CMPM 163: Game Graphics

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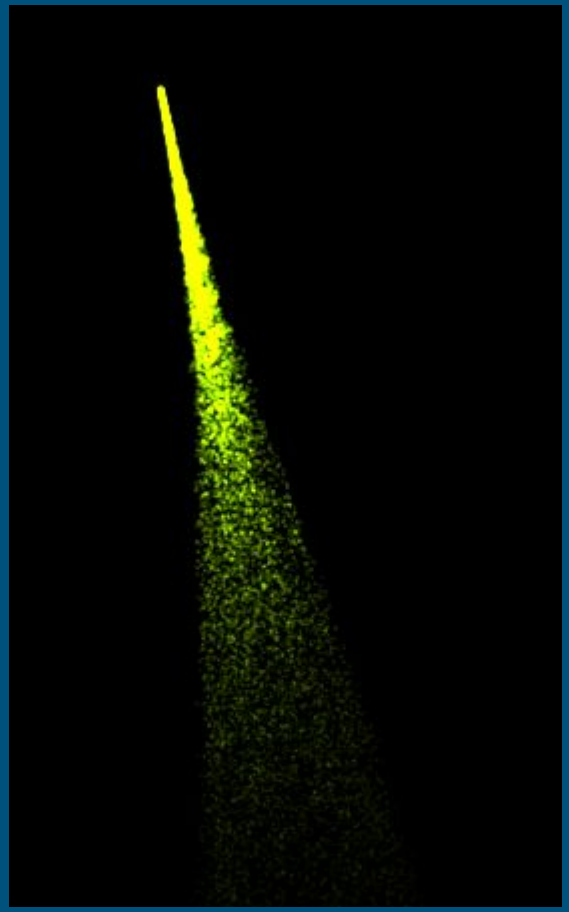
Bellagio Fountains

Fireworks



Area of Effect

Implementation

Create Firework object, put into an array with every Firework obj

- Object holds important vars such as position, velocity, color, angle, etc

Going to use the particle system to create streams of sparks and light

- Also put a light at the head of the firework that moves with it to create light for reflection

Once firework detonates

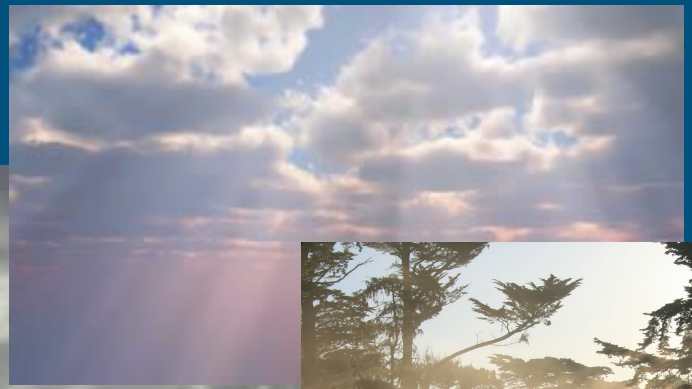
- Extremely bright blast of light for a couple tenths of a second

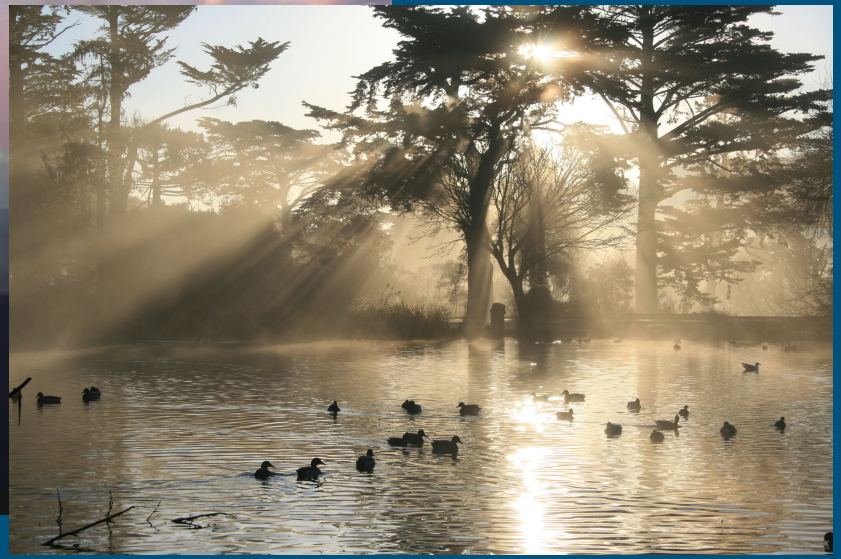
Splits off into multiple lines of light

- Each light added to our firework object array
- Lines follow inverse exponential curve

