Self-Adaptive Methods to Characterize Bio-Acoustic Scattering and Propagation

W. A. Kuperman
Marine Physical Laboratory of the Scripps Institution of Oceanography
University of California, San Diego
La Jolla, CA 92093-0238
phone: (858) 534-7990 fax: (858) 246-0182 email: wkuperman@ucsd.edu

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LONG-TERM GOALS

We intend to develop physics-based models of acoustic wave propagation and scattering in complex media that could help to predict backscattering and forward scattering by marine animals by applying dat-based signal processing techniques for understanding and characterizing biological-acoustical coupling in acoustic propagation and scattering

OBJECTIVES

The objective of our research to develop data-based sensitivity kernel analysis methods to detrmine the location and potentially scattering properties of individual scatterers embedded in a complex propagation environment.

APPROACH

The approach is to collect data in an laboratory setting and then develop and apply a data-based sensitivity anlysis to locate the scatterers and potentially determine their cross sections.

WORK COMPLETED

We had performed a laboratory experiments using a collection of scatterers (ping pong balls) placed in a large, reverberant tank (~5 m diameter). Using a set of sources and recievers, we collected and ananlyzed the data and applied the data-based sensitivity kernel analysis to localize individual scatterers.

RESULTS

Using the source receiver arrangement shown in Fig. 1 we collected scattering data from scatterers within the tank. From this set of data, we constructed a sensitivity kernel from which we could localize scatterers. If the scatterer was at one of the measured grid points, then of course, the localization was straightforward since that data was also contained within the sensitiity kernel matix.

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The issue and important result was to locate scatterers not placed at a grid point using the measured data set. A method was developed to localize such scatteres not on the measured grid points without using a complex propagation/scattering model. Figure 2 is an example of such results. These results are presently being written up for submission to JASA.

IMPACT/APPLICATIONS

The typical approach to localization in a complex medium involves some sort of modeling, Mulitple scattering in a complex medium is an extremely difficult and computationally intense modeling problem. Here, we have shown that using measured data, we can potentially perform such localizations without complex modeling, albeit, under the limited conditions of this experiment. However, this start may be generalizable to more practical scenarios

RELATED PROJECTS

This project addresses topic # 4 of the ONR Fish Dynaimics BRC.

