Acoustic Fossil Imaging

Functional Description
By
Matt Kaiser and John Lewis

Advisors: Dr. James H. Irwin and Mr. José Sánchez

Project Description
The acoustic imaging system will consist of three major components the ultrasonic sensor, sensor controller, and personal computer. The ultrasonic sensor will capture the sound wave input while the personal computer will display the image output on a computer screen. The block diagram for this system can be seen in Figure 1. The personal computer will use MATLAB to process the signals provided by the ultrasonic sensor. The goal of the project is to be able to image fossils buried within a rock. Preliminary work will be done using a fish tank filled with water and sand. Objects will be buried in the sand, and the imaging system will attempt to locate and image the objects. This implies that an accurate picture of the buried object can be portrayed on the PC screen. The key component of the imaging system will be the ultrasonic sensor.

Function of System Inputs and Outputs
Ultrasonic Sensor/Controller
A high frequency ultrasonic sensor will be used to attempt to image the objects. An immersion transducer will be used for the ultrasonic transmitter. The benefit of an immersion type transducer is that it is impedance matched to water. The sensor will have to operate at a high frequency of around one megahertz in order to properly propagate and penetrate the water and sand. Objects will return echoes that will be captured with a receiver. The receiver can either be mounted with the transmitter or as a separate unit. Also, if time permits multiple receivers will be used for better triangulation. The transmitter and receiver(s) will be mounted at fixed points for more accurate data acquisition. It is also possible that the sensor could scan up and down the tank using a control mechanism.

Data Acquisition
After the ultrasonic sensor takes readings the data will be sent to a personal computer for data manipulation. A data acquisition card will be acquired in order to bring the sensor data into the personal computer. Once the data is in the personal computer, MATLAB will be used to do the signal processing. Measuring the time delay of the echoes received by each receiver will allow the objects position to be determined. The strength of the echoes will determine that there is some object buried beneath the sand. The processed information will then be displayed graphically via the personal computer monitor.
Figure 1: High-Level System Block Diagram

Figure 2: Data Acquisition and Computation Routine