiple sensors integrated into the apparatus. I also wrote a computer program called Rapid Information Procurement with Real-time Analysis Program (RIPRAP) which collects and analyzes data in real time. Thermocouples and pressure sensors were placed in the engine burn chamber and nozzle to monitor temperature and pressure. Analog signals from the sensors were converted to digital signals, imported into RIPRAP and analyzed.</p> <p>Results RIPRAP calculated the amount of fuel spent, the amount of fuel remaining, the dynamic pressure in the engine and nozzle, the volume and speed of the gas exiting the burn chamber through the nozzle and the energy and force produced over time. RIPRAP also generated theoretical flight profiles. All data was saved in spreadsheets for re-analysis with user-defined parameters to predict performance prior to building new engines. Finally, RIPRAP monitored engine performance against predefined values and generated digital output signals when appropriate.</p> <p>Conclusions/Discussion Future work will integrate these output signals into the rocket test device thereby completing the information and control loop.</p>	
Summary Statement Using a computer program that I wrote, data from rocket engines was collected and analyzed in real time and used to further optimize the test engines.	
Help Received Tuong Phan - taught me basic LabView programming, Phil Salzman - taught me how to work with pressure and temperature sensors, my dad helped me build the rocket engine test devices.	