Department of Mathematical Sciences Colloquium

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On the hp-FEM for Time-Harmonic Maxwell's Equations

The *hp*-FEM is a modern version of the finite element method (FEM) which achieves outstanding efficiency through optimal combination of the size and polynomial degree of elements. In this talk we present a couple of our recent results related to time-harmonic electromagnetic fields.

We begin by introducing a new class of higher-order $H(\mathrm{curl})$-conforming shape functions based on the generalized eigenfunctions of the curl-curl operator. These shape functions possess a unique simultaneous orthogonality in the semidefinite curl-curl product and in the L^2 product. This property has a positive impact both on the sparsity and conditioning of the stiffness matrix, and moreover, the new shape functions fit naturally into the De Rham diagram. Numerical comparisons show that these shape functions have better conditioning properties than other widely-used shape functions for electromagnetics.

In the second part we discuss automatic *hp*-adaptivity with arbitrary-level hanging nodes. In this way, all element refinements are completely local which greatly simplifies the design of adaptive algorithms compared to other approaches. It is demonstrated numerically that the employment of arbitrary-level hanging nodes also has positive impact on convergence rates.

Finally we discuss the treatment of curvilinear triangular and quadrilateral elements via NURBS. Curvilinear elements allow for better approximation of curved boundaries and they can improve the performance of the *hp*-FEM significantly. Numerical examples are presented.

Friday, February 16, 2006 at 3 pm in Bell Hall 143
The University of Texas at El Paso

Refreshments will be served in front of the colloquium room, 15 minutes before the start of the colloquium.

For further information, please contact Dr. Pavel Šolín, Bell Hall 220. Phone: (915) 747-6770, email: `solin@utep.edu`.