Advanced Computer Graphics
CS 563: *Project Proposal*

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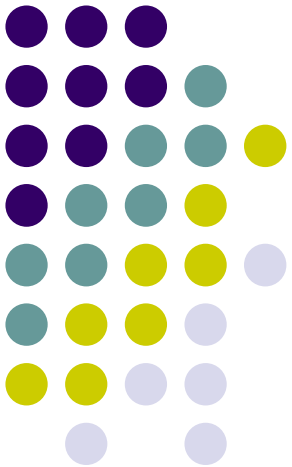
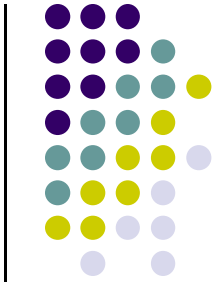
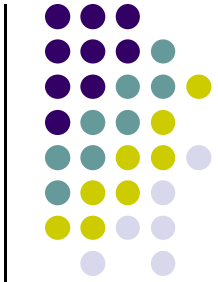


Real-time Simulation of Large Bodies of Water with Small Scale Details



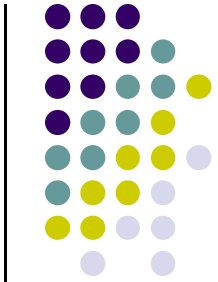
- Eurographics 2010 :
  - Nuttapong Chentanez and Matthias Müller
  - NVIDIA Corporation
- Combination of mesh grid and particle simulation of surface water
- Render particles in an efficient manner

Overview of Complete Algorithm

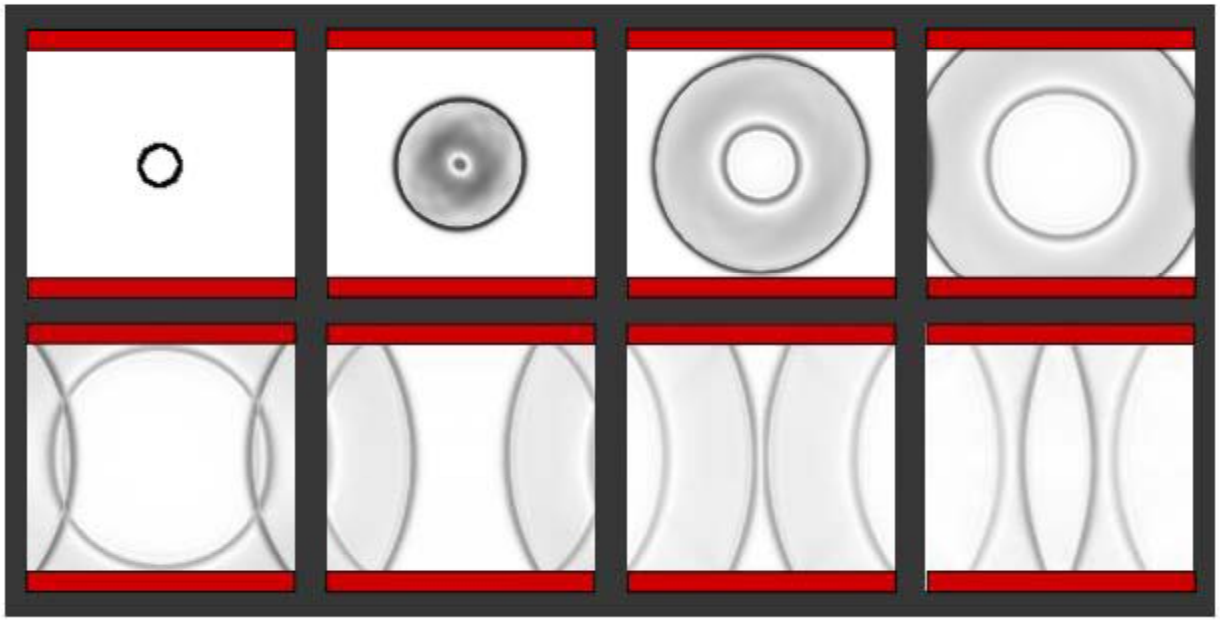


- Height field fluid simulation
- Solids simulation
- Two-way coupling of height field and solids
- Particles generation and simulation
- Rendering

