Department of Mathematical Sciences Colloquium

PAVEL ŠOLÍN
Department of Mathematical Sciences, UTEP

New Discrete Maximum Principle for hp-FEM

Maximum principles belong to the most important results in the theory of partial differential equations (PDEs). Briefly said, they make it possible to bound the values of the solution inside a domain by means of its values on the boundary. For example, a classical maximum principle for the Laplace operator says: Every bounded harmonic function ($-\Delta u = 0$) attains both of its extrema on the boundary. Such results have many interpretations in computational physics – u can be, e.g., the temperature, electric charge density, flow pressure, or neutron flux in nuclear power stations. Maximum principles also are crucial for convergence proofs of finite difference (FDM) and finite element methods (FEM), and in numerical analysis of PDEs in general.

In order to comply with physics, every numerical method for PDEs should transfer the maximum principles to approximate solutions (then they are called *discrete maximum principles*). Unfortunately, most methods need careful analysis and adjustments before they do. The analysis of discrete maximum principles is highly desirable from the point of view of reliable engineering and scientific computing.

Although numerous results exist on the DMP for traditional lowest-order finite element methods, almost nothing is known about the DMP for modern higher-order finite element methods (*hp*-FEM). In 1981, Höhn and Mittelman published a negative result which indicated that extensions of DMP to the *hp*-FEM are not likely to hold. This was generally assumed until several months ago, when we succeeded to prove a positive result on this topic (of a qualitative nature). In the present talk we introduce a new, more advanced result which is quantitative, and therefore much easier to use in practical computations. This is a joint work with Dr. Tomáš Vejchodský (Academy of Sciences of the Czech Republic).

Friday, January 20, 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`.