Crepuscular Rays

- God Rays



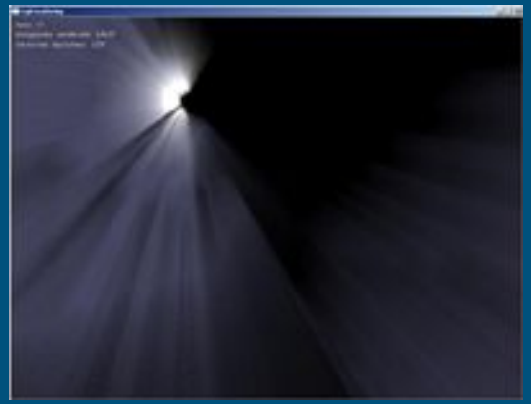


How

- Create a source object which emits light
- Volumetric light scattering in the fragment shader
  - Render the light source geometry that is not occluded
  - Blur it, starting from the center of the source object
  - Based on the density, decay, exposure, and weight parameters, it will create these streaks of light

God Rays

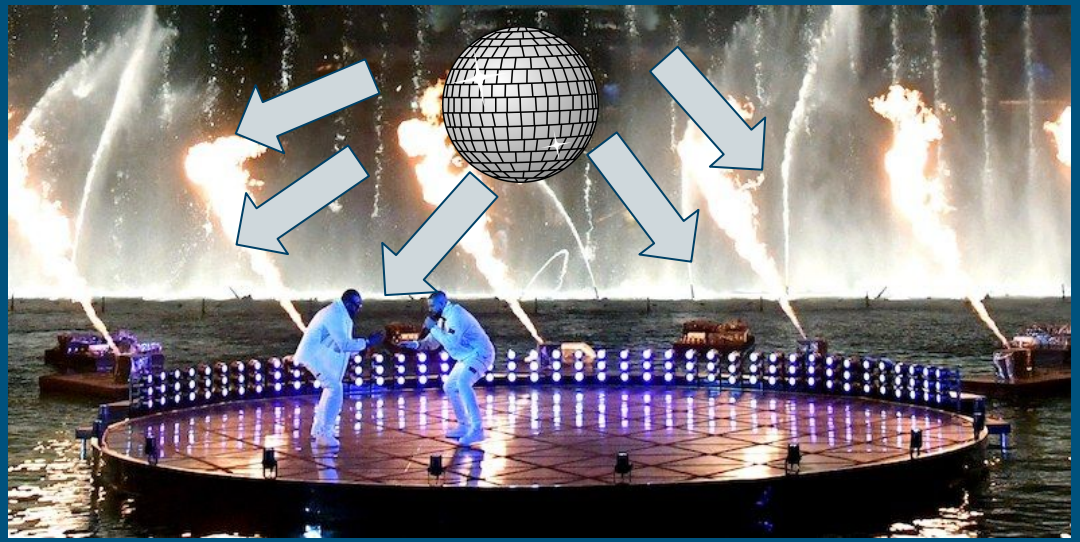
- 2D post processing effect
- Blend the frame buffer objects with the frame buffer



