Discussion of *Derivation of high-order advection-diffusion schemes* by Pavel Tkalich, 2006 *J. Hydroinf*. 8(3), 149–164

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The Discusser would like to congratulate the Author for rigorous development and complete treatment of numerical characteristics of finite difference schemes derived from the concept of polynomial interpolation of advected (concentration) values at the foot of backwards characteristic. It is important that such complete treatment is published nowadays because the current practice of using market-available codes without knowledge of underlying numerical problems leads not only to the blind application of "encapsulated methods" but also does not help to awaken a vocation and liking for numerical analysis in younger generations.

This said, the Discusser is disappointed to see that the paper seems to imply that the only way to obtain high-order schemes is to develop them from piece-wise interpolation algebraic polynomial such as given by Eq. 2. Such procedure leads automatically, when higher order approximations are concerned, to involvement of more than two computational points in space. Thus the difference upwind formulas needed to compute the advected values at point x_i^{n+1} involve computational points x_i, x_{i-1}, x_{i-2}, and even x_{i-3} at times level t_n. While such an approach is perfectly correct for functions that do not present large variations in space, it is awkward to apply in simulation systems for real rivers and streams. Indeed, not only boundary conditions ask for special procedures (as the Author shows in Appendix B) but it is very difficult and even tricky to include internal special conditions such as weirs, brusque variations of cross-sections, bifurcations etc. Such difficulties are well known to all developers of the schemes applied to simulate unsteady flows that include more than two space computational points (or more than one space interval). For that reason a fourth-order two-point advective transport scheme has been developed and it is disappointing that the Author neither mentioned nor included the reference to that development in his bibliography. This fourth-order two-point scheme is based on the hermitian interpolation of advected values at the foot of backwards characteristic and its originality comes from this approach: instead to follow classic algebraic polynomial procedure new finite difference scheme was developed, or should we say invented, to be coherent with a two-points *unsteady flow* simulation scheme. This scheme virtually eliminates numerical diffusion and thus permits modelling physical convection and physical diffusion without having to compensate for numerical inadequacy.

The development of the fourth-order two-point scheme was carried out by F.M. Holly, Jr and A. Preissmann (1977). The description and details can be found in this paper and other referenced papers (Cunge *et al.* 1980; Holly & Usseglio-Polatera 1984; Holly and Toda 1984).

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