Cutting Ice - Ray Tracer Extension

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CSCI-711

Recap of Project Description

- Simulation of ice and the cutting of ice in my ray tracer
- Originally thought about adding it to Unreal but decided on ray tracer addition
- A chunk of ice is ‘cut’ randomly from a large sheet of ice
- Snow falls down as the ice is being cut to add more of an atmosphere
- Block of ice will then be raised with any snow that has fallen on it
- Inspiration for this is from a hockey skate blade cutting through ice

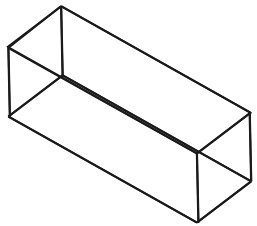
Architecture

- Ice
  - Using a slightly blue color, highly transmissive
  - Needed something underneath the ice to show the refraction occurring under the ice
    - Decided to add a large red sphere under the ice that is reflective
  - Represented as a polygon
- Snow
  - Not a ton changed from the midterm
  - Represented as spheres that are slightly reflective and very white
  - Varying size
  - Randomly start at x,y,z positions
  - “Fall” over time using a function called every frame
    - Each snowflake has a randomized amount it moves down by
- Video
  - Created using OpenCV’s VideoWriter
  - Each frame ray-traced and added to the video iteratively

System

- Cutting mode # 1
  - Original idea was to just create amount of cuts a user wanted from points they specify
  - Turned into a function that takes in the amount of cuts and creates that number of randomly placed cuts
  - How to represent in polygons?
    - I settled on what is essentially a hole inside of the ice
    - Build polygons for ice around the hole to extend to edges of ice
  - This worked, but didn't look very interesting
- Cutting mode #2
  - Trying to make the scene look cooler
  - Cut a block of ice out instead, and raise this block out of the scene after being cut
  - Snow on top of the block moves with the block
  - More visually appealing in my opinion

System



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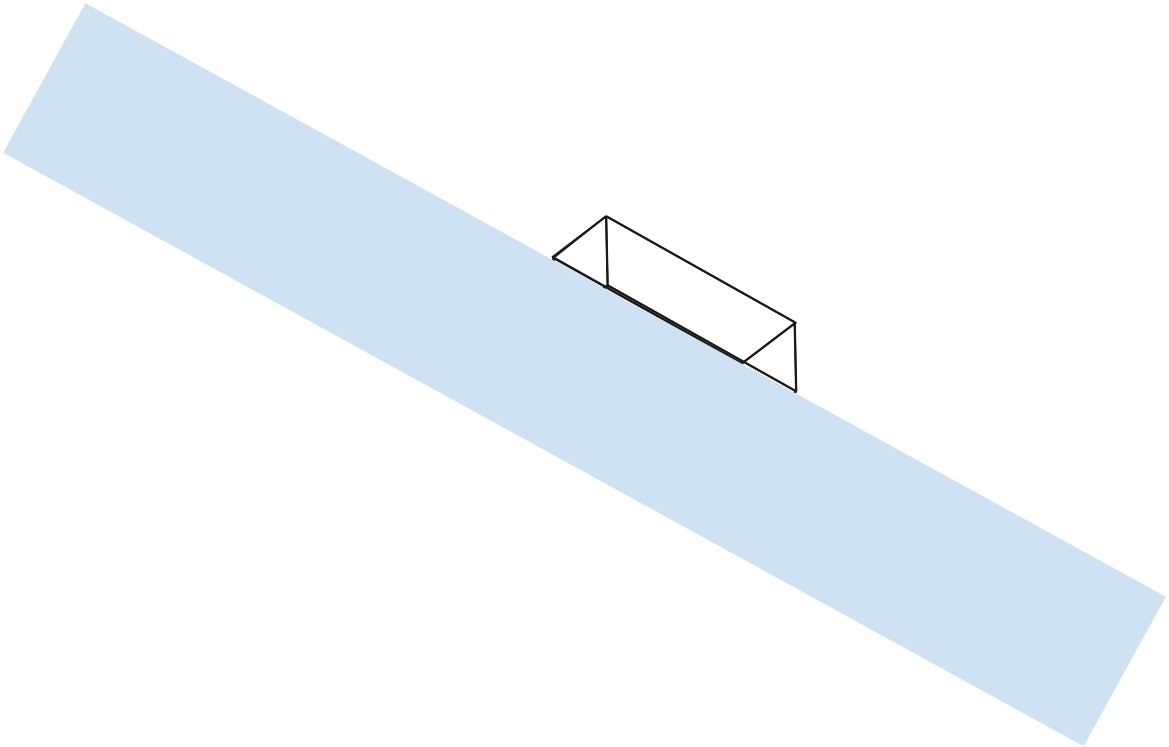

