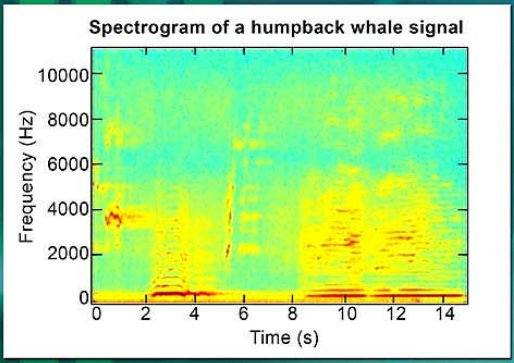
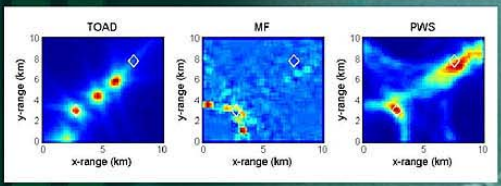
MAUI HIGH PERFORMANCE COMPUTING CENTER

Tracking Humpback Whales with Passive Acoustics

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Since many marine mammals are very vocal, passive acoustic techniques present a highly promising approach to marine mammal studies, monitoring, and human impact mitigation. They can be used as an addition/alternative to more traditional visual and tagging techniques, which may be costly, invasive, and limited to favorable environmental considerations (such as sunlight and calm seas). Advantages of passive acoustic methods include relative cost-efficiency, non-invasiveness, and potential for long-term monitoring.





Ambiguity surfaces (probabilistic indicators of source location with red indicating highest probability) in plan-view using the TOAD, MF, and PWS processing methods. Three receivers were used to localize two sources (indicated with white triangles) in 0 dB signal-to-noise ratio. Environmental uncertainty is in the form of incorrect bottom depth: 200 m for the forward model, 204 m for the inversion. Only PWS finds both sources correctly.

Use of HPC Resources: Computational demands associated with the prediction of Green's functions for each receiver/candidate source location pair increase with the product of frequency and range. Since our localization uses frequencies up to several kHz and we wish to localize at ranges of up to tens of kilometers, high-performance computing (HPC) resources are required to use the PWS method. Fortunately, the computations of Green's functions at different locations are independent, which means they parallelize well. Further computational demands are associated with spectrogram computation and inner products. Once again, since computations for difference candidate source locations are independent, this step parallelizes well. Once our algorithms were developed and implemented on a partial scale (fewer frequencies, shorter ranges) using desktop PCs, they were parallelized and ported to the Squall system at MHPCC for full scale testing and simulations.

Results and Future Work: We developed and tested PWS processing on simulated data.1 One of our more recent simulations is shown in Figure 1. The PWS method clearly outperforms both the TOAD and MF method in localizing both sources. We are currently collecting data of singing humpback in Hawaiian waters that will be used to test PWS in a real life situation. Processing of this data will require HPC resources for which we plan to continue to use the Squall system, and possibly the Tempest system, at MHPCC. We are also working on a variety of different processing techniques for localizing other species, such as sperm whales,2 blue whales, and spinner dolphins.

Solving the hard problems...