

# Fluid Simulation

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# Description

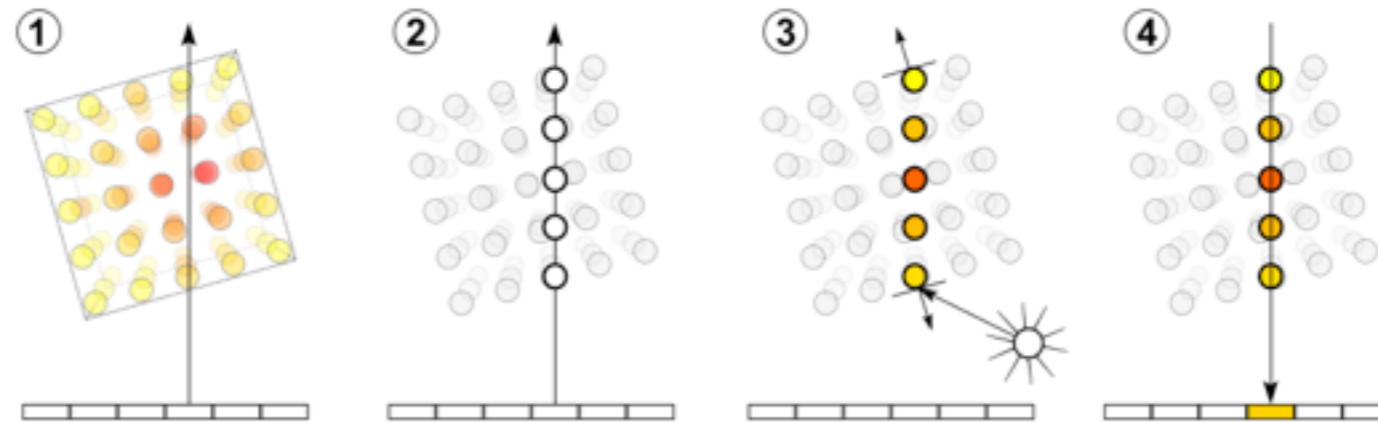
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An interactive 3D fluid simulation that is reasonably accurate and not super slow.

Not liquid fluids, gaseous fluids!

# Renderer

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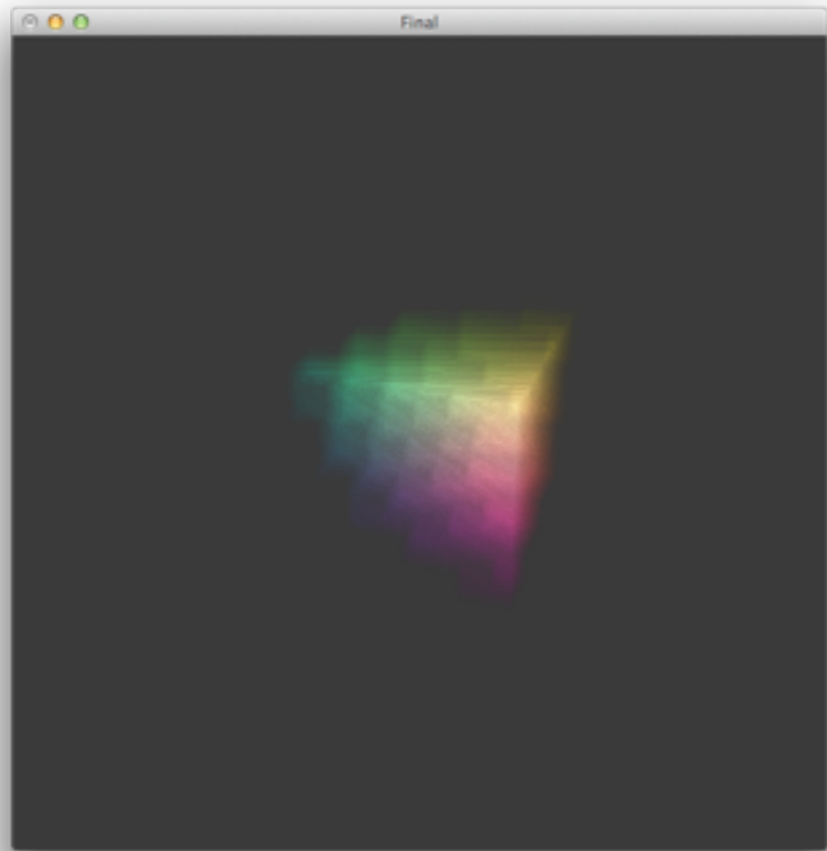


Raymarching over a 3D texture containing color data for each voxel within the fluid bound.