http://fabiensanglard.net/lightScattering/index.php

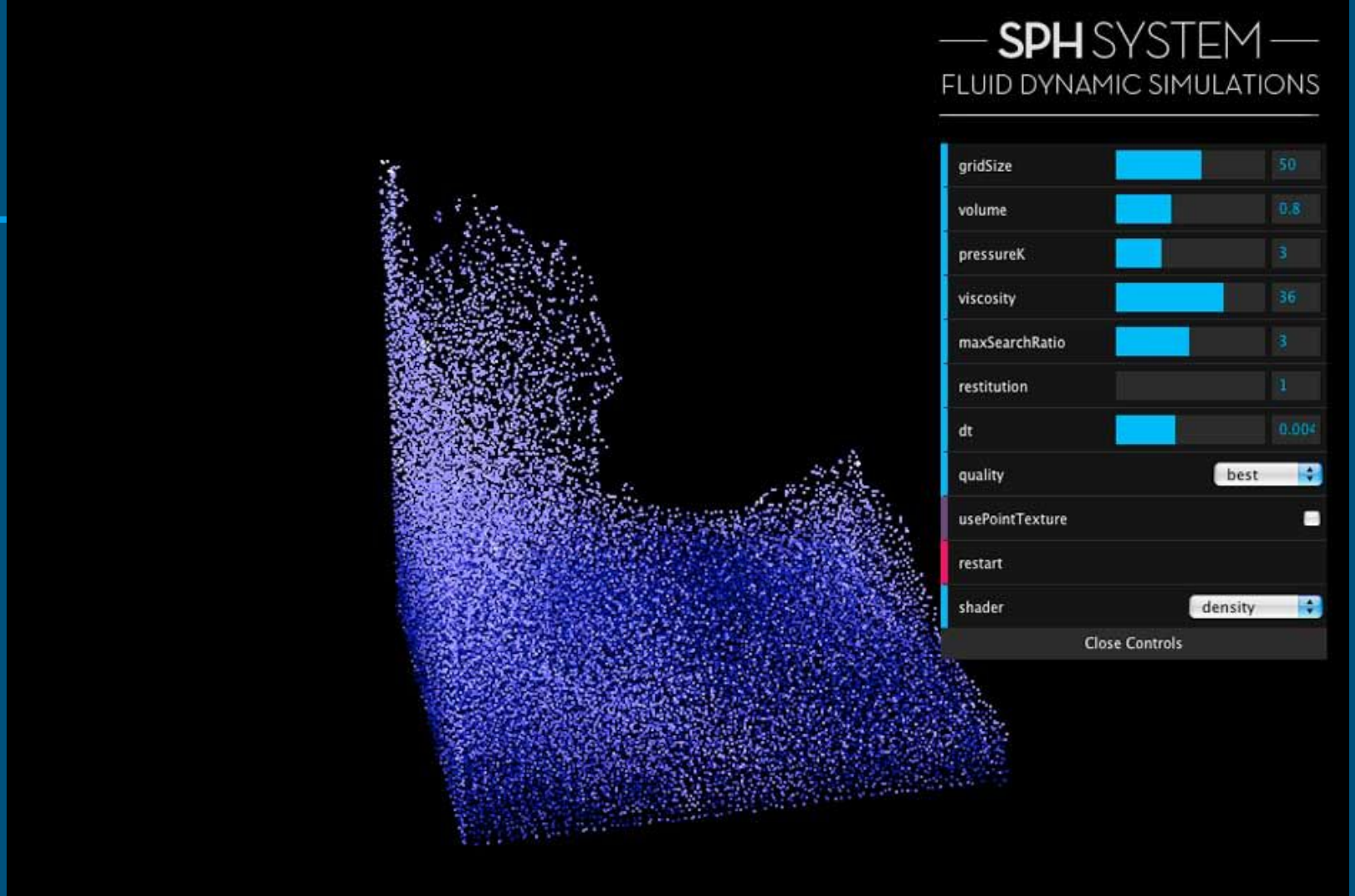
Implementation

- Our source object emitting these light rays will either be
  - Sun
  - Disco Ball in the top center, reflecting light rays



Smoothed Particle Hydrodynamics

- Simulate a fluid by taking a weighted average of discrete points.
- Use complicated physics things to determine the density and velocity of each particle, and interpolate them across.
- Use a cubic spline kernel to smoothly interpolate the data across the points.

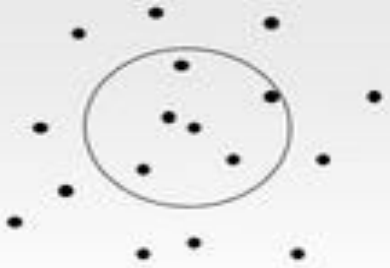

SPH SYSTEM
FLUID DYNAMIC SIMULATIONS
gridSize
50
volume
0.8
pressureK
3
viscosity
36
maxSearchRatio
3
restitution
1
dt
0.004
quality
best
usePointTexture
restart
shader
density
Close Controls

Smoothed Particle Hydrodynamics (SPH)

Some particle properties are determined by taking an average over neighboring particles

