A Cell-Centered Anisotropic Diffusion Scheme on Two-Dimensional Unstructured Meshes

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- **Introduction**

The goal of this presentation is the description and investigation of a new finite volume scheme for solving anisotropic diffusion equations on two-dimensional unstructured grids. Our scheme is primarily intended for use in applications where occur a strong coupling with a cell-centered hydrodynamic scheme. Therefore, we have developed a robust, cell-centered diffusion scheme, which provides accurate results even on highly distorted grids.

- **Isotropic scheme**

The main feature of this scheme lies in the introduction of two normal fluxes and two temperatures on each edge. A local variational formulation written for each corner cell provides the discretization of the normal fluxes. This discretization yields a linear relation between the normal fluxes and the temperatures defined on the two edges impinging on a node. The continuity of the normal fluxes written for each edge around a node leads to a linear system. Its resolution allows to eliminate locally the edge temperatures as function of the mean temperature in each cell. In this way, we obtain a small symmetric positive definite matrix located at each node. Finally, by summing all the nodal contributions one obtains a linear system satisfied by the cell-centered unknowns. This system is characterized by a symmetric positive definite matrix. We show numerical results for various test cases which exhibit the good behavior of this new scheme. It preserves the linear solutions on a triangular mesh. It reduces to a classical five-point scheme on rectangular grids. For non orthogonal quadrangular grids we obtain an accuracy which is almost second order on smooth meshes.

- **Anisotropic scheme and applications**

The anisotropic extension is straightforward since the discretization is based on a local variational formulation. The scheme is derived in the same way as in the isotropic case. We show on several numerical test cases the good behavior of the scheme. We also show that our scheme can deal with the anisotropic Braginskii conductivity, which is used to modelize electronic heat conduction in a magnetized plasma.