Image from [http://en.wikipedia.org/wiki/Volume\\_ray\\_casting](http://en.wikipedia.org/wiki/Volume_ray_casting)

# Early Attempts

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It's a 10x10x10 cube with some fancy rainbow colors!

Banding and noise issues not resolvable by simply increasing texture dimension.

# Fluid Solver

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Based on methods outlined in Stam's GDC '03 paper.

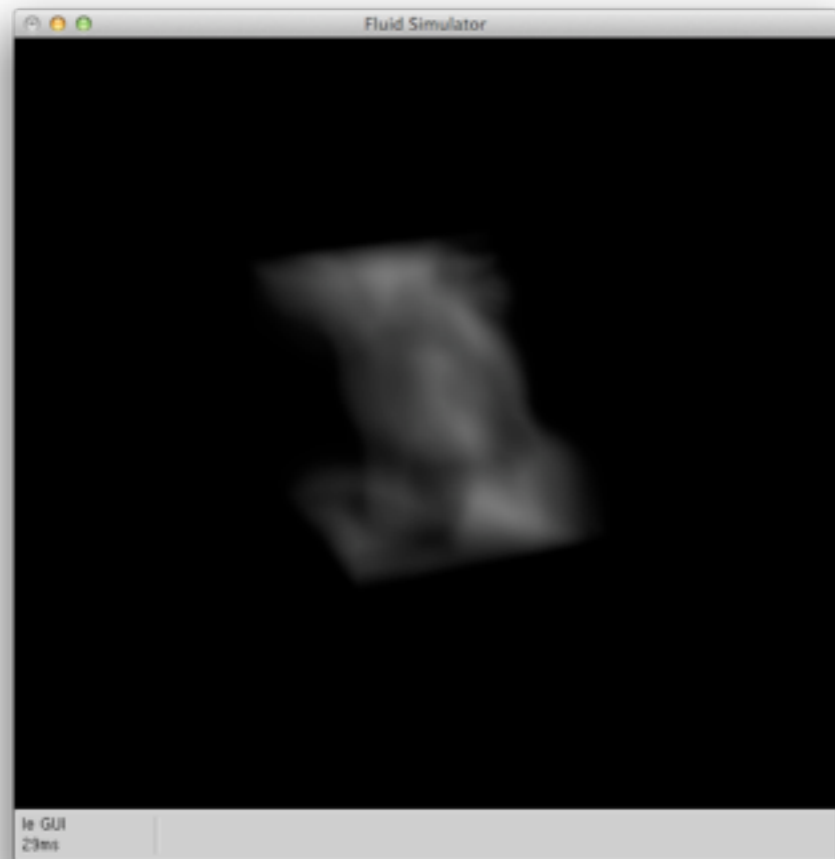
Buffers: Density, Velocity

Steps: Diffusion, Advection, Projection

Density buffer is used as 3D texture. Each step must be run for each color channel.

# CPU Solver

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It's really slow!

~30-40ms per frame with a  
32x32x32 volume and only  
one color channel.

# GPU Solver

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Simulation is highly parallelizable, 3 color channels and interpolation for free!

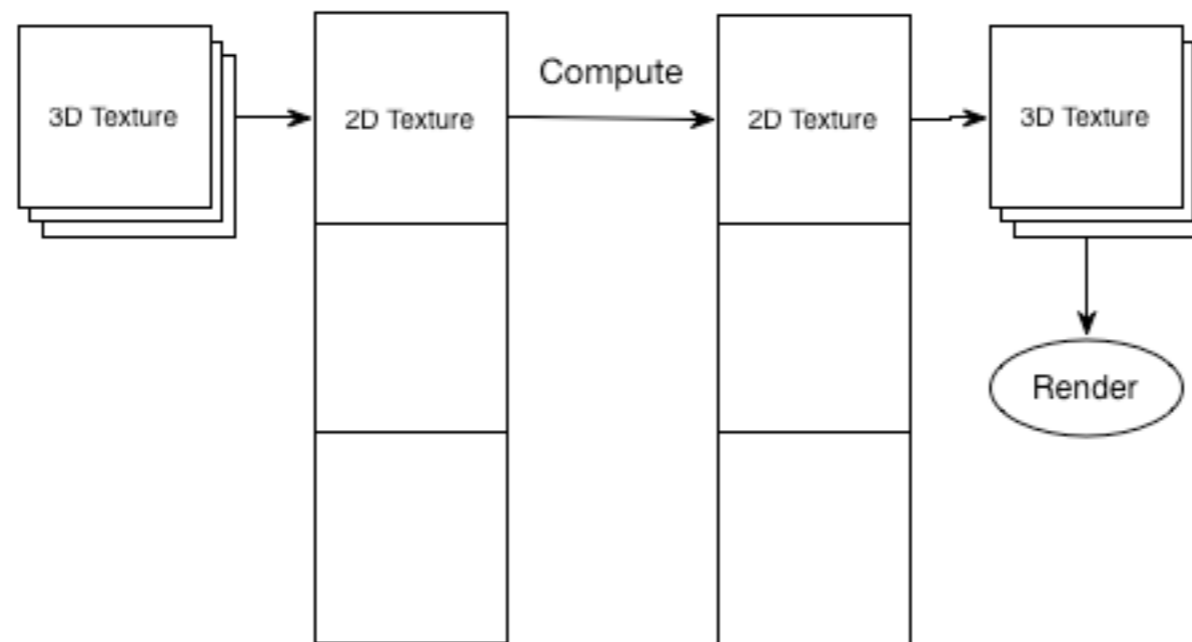
Density and velocity buffers can be treated as float textures mapped to a full screen quad with shaders for computation.

