Graduate Talk
Discontinuous Galerkin Methods: A (very short) overview

In this talk, we give an overview of the development of the Discontinuous Galerkin methods. These methods were introduced back in 1973 for linear hyperbolic problems and are currently being applied to a wide variety of problems including KdV-type equations, granular flows and computational structural mechanics. In this talk, we describe these methods and uncover the properties that render them so attractive in each of the following type of equations: linear hyperbolic, second-order elliptic, incompressible fluid flow and, finally, compressible fluid flow.

Colloquium
New hybridization techniques

Hybridization of numerical method was introduced back in 1965 by Fraejis DeVeubeke as a trick to numerically solve the equations of linear elasticity. Twenty years later, Arnold and Brezzi discovered that the technique can also be used to actually enhance the quality of the approximation. Recently, new, unsuspected applications of hybridization have been uncovered. It can be used to implement mixed method in a more efficient way, it can be used to bypass the inf-sup condition, and it can be used to obtain exactly incompressible approximations to the Stokes problems without having to actually construct divergence-free finite dimensional spaces (something considered to be a very difficult challenge). In this talk, we describe the technique and illustrate each of the above applications.

Colloquium
Continuous dependence, error estimation and adaptivity
for Hamilton-Jacobi equations

In this talk, we show how to construct continuous dependence results for parabolic equations that remain valid when the second-order term vanishes. These continuous dependence results can then be used to characterize the exact solution of Hamilton-Jacobi equations (the so-called viscosity solution) and to establish the corresponding approximation theory. A posteriori error estimates are obtained which are then used to devise adaptive algorithms for Hamilton-Jacobi equations. Numerical results in one and two space dimensions are shown which indicate that the adaptive method enforces a strict control of the error in the uniform norm with optimal complexity.