

Ultrasonic Imaging System (Digital Sonar)

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Abstract

For this project we will design and implement a system that uses the information collected from ultrasonic echo detection to construct a graphical representation of its environment. This will require the construction of a support structure for a set of ultrasonic transmitters and receivers, as well as any circuitry necessary for signal amplification and analog to digital conversion to interface with the labkit FPGA. All signal processing beyond basic amplification and filtering will be implemented as Verilog modules running on the Xilinx FPGA. These signal processing tasks include pulse generation, echo detection and interval measurement, coincidence detection, buffering data to memory, constructing the environmental representation, and interfacing with the video hardware to display this representation on a VGA monitor.

The initial part of the project will require us to construct and test the interface circuitry for the ultrasonics, as the results of these experiments will determine which of two strategies we pursue. If our signals are relatively weak and spatial resolution is poor, we will pursue a solution which mechanically sweeps the ultrasonic array through a fixed angle, measuring the distance to objects in its perimeter. If the signals are strong and distinct enough, we may attempt to use the information from multiple echo paths to construct a real-time image of the three-dimensional space in front of the ultrasonic array.