



**CALIFORNIA STATE SCIENCE FAIR  
2004 PROJECT SUMMARY**

<b>Name(s)</b> <b>J. Robbie Eaton</b>	<b>Project Number</b> <b>S0704</b>
<b>Project Title</b> <b>DigiSonic Batman: He's Watching You!</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> My project explores the feasibility of using 5 kHz sound pulses and twin microphones to determine both distance and location of target objects. The application is for autonomous robots or as a blind guidance aid.</p> <p><b>Methods/Materials</b> The last version of my sonar system is composed of a high power tweeter speaker, two condenser microphones, a commercial microcomputer board, an analog signal board, and a servo-controlled dummy head pointing device. The system acts as an interferometer, comparing the phase of signals from two microphones. The microphone signals are amplified and noise filtered, then digitized and fed to the microcomputer which uses triangulation to find the azimuth of the closest target. My program then generates a control signal based on the azimuth which drives the servo pointer. After extensive problems and experimentation with false signal detection, I applied a cross correlation technique used in aircraft transponders which significantly improved operation.</p> <p><b>Results</b> After re-working the analog electronics several times and trying a number of different approaches to detecting the sound pulse, my model now demonstrates that both range and azimuth of a target can be determined. I found that low-frequency and subsonic background noise ("thuds") must be completely filtered to get reliable results.</p> <p><b>Conclusions/Discussion</b> The method used to detect and compare the received signals has a large impact on the reliability of this sonar system. My work could be extended to include multiple target detection. Using a higher frequency sound pulse may help eliminate background noise, but finding very small microphones (because of decreasing wavelength) could be a challenge.</p>	
<b>Summary Statement</b> My project involves the design, construction, and experimentation on a phase comparison sonar useful as an autonomous robot guidance system.	
<b>Help Received</b> Father gave me a paper design for the analog circuits for me to build and debug since I don't know how to design analog yet. Flight instructor explained cross correlation technique. Mother drove me to buy parts, and also took pictures of my project.	