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Abstract.

Keywords: SPH-ALE; Riemann problem; Least square.

Smoothed Particle Hydrodynamics is a mesh-less numerical method, which knows a great development in hydrodynamics. It was developed by Gingold and Monaghan (1977) and Lucy (1977) initially for astrophysical problems. Meshless methods do not require a predefined mesh connecting data points of the simulation domain. SPH is also very efficient to model rapidly varying phenomena like hydrodynamic impacts and fracture mechanics.

First introduced in [1,2], the Smooth Particles Hydrodynamics in Arbitrary Lagrangian Eulerian formulation (SPH-ALE) proposes a new strategy to provide high-order approximations to hyperbolic scalar or vectorial problems. The key concept of SPH-ALE is a the summation of FV like flux schemes between interacting particles through an SPH numerical stencil. Upwind flux schemes like Riemann solvers and MUSCL are used to manage interactions between calculation points and with boundaries. The method is a hybrid of SPH and FV with an arbitrary transport velocity that allows description to be lagrangian, eulerian or arbitrary.

In this work, we extend SPH-ALE schemes to high-order (order 3, 5) . To this purpose, we develop a high-order piece-wise polynomial reconstruction based on least square principle for each interface between two interacting particles. We compare some piece-wise polynomial reconstruction techniques : moving least square (MLS), weighted essentially non-oscillary (WENO) with MUSCL. Indeed, SPH fluxes are responsible for some dissipation because Riemann solvers involve distant neighbours located inside the kernel function support. Instead of using local particle refinement, this work aims at reducing discontinuities at interfaces between interacting particles by computing local reconstructions with little spatial error.

Preliminary results have been obtained for the 1D linear advection equation in ALE description. After that, we will focus on the improvement of piece wise polynomial reconstruction to solve Euler equations in 1D [figure 1,2,3]. At the conference, detailed validations and comparisons will be provided for the 1D linear advection and the 1D Euler equations cases in ALE formulation. The choice of kernel function, or others parameters will be discuss.

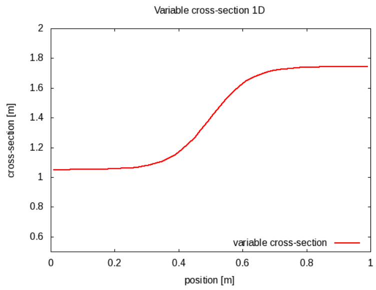

FIGURE 1: Pipe with variable cross section(one dimensional approximation)

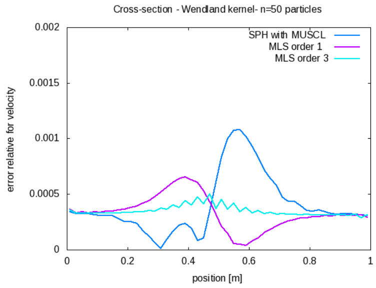

FIGURE 2: Error relative for velocity for a flow in a pipe with variable cross section(one dimensional approximation)

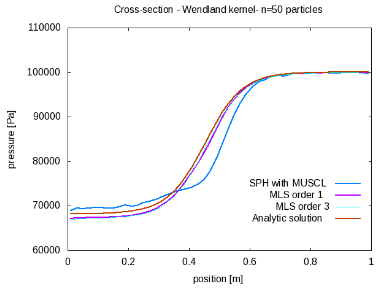

FIGURE 3: Pressure for a flow in a pipe with variable cross section(one dimensional approximation)

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