Literature Review

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Smoothed Particle Hydrodynamics (SPH) is a Lagrangian simulation method first proposed independently by L.B. Lucy and R.A. Gingold and J.J. Monaghan to simulate stars[3][5]. J.J. Monaghan later extended the method to free surface flows[6]. Refer to Ting Ye, et al. for a modern review of various advances in the method.

Mathieu Desbrun and Marie-Paule Gascuel applied the Courant-Friedrichs-Lewy criterion to SPH, providing an upper bound on the time step based on the kernel support size and the maximum particle velocity[2]. This means that in practice the time step must often be very small in order for the simulation to remain stable. Predictive Corrective Incompressive SPH (PCISPH) attempts to address this problem for incompressible fluids such as water, where the problem is exacerbated by the high stiffness required in the equation of state (EOS)[8].

Another approach is to avoid a global time-step altogether. Prashant Goswami and Christopher Batty propose segmenting the time-step by spatial chunks.[4]. Asychronous SPH allows every particle to have its own time frame[7][1][2].

References

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