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3-D Structural Acoustics Modeling with HP-Adaptive Finite Elements

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The Centre has developed a 3-D hp-adaptive finite-element structural acoustics code for modeling acoustic scattering from underwater elastic structures. The entire fluid-structure domain is treated as a single continuum, which is modeled using only one type of finite element: a fluid-solid element. The wave equations for both media are derived from the same underlying equations of continuum mechanics, and then combined into a single wave equation, from which the fluid-solid finite element is derived. 3-D continuum mechanics is used throughout the computational domain; thin structural components, such as plates and shells, are modeled with 3-D physics rather than plate or shell theories. The formulation is therefore fully 3-D, i.e., in both physics and geometry. The paper describes an unusual approach to code development, explains the underlying physics and mathematics, and presents several scattering and propagation models.

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