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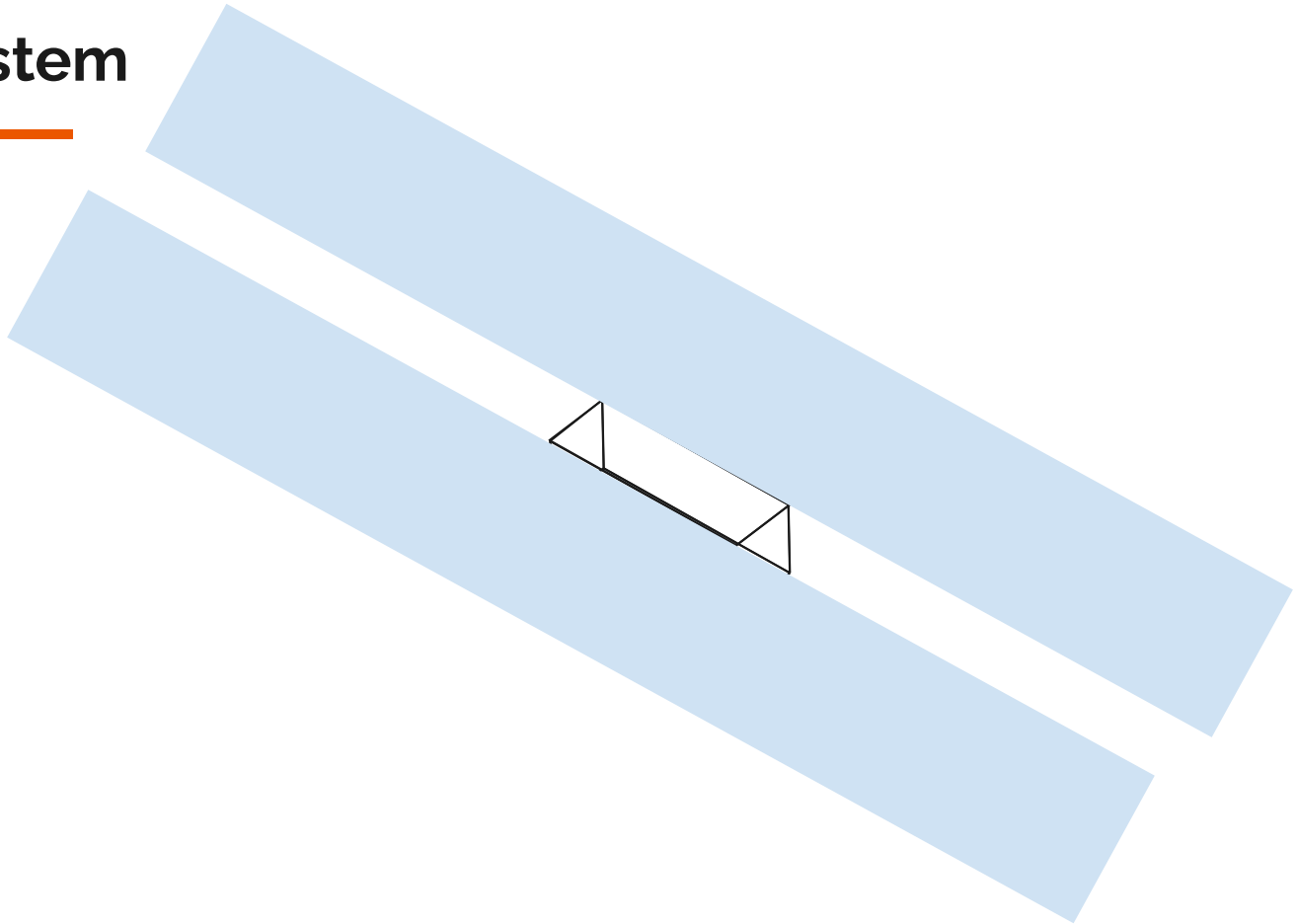

