High-order accurate Lagrange-remap hydrodynamic schemes on staggered Cartesian grids
Gautier Dakin, Bruno Desprès, Stéphane Jaouen, Hervé Jourdren

To cite this version:
Gautier Dakin, Bruno Desprès, Stéphane Jaouen, Hervé Jourdren. High-order accurate Lagrange-remap hydrodynamic schemes on staggered Cartesian grids. CEA GAMNI, Jan 2016, Paris, France. 2016. hal-01280732

HAL Id: hal-01280732
https://hal.science/hal-01280732
Submitted on 2 Mar 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Interpolation along the grid lines:

- In the 1D problem, the first step is to choose a grid with a certain number of points, say $N$. For each point $x_i$, we define a polynomial $p_i(x)$ such that $p_i(x_i) = \rho(x_i)$, where $\rho(x)$ is the mass density at the point $x$. The polynomial is chosen to be a Lagrange polynomial of degree $N-1$.

- For the 2D problem, we use a similar approach, but with two polynomials $p_i(x)$ and $p_j(y)$ for each point $(x_i, y_j)$.

- The fluxes at the interfaces between grid points are then interpolated using these polynomials.

- Finally, the interpolated values are used to compute the fluxes at the cell centers using standard upwind or Rusanov schemes.

- This interpolation process is repeated at each time step to ensure that the solution is smooth and continuous across the grid.

- The resulting numerical scheme is second-order accurate in space and time, and it can be extended to higher order by increasing the degree of the interpolation polynomials.

- The scheme is verified by comparing the numerical results with analytical solutions for several test problems, such as the Euler equations for compressible flow.

- The results show that the scheme is capable of capturing sharp features and shocks with high accuracy.

- Overall, the scheme is a promising approach for solving high-order Lagrange-remap hydrodynamic problems on staggered Cartesian grids.

- Future work could involve extending the scheme to more complex geometries and flows, as well as incorporating additional physical effects such as turbulence and heat transfer.

- The scheme also presents opportunities for parallelization and scalability, which could be explored in future studies.

- In conclusion, the high-order Lagrange-remap hydrodynamic scheme on staggered Cartesian grids is a promising approach for solving complex fluid dynamics problems with high accuracy and efficiency.

- Further research in this area is needed to fully explore the scheme's potential and to compare it with other state-of-the-art methods.