STUDY OF A 3rd ORDER RESIDUAL DISTRIBUTIVE SCHEME FOR ADVECTION DIFFUSION EQUATION

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The multidimensional upwinding Residual Distribution (RD) schemes are a robust class of schemes for the solution of hyperbolic systems of equations. (RD) extension to order of accuracy higher than 2 is still an open problem. Preliminary results have been obtained by Abgrall *et al.* for pure steady advection. But, the extensions to advection-diffusion, to the time dependent case and to non-linear schemes are still open questions. The goal of this project was the study of the afore-mentioned problems: devise a 3rd order scheme for unsteady advection-diffusion and to test its performances. This has been accomplished through mixed (Residual Distribution/Petrov-Galerkin) approach allowing to find a treatment of the diffusion terms consistent with the underlying RD scheme. In particular, the main goal of the project was to find a weight function such that we had an equivalence between the PG approach and the Residual Distribution scheme. Some results are presented to confirm the validity of the approach. Then, we have verified that it was possible to solve advection diffusion using a RD scheme for the advective part following the approach of Abgrall *et al,* and to use the RD-PG approach for the diffusive part. We have verified that this approach was 3rd order and we have used this approach to solve unsteady advection diffusion. Indeed, we have applied Abgrall's approach for the unsteady and advective term and the mixed RD-PG approach for the diffusive part. Some results are presented to confirm the validity of the approach. On the following figure we compare the 2nd order scheme (dashed line), the 3rd order one (square) and the analytical solution for scalar convection in a rotational velocity field with five oscillations in inlet. The solution is plotted after 180° rotation of the inlet field. Clearly, for the same number of degrees of freedom, the third order scheme (P2) preserves the inlet profile much better than the second order scheme (P1).

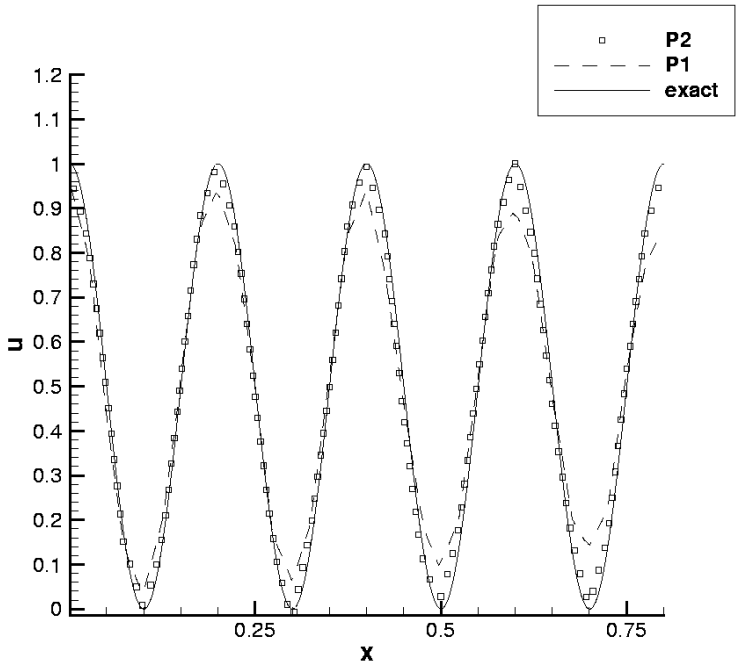

Figure 1: Comparison between 2nd and 3rd oder schemes