PERFORMANCE PREDICTION VIA THE JAVA ACOUSTIC MODEL INTERFACE

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1. INTRODUCTION

Performance prediction provides an important and essential link between the underwater acoustics research community and industry (environmental concerns) or the military (surveillance). Nominally, performance prediction (e.g. CASS-GRAB [Keenan, 2000] or SPADES [Brooke, 2008]) involves the use of an acoustics model to generate field predictions for a particular ocean environment given locations of particular sensors and targets; these data are then combined with some detection criteria and assumed (or computed) noise background to produce and display a measure of the performance of sensor against target [Ellis and Pecknold, 2010]. Currently, no one acoustics model can handle the wide range of frequencies implied by either military or industrial applications. The java Acoustic Model Interface (jAMI) is under development with the intent of providing a framework for a Client-Server approach to performance prediction in which the problem configuration and display reside on a thin Client and the models and other computational engines are centralized on a more powerful backend computer or Server.

In jAMI, the Client is programmed exclusively in Java whereas the backend consists of a combination of C and FORTRAN code designed to take advantage of as many existing and publicly available codes as possible. Currently, jAMI supports SAFARI [Schmidt, 1988], PECan [Brooke et al., 2001], POPP [Ellis, 1985], and BellHop [Porter, 1987] for simple propagation studies and the DRDC Clutter model [Ellis et al., 2008; Brooke et al., 2010] for reverberation and target predictions. A C-interface layer has been written that provides seamless interaction of all three languages. This same interface also provides the links to public domain environmental databases for bathymetry (Gebco), sound speed via temperature and salinity (World Oceanographic Atlas, WOA), and bottom composition (Deck41). Ultimately, the goals are to develop a chart-based application that performs transmission loss, target echo, reverberation, and ambient noise computations for real ocean environments obtained from the databases at specific locations as well as process pathological test cases supplied by the user. Standardized displays for environmental and acoustic parameters are under development, that coupled with the chart and database capabilities should result in a comprehensive and powerful performance prediction application.

In this paper we describe some of the software architecture considerations, the Java parameter interface and display capability, and finally present some transmission loss and reverberation results for select cases.

2. SOFTWARE ARCHITECTURE

A schematic of the jAMI application is shown below in Fig. 1. One of the main design considerations has been the separation of the parameter input and display capability (i.e., the Client) from the computational engine (i.e., the Server or backend). As illustrated, this has been effected using a TCP/IP socket connecting the Client to a C-interface layer on the Server side. This allows the Client to be programmed exclusively in Java; Java is freeware, relatively easy to port between operating systems, and has powerful Graphical User Interface (GUI) building capabilities. As shown, the Client allows the User to input parameter values, choose between models, choose between output field quantities, run the models, display the results, and, finally, using a special 'Browser' component, allows the User access to HTML HELP files (and the Web if desired).

The C-interface layer accepts data from the TCP/IP socket connection and then links up to the appropriate model and if necessary to the environmental databases. Currently, at time of writing, the model suite is limited to the existing FORTRAN codes (listed in the figure) but in future, models written in C could also be accommodated. Similarly, the code currently supporting the manipulation and extraction of environmental information from special, packed ASCII files is written in C but this does not preclude FORTRAN database code in the future. Finally, it is worth mentioning that the jAMI application can be run in various standalone configurations and the total package (including database files) fits comfortably on a modern laptop computer.

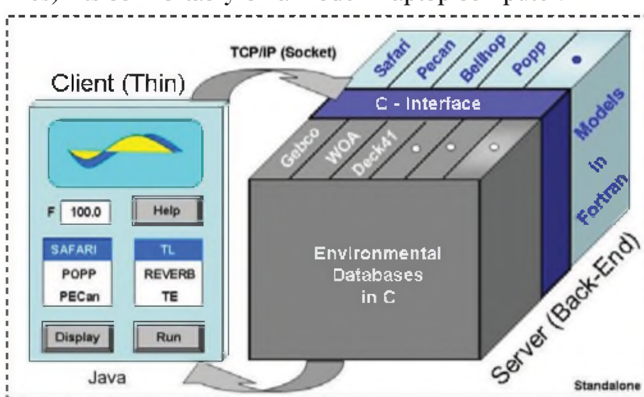

Figure 1. jAMI software architecture and configurations.

3. RESULTS AND EXAMPLES

Active sonar performance prediction involves the calculation of reverberation. jAMI currently employs the DRDC clutter model for such calculations. A typical 'clutter map' display of beam (bottom) reverberation as a function of range and azimuth is presented in Fig. 2 below. This pathological case and involves a 32-element horizontal line array oriented perpendicular to an iso-speed shallow-water wedge waveguide. The figure indicates more reverberation from the directions in which the water depths are shallowest, as expected.

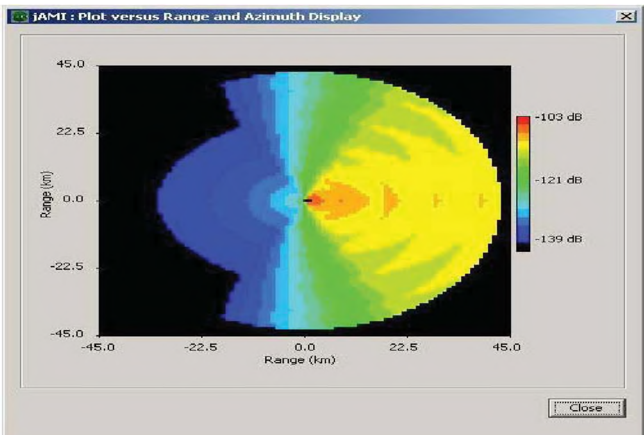

Figure 2. Beam reverberation plotted as a 'clutter map'.

A very important aspect of accurate performance prediction involves the proper use of acoustic models to account for the propagation effects. One of the primary design goals for the jAMI application was to allow access to a number of established propagation models via a common GUI and display. Plots of propagation loss versus range or depth provide useful information when deciphering performance issues. A typical range display is shown in Fig. 3 below where we plot propagation loss versus range for two different models (SAFARI and PECan) applied to the shallow water (100 m), Pekeris waveguide test case known as NORDA 3b [Davis et al., 1982]. The two models agree very well over the entire range as expected. These results were obtained by configuring the models in the Client,

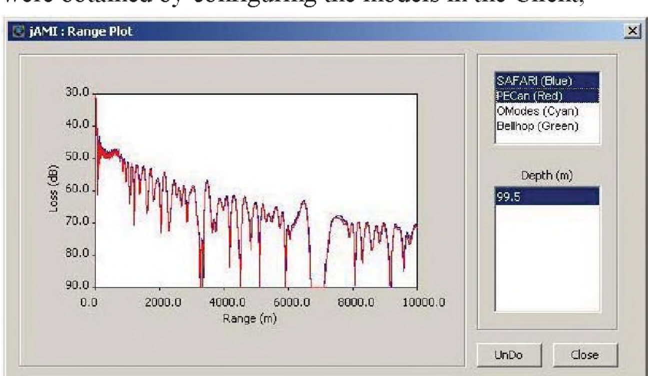

Figure 3. Propagation loss versus range (NORDA 3b test case).

running the models on the Server, and then displaying the results back on the Client.

4. DISCUSSION

The jAMI application is constantly evolving and being refined. One of the strengths of Java is the relative ease by which changes can be made to the GUI and display code. By design, jAMI has been modularized so that other models/databases can simply be 'plugged in'. Future plans include a chart display and environmental viewer/display functionality.

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