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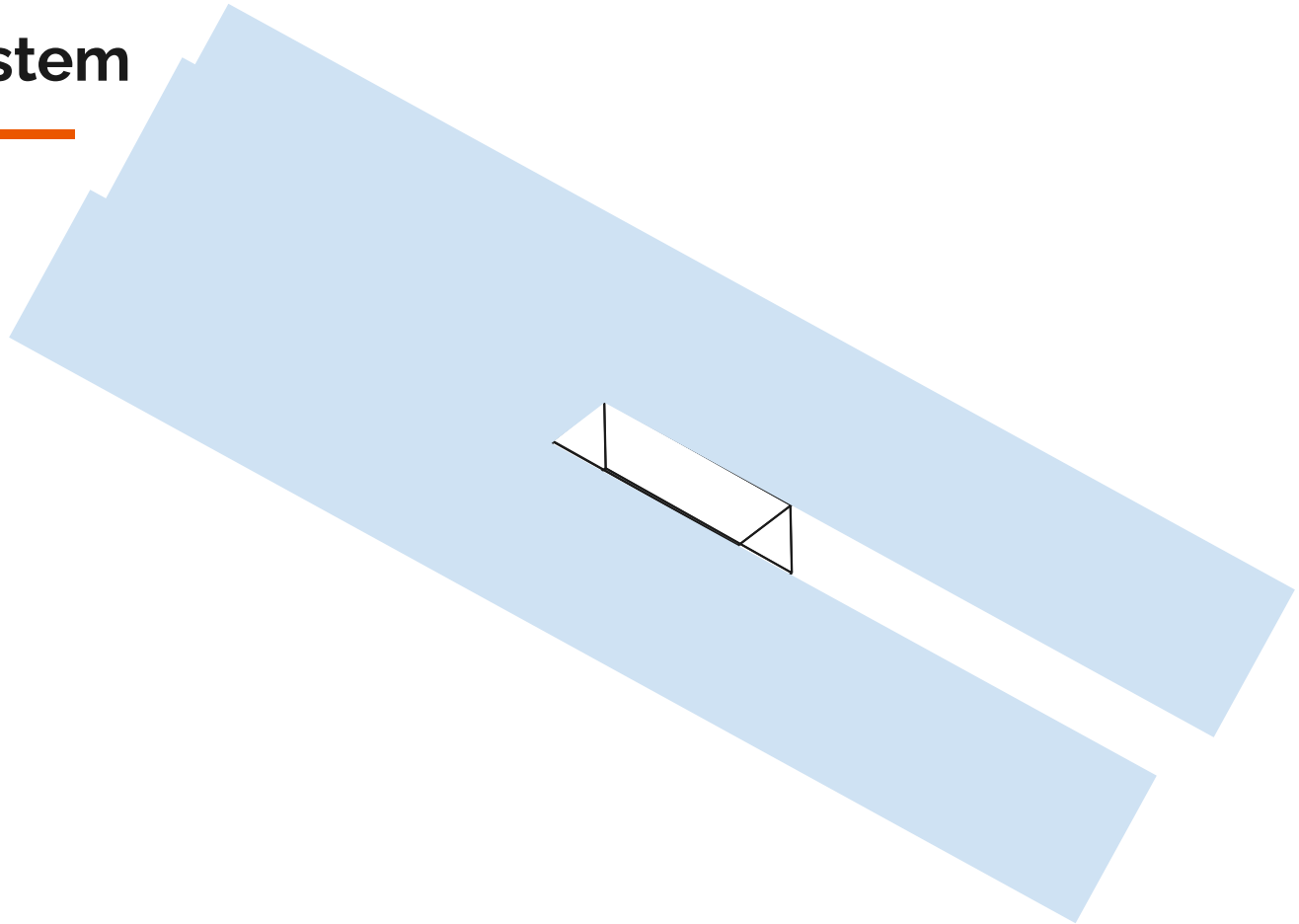

