ABSTRACT

The objective of this thesis is to design and implement a sound tracking system. The system is designed to track a moving target (a car) and guide an interceptor (another car). The sound tracking system is designed using an acoustic sound array constructed from three microphones that can resolve sound disturbances up to 3000 Hz. The interceptor is controlled using a PD controller.

To achieve this goal, numerical simulations were first considered. The simulations were performed to examine different signal filter techniques, design a suitable array of sensors and geometrical considerations to track high sound frequencies. A Fourier transform was performed to analyze the signals in the frequency domain, and a delay and sum approach was used to process the signals. Kalman filter was used to filter the noise. Successful simulations were performed to track and guide the interceptor for a dummy simulated target.

The experimental portion of this thesis consists of a set of experiments which were developed with increasing complexity. First, the acoustic array was used to identify the location of a fixed sound source with known disturbance frequency. Then the fixed acoustic array was used to identify the angle, hence the location of a moving target. Finally, the acoustic array was used to guide the interceptor to track and intercept the moving source. The nonlinear behavior of the interceptor was taken into consideration using saturation element. The problems that arose from nonlinear element was solved using gain schedule PD controller. Experimental results show that the system was successful in tracking and intercepting the moving target. The final system has the advantages of the homing guidance with the simplicity of the command guidance so that this thesis has shed light to the different aspects of implementation of guidance systems.