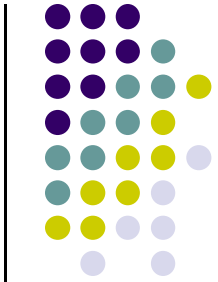
Part I: Height Field Fluids



- Conservative expressions for mass and momentum over a regular 2D grid
- Boundary nodes can be marked for reflection or absorption

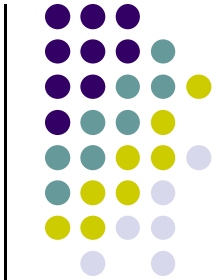


Part II: Solids Simulation



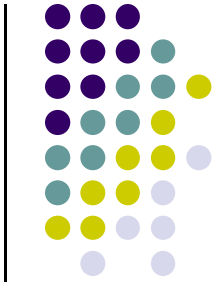
- This part was handled by some existing physics engine
- Might use Bullet Physics
- Easy to use / decent performance
- Will only use for particle static and field mesh interaction

Part III: Solids – Fields
Fields - Solids



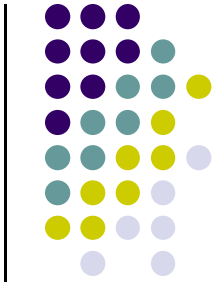
- Compute interactions of the field with static and dynamic objects
- Simultaneously compute forces/displacements in both directions
- Will not be included in this implementation
  - More of an animation focus

