Efficient upwind finite element methods and finite point method for convection diffusion problems.

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In this talk, we consider the design of robust and accurate numerical approximation methods for solving convection-diffusion problems.

We develop some two-parameter streamline upwind schemes with piecewise bilinear (or linear) trial functions and show that these schemes satisfy the necessary conditions for L2-uniform convergence of order greater than 1/2. For smooth problems, the schemes satisfy error bounds of the form O(h)lul_2 in an energy norm.

We also study a tailored finite point method (TFPM) for solving the convection diffusion problems. The solution basis functions for the TFPM are constructed for a 5 point, 7 point and 9 point stencil. Some truncation error calculations are given.

Numerical tests are given on problems containing a boundary or interior layer. The tests compare TFPM with several versions of a upwind finite element schemes, and suggest that TFPM gives superior resolution of the layers without any requirements on alignment of flow and grid.