The fluid is represented by a particle system

Fluid dynamics



1. Only neighbors contribute to the average
2. Close particles should contribute more than distant particles

In the average: Use a weight function

Equations of Motion

- Navier-Stokes equations:

$$\frac{\mathrm{d}\rho}{\mathrm{d}t} = -\rho \nabla . \mathbf{v}$$

$$\frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t} = -\frac{1}{\rho}\nabla p + \upsilon_o \nabla^2 \mathbf{u} + \mathbf{F}_i$$

- Recast in particle form as

$$\frac{\mathrm{d}\mathbf{r}_i}{\mathrm{d}t} = \mathbf{v}_i + \varepsilon \sum_j m_j \left(\frac{\mathbf{v}_{ji}}{\bar{\rho}_{ij}} \right) W_{ij} \qquad \text{(XSPH)}$$

$$\left(\frac{\mathrm{d}m_i}{\mathrm{d}t} = 0 \right)$$

$$\frac{\mathrm{d}\rho_i}{\mathrm{d}t} = \sum_j m_j \left(\mathbf{v}_i - \mathbf{v}_j \right) \cdot \nabla_i W_{ij}$$

$$\frac{\mathrm{d}\mathbf{v}_i}{\mathrm{d}t} = -\sum_j m_j \left(\frac{p_i}{\rho_i^2} + \frac{p_j}{\rho_j^2} + \Pi_{ij} \right) \nabla_i W_{ij} + \mathbf{F}_i$$

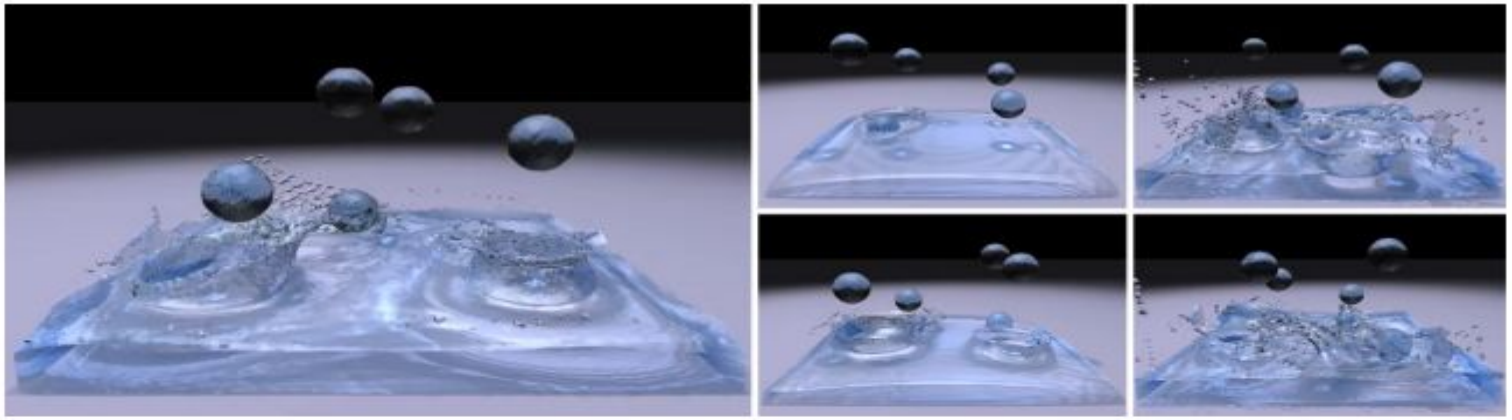


Fig. 7 Balls of fluid is fallen into a tank.

