SANTIAGO NUMÉRICO I
Cuarto Encuentro de Análisis Numérico de Ecuaciones Diferenciales Parciales
Facultad de Matemáticas, Pontificia Universidad Católica de Chile, Enero 14 - 16, 2009

hp-Adaptive Finite Elements for Multiphysics Wave Propagation Problems

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Abstract

I will attempt to combine an overview of our experience with *hp* finite elements and the automatic *hp*-adaptivity for wave propagation problems, with a presentation of new research topics focusing on multiphysics coupled problems.

The first part of the talk will focus on fundamentals of *hp*-discretizations of wave propagation problems: acoustics, elasticity and electromagnetics. We will shortly discuss the issues of stability and approximability for time-harmonic problems emphasizing the difference between the elliptic and Maxwell problems. I will review the main results of the theory of projection-based interpolation and discuss its importance in both the theoretical (proof of discrete compactness for *hp* methods) and practical (automatic *hp*-adaptivity) context. This part of the presentation will deliver "punch lines" only, and I will finish it by "flashing" a few representative examples.

The second part of the presentation will address our current work on multiphysics coupled-problems. Using a coupled acoustics/elasticity problem, I will outline new challenges that we have faced when generalizing the *hp* methodology to this class of problems. This will include a discussion on *hp* data structures, use of fractional Sobolev norms, and both energy- and goal-driven automatic *hp*-adaptivity algorithms. The discussion will be illustrated with numerical solutions of 3D axisymmetric problems.

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