Part IV: Particles

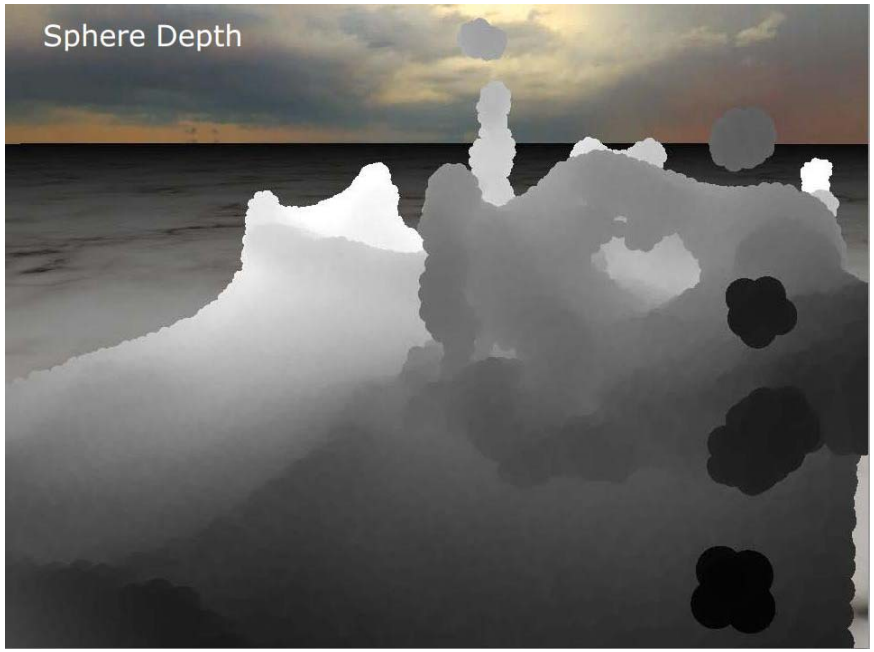


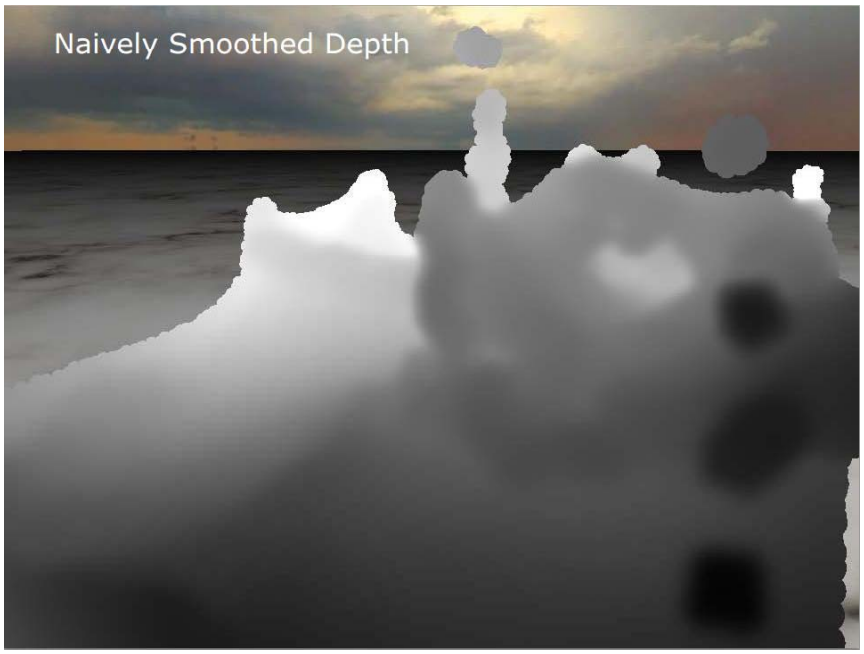
- Generated when the mesh grid cannot support water behavior
  - Discontinuities in height (waterfalls)
  - Waves breaking
  - Foam

Part V: Rendering



- Use tiled FFT to perturb surface height and normals
- Render particles as point sprites
- Render most in screen space, as spheres
  - Splats contain spherical density/depth information

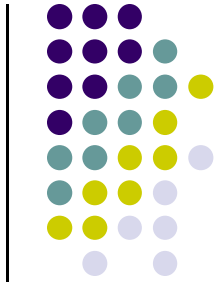




Density

FFT

Most Critical Components

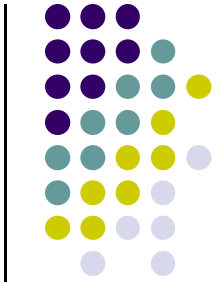


- Include:
  - Height field fluid simulation with boundary conditions
  - Some particle effects
  - Rendering

	Boat	WaterF	PML	Beach	Ocean
Grid	900x135	128x128	128x128	128x128	256x256
Par	250K	56K	2K	220K	83K

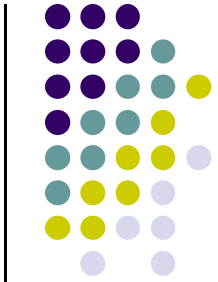
- Exclude:
  - Fields – Solid interaction
  - Solid – Fields interaction (might include)
  - Exotic particle effects

Optimistic Timeline



- Week 1: Fields Simulation + Integrate Physics Engine
- Week 2: Boundary Conditions + FFT
- Week 3: Particle Effects + SS Rendering
- Week 4: Final Presentation

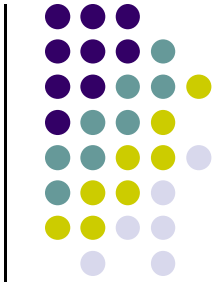
Progress



- Partial Integration of Bullet Physics Engine
- Partial Implementation of conservative fields

References

- Nuttapong Chentanez , Matthias Müller, Real-time simulation of large bodies of water with small scale details, Proceedings of the 2010 ACM SIGGRAPH/Eurographics Symposium on Computer Animation, July 02-04, 2010, Madrid, Spain
- http://www.youtube.com/watch?v=bojdpqi2l_o



References

- Wladimir J. van der Laan , Simon Green , Miguel Sainz, Screen space fluid rendering with curvature flow, Proceedings of the 2009 symposium on Interactive 3D graphics and games, February 27-March 01, 2009, Boston, Massachusetts
- http://developer.download.nvidia.com/presentations/2010/gdc/Direct3D_Effects.pdf