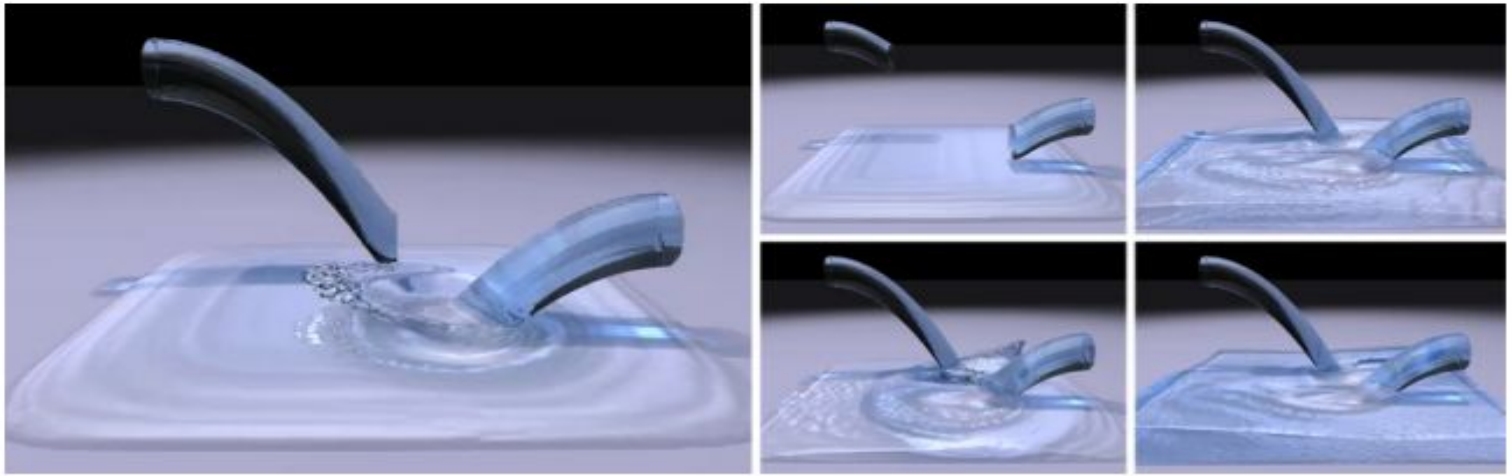
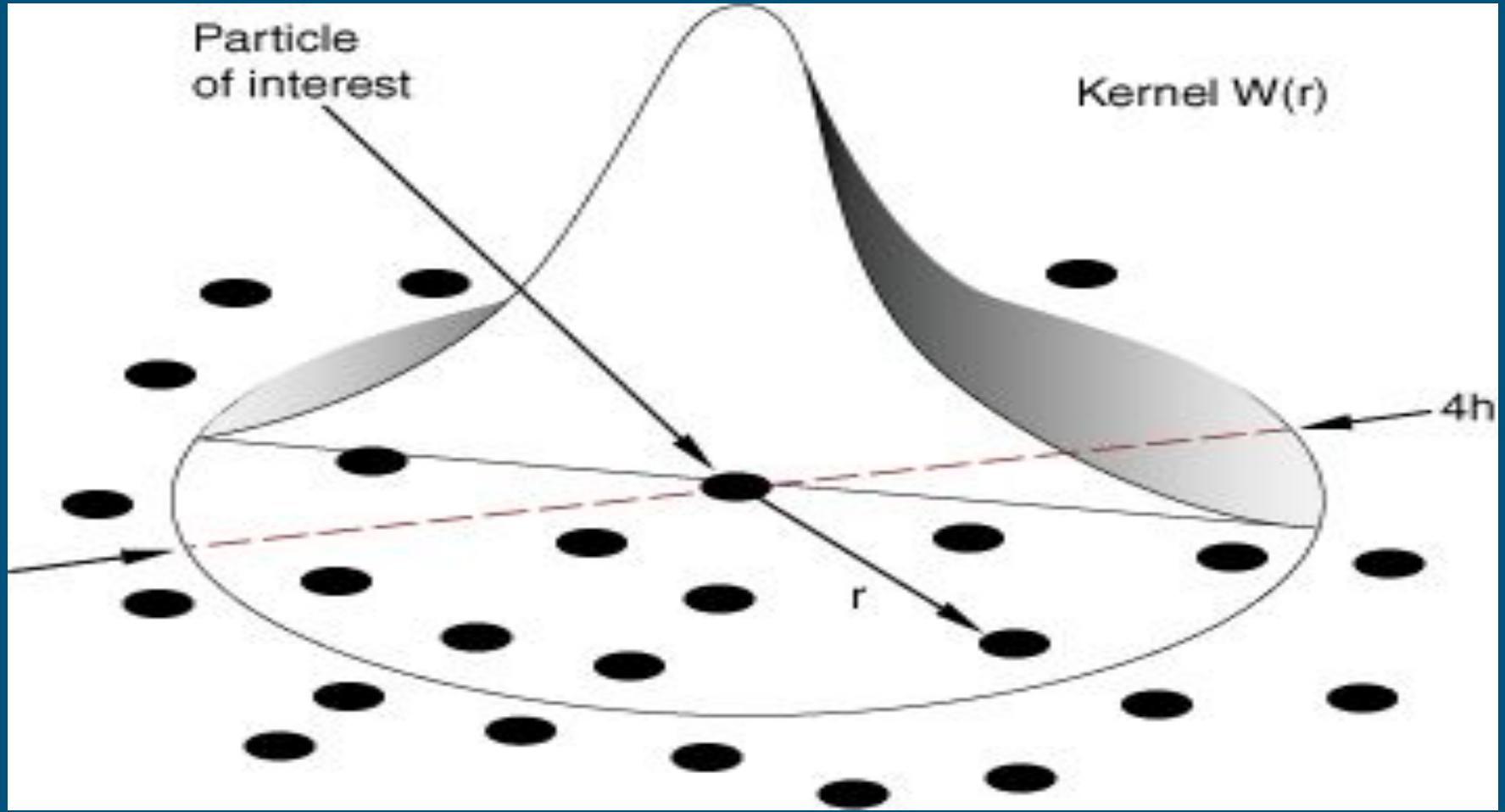


