Smoothed Particle Hydrodynamics

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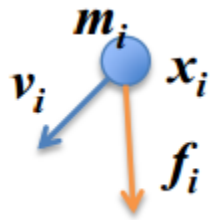
Why is this important?

- Particle simulations everywhere
- Examples : Fluids, smoke, astrophysics and solid mechanics.
- Exploit parallelism, large no of particles.
- Simulation at interactive rates, higher particle resolution, particle rendering.
- Complex problems understood more intuitively

Challenges

- Inter-particle interactions difficult , O(n)and not O(n^2) implementation
- Fluid solver requires neighbor search
- Physically correct parameters for solver
- Use spatial data structure
- Conserves volumes, and mass



Spatial Data Structures

- Kd trees very efficient, but quite complicated to build
- Our Solution : Uniform Grid (sorted)
- Grid size double the radius of particle
- Predefined max. no of particles per grid
- One particle can't be in more than one grid cell.

Building the Uniform Grid

- Assign each particle to a grid cell using center Write to global memory.
- Sort the grid (fast radix sort)
- Find start and end indices of each cell (using change)

Learning outcomes

- Scattered writes very useful in some cases. Building the grid is impossible this way without that.
- Uniform grids are simple but inefficient. High memory usage. Fixed number of particles per block.
- Better alternatives are hierarchical grids, Octree, kd trees.