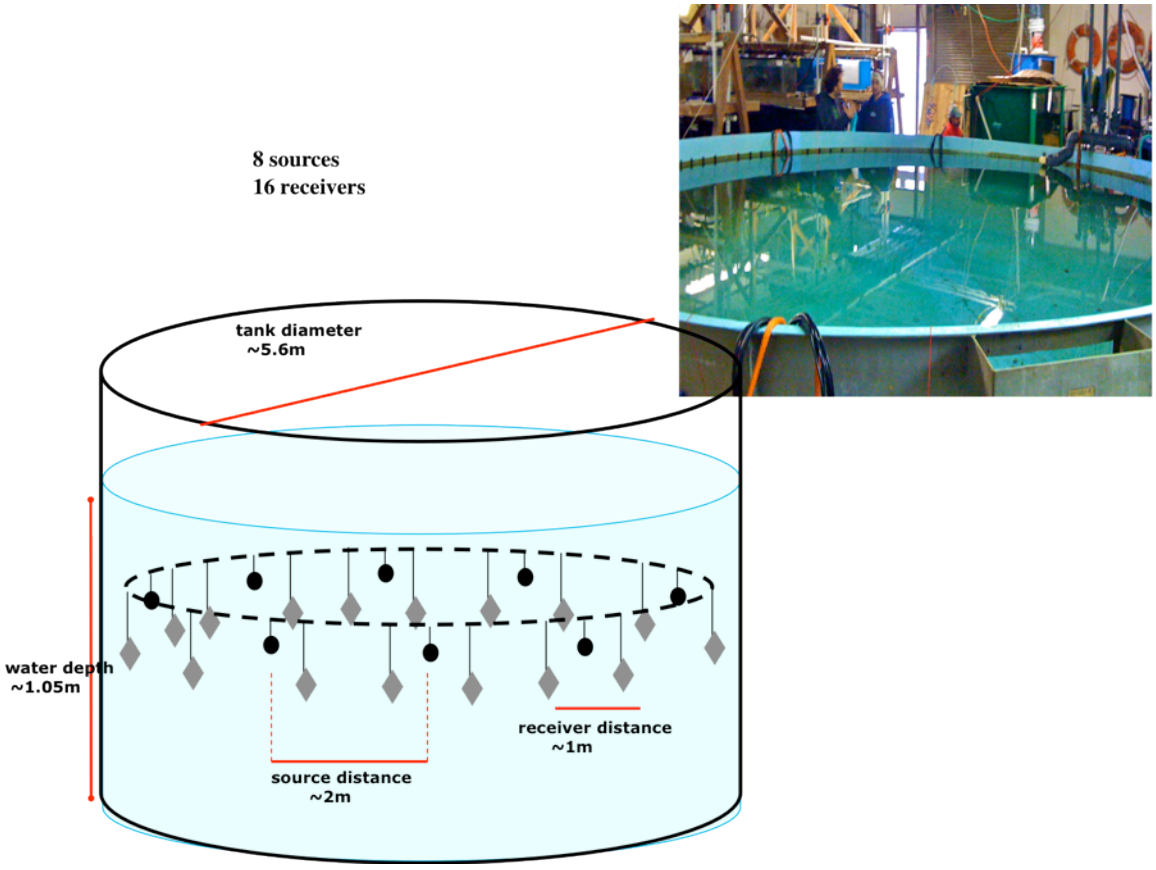

Figure 1. Tank Experiment. The tank contains a grid (next figure) at the acoustic data is accumulated for a scatterer at a set of grid determined locations.

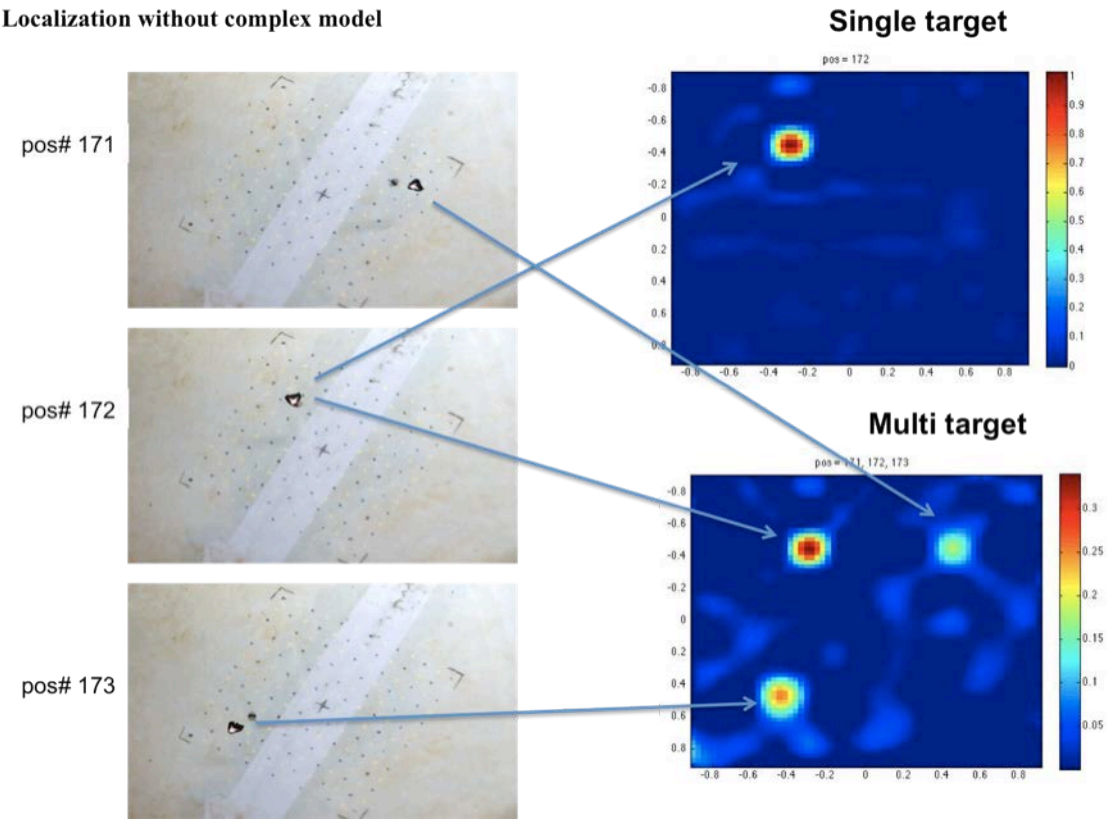

Figure 2. Examples of locatlization ot 1 and three scatterers not placed at the grid points.