Why not OpenCL or CUDA? This is more fun!

# GPU Solver

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Density, velocity buffers must be mapped to 2D textures or computed in slices.

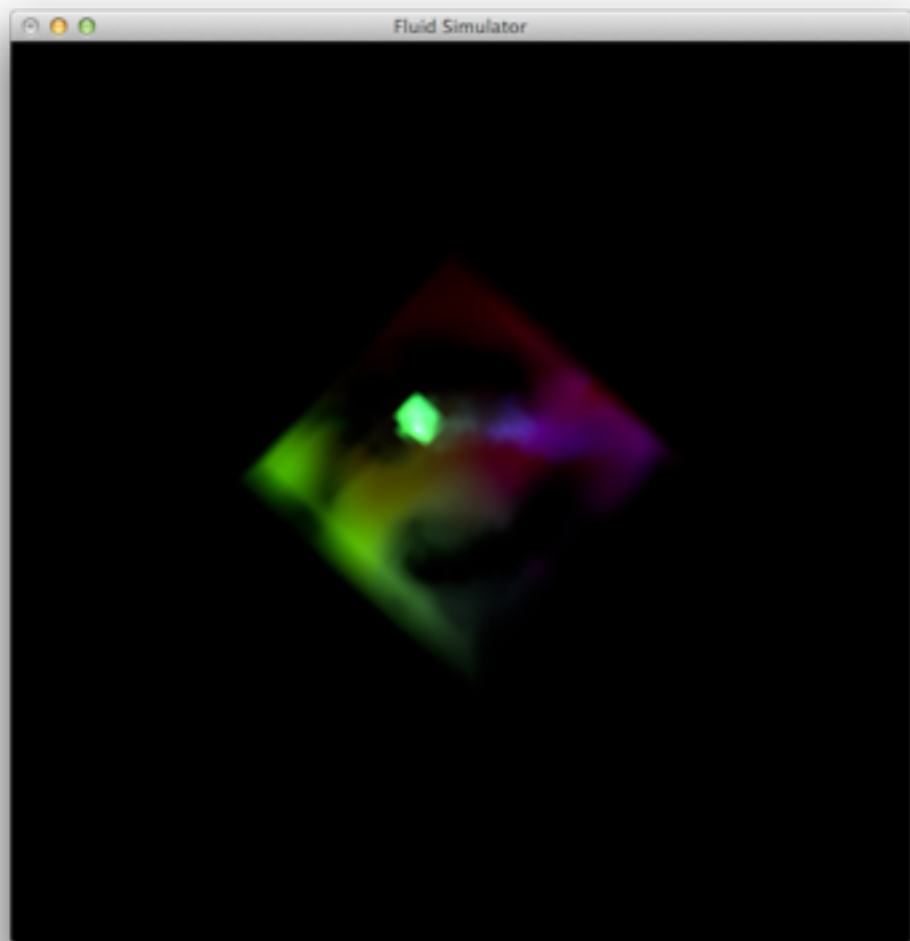


Minor issue: z interpolation lost in 3D to 2D mapping.



# Work in Progress

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Advection running on GPU,  
Projection running on CPU.

~25-35ms, 32x32x32, 3 color  
channels.

Better, but still not ideal.

# To Do

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- Lighting, more sophisticated shading
- Full GPU solver implementation
- Fancy particles?