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# Computational Acoustics

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## LONG-TERM GOAL

Development of new, efficient, 3-dimensional, mathematical and computer models useful for solving acoustic propagation and all-direction scattering problems covering long-range, rough-bottom, and fluid/elastic interfaces in complex shallow water, as well as intermediate water depth, environments. Writing review papers in Ocean Acoustics.

## OBJECTIVES

For FY98, we continued to collaborative efforts with university scholars in making valuable contributions for Navy applications in the following ongoing research areas: (1) 3-dimensional coupled fluid-elastic modeling, (2) scientific technical activities involving: (a) publications, (b) delivering invited and contributed papers to international scientific conferences as a means of reporting our progress, disseminating information, and attracting more interest in the field, (c) fulfilling the role of editor-in-chief of the J. Computational Acoustics, and (3) remain current on other state-of-the-art technical developments related to our research topics that may stimulate our research topics.

## APPROACH

Develop practical ocean acoustic wave propagation prediction models for solving Navy problems as the first step. Incorporate additional useful capabilities to our existing models. Create new numerical mathematical schemes along with the application of theoretical and applied mathematics required for the development of propagation models. Models are developed to handle all complex ocean environmental conditions by means of scientific computing (moderate to large-scale computations).

## WORK COMPLETED

Prior to FY98, besides new numerical schemes, we had developed 2 acoustic wave propagation prediction models, the IFD (a 2-dimensional model) and the FOR3D (a 3-dimensional model). The accomplishments during the past Fiscal Year include: (1) the development of a 3D coupled fluid-elastic wave propagation mathematical model, (2) a numerical solution for the above mathematical model, (3) attempting an effort to incorporate the fluid-elastic interface into the FOR3D model, and (4) publications.

## **RESULTS**

Results include: (1) development of a mathematical model which represents a 3D coupled fluid-elastic wave propagation, (2) introduced a convergent numerical scheme to solve the above equations, (3) 2 invited presentations, and (4) 2 publications.

## **IMPACT/APPLICATION**

A large number of fellow scientists and scholars nationwide and worldwide have been using our models for research, applications, reference, and Ph.D. thesis writings. Prior to calendar year 1997, our record showed over 100 users who requested our codes for various purposes. The number of users increased, especially for the 3D (FOR3D) model.

## **TRANSITIONS**

The FOR3D model has been placed on the World-Wide-Web for public use. National Taiwan University has been using the FOR3D model for real shallow water applications.

## **RELATED PROJECTS**

This research project is related to NUWC Independent Research Project: Fluid-elastic Interface Modeling.

## **REFERENCES**

- [1] Lee, D. and S.T.McDaniel, *Ocean Acoustics Propagation by Finite Difference Methods*, Pergamon Press, Oxford, 1987.
- [2] Lee,D. and M.H.Schultz, *Numerical Ocean Acoustic Propagation in Three Dimensions*, World Scientific Pub. Co., Singapore, 1995.

## **PUBLICATIONS**

- [1] Lee,D. and E.C.Shang, "Numerical Treatment of Bottom Interaction in Shallow Water Environment," *Proc. SWAC '97*, Beijing, China, 1998, 59-64.
- [2] Lee,D., R.J.Nagem, D.Resasco, and Chifang Chen, "ACoupled 3D Fluid-elastic Wave Propagation Model: Formulation and Analysis," *J. Applicable Analysis.*, Vol.68, 1998, 147-178.