Title: **A Conservative Characteristic Finite Volume Element Method for Solution of the Advection-Diffusion Equation**

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Advection-diffusion equation presents a challenge for numerical methods for cases in which the diffusion term is not clearly dominant. Standard finite volume methods can model diffusion dominated processes to a high degree of accuracy and proper preservation of mass. Unfortunately the introduction of any significant advection introduces spurious dispersion effects in the solution, destroying the accuracy for all practical purposes. Thus, finite volume methods are not well suited to solve hyperbolic equations because of their inability to follow sharp fronts and preserve mass. Numerical approaches that follow the characteristic method are better suited for the advancement of the solution of pure advection equations.

Eulerian-Lagrangian methods capture the advantages of the characteristics method and the computational convenience of a fixed grid. The critical component of these methods is the interpolation method that may degrade mass preservation.

The author presents a scheme that combines the properties of the characteristics method with the mass conservation of the Eulerian-Lagrangian localized adjoint method, *ELLAM*[1]. One of the features of the proposed scheme is that existing computer procedures for the characteristic and finite element analysis can be readily adapted to the proposed method.

For the finite volume, emphasis was put on obtaining a formulation that conserves mass globally and locally on the Lagrangian, space-time control volume.

The numerical example of the two-dimensional rotating Gaussian pulse is used to show the accuracy and mass preservation properties of the proposed

algorithm.

References:

1. M. A. Celia, T. F. Russell, I. Herrera and R. E. Ewing *An Eulerian-Lagrangian Localized Adjoint Method for the Advection-Diffusion Equation*, Adv. Water Resour. Vol 13, 187–206, 1990.

See also:

1. F. Gao and Y. Yuana *The characteristic finite volume element method for the nonlinear convection-dominated diffusion problem*, Computers and Mathematics with Applications Vol. 56, no. 1, pp. 71-81, 2008.

2. J. Gárfias, I. Herrera, C. André, H. Llanos, *Generalized Eulerian-Lagragian Method of Cell for Contaminant Migration and Comparison with other Methods*
`http://www.mmc.igeofcu.unam.mx/iherrera/Articulos/156.pdf`