



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

<b>Name(s)</b> <b>Andrew T. Land</b>	<b>Project Number</b> <b>S1009</b>
<b>Project Title</b> <b>Light on the G String: Novel Optical Pickup for Electric Cello</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The goal of this project is to develop and demonstrate an electric cello utilizing novel optical sensors directly monitoring the vibrations of each of the cello strings independently. The tone from each string can be independently processed in real-time giving unique flexibility for musical experimentation and performance on the opto-electric cello.</p> <p><b>Methods/Materials</b> The prototype began as a basic beginner cello. Novel optical sensors were designed, major structural surgery performed, and custom electronics designed. The optical sensor is a dual-segment photodiode placed close to the string. This is illuminated by a laser diode, with the string casting a shadow on the sensor. The differential signal across the photodiodes is proportional to the string displacement, independently digitized and read into a computer for real-time processing.</p> <p><b>Results</b> The optical sensors have been evaluated for frequency response and distortion characteristics relevant to the specific application of cello performance. Various processing options have been explored: transposing individual strings for different cello tunings; harmonically adjusting string tone; weird and wonderful distortions for novel applications. Frequency spectrum analysis of signals recorded from a high quality cello are compared with raw and processed tones from the opto-electric cello.</p> <p><b>Conclusions/Discussion</b> An opto-electric cello based on novel optical sensors independently monitoring each of the strings, with real-time computer audio processing, has been successfully developed. The power and flexibility of monitoring each cello string independently with these optical sensors and electronics offers a significant new range of capabilities for cello performance.</p>	
<b>Summary Statement</b> An opto-electric cello based on novel optical sensors independently monitoring each of the strings, with real-time computer audio processing, has been successfully developed.	
<b>Help Received</b> My dad subsidized the necessary materials, helped me with the data acquisition and the poster graphics.	