Fig. 8 A fluid is poured into a tank.


Particle
of interest
Kernel W(r)
4h
r

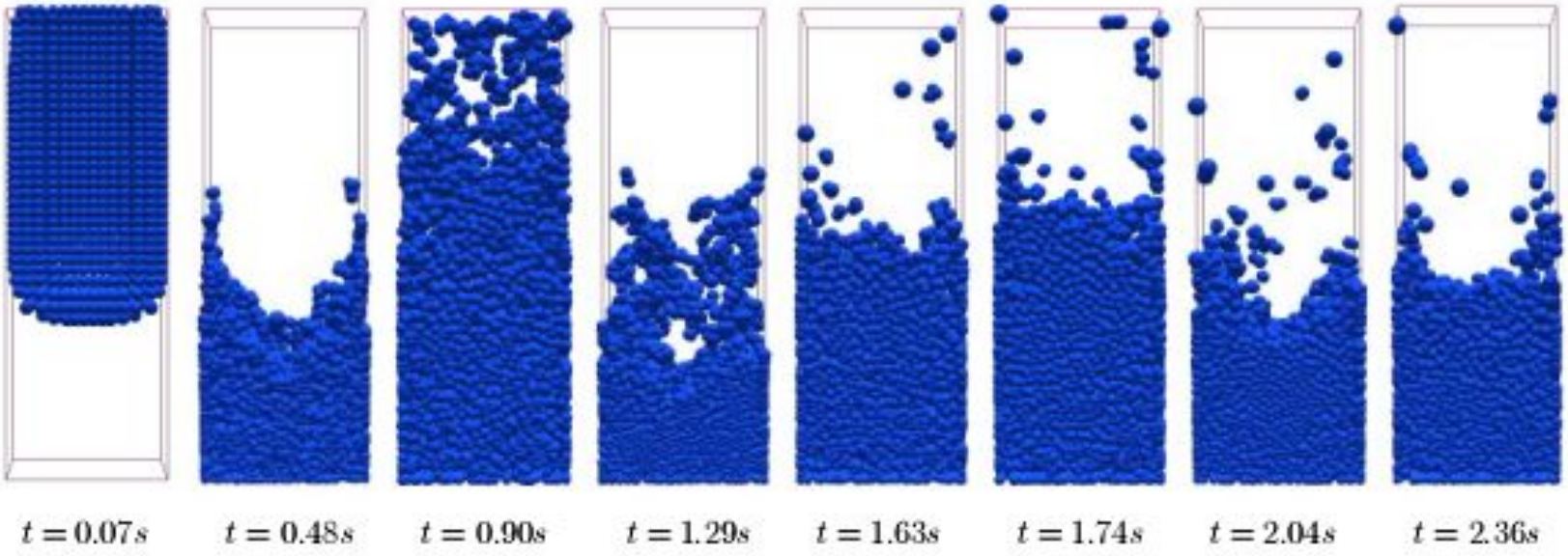


Figure 6.19 Instabilities occur when the pressure becomes too high for a compressible fluid.

Reactive to Music (If we can)

- Determines the frequency of a note, and causes an effect
  - Bass lines
- Times effects with certain bass notes
  - Fireworks explode
  - Waves splash
  - etc