Factors that Affect the Accuracy of 3-Dimensional Acoustic Locating for Sound Emitting Objects

Zakharova, Maria

The aim of this project in acoustics/physics was to investigate factors affecting the accuracy of 3-dimensional acoustic locating of objects that emitted sound in air. The study dealt with such phenomena as “sound” and “waves”. An audible sound source (punctured balloon) was located using experimental time-of arrival measurements on four microphones pre-installed in a room. A localization algorithm has been implemented using a method inspired by the Global Positioning System. The apparent coordinates of the object were compared with the actual ones in order to quantify the locating error. Some hypotheses have been formulated regarding the factors that might affect the locating accuracy (such as reduced accuracy with range, dependency on microphone layout geometry and sampling frequency), and tested experimentally. Particular attention was given to theoretical explanation of the experimentally observed effects and dependencies. The main theory for explaining the observed locating errors was the Positional Dilution of Precision. The challenge of explaining some experimentally observed anomalies was solved through analysis of the discrete nature of data acquisition. Based on better understanding of how the 3-dimensional acoustic locating systems worked, a couple of practical recommendations regarding the data sampling frequency and layout of the microphones were formulated to improve the precision. The results of this investigation may be of interest for the engineers who design the acoustic locating systems.