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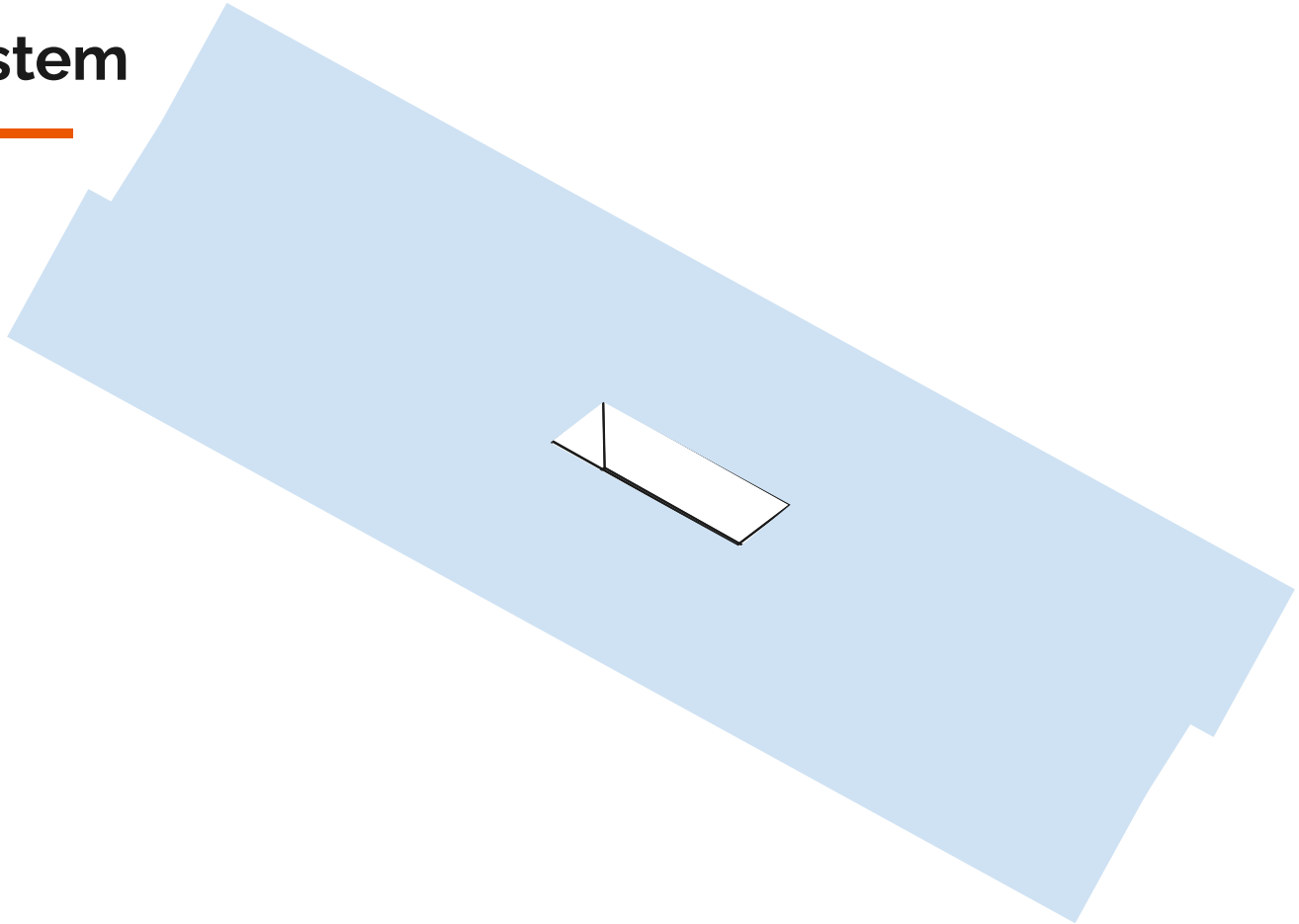


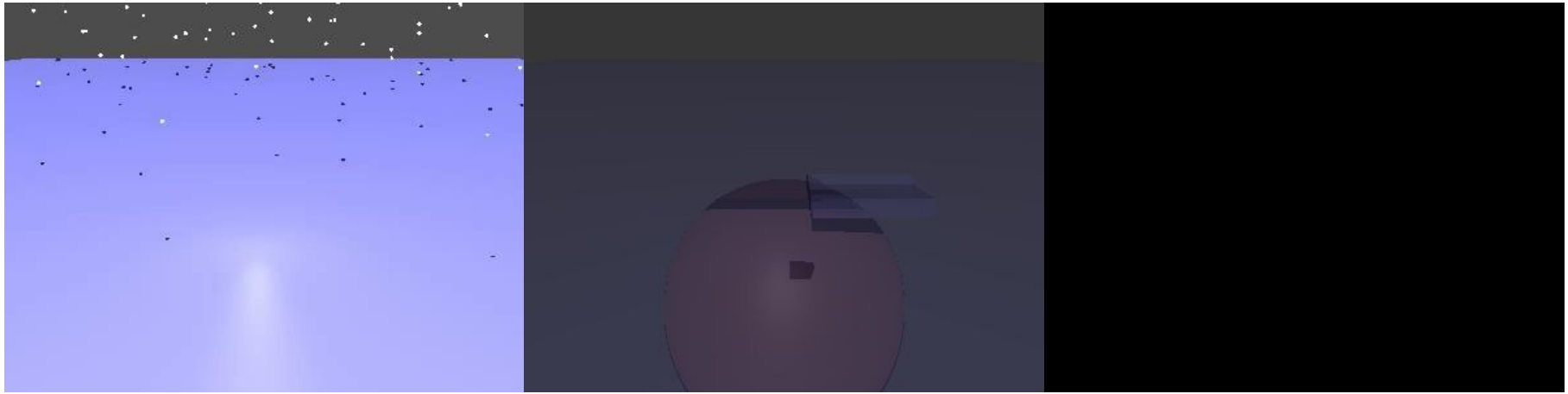
Cutting Mode #2

- One main cut, but a much larger cut than the random ones generated in mode #1
- Show cut in progress
  - As frames increase, length of cuts increase
  - Add one side of the polygon, extending length until we have added the full side
    - Then we draw the next side, etc. until all sides are drawn
  - We do this by removing the cut objects and re-adding them in each scene
    - This isn't terribly efficient
    - Doesn't matter since it takes no time versus the actual ray-tracing
- Once cut is done
  - Add objects for actual piece of ice and the hole that it is in
  - Move the ice block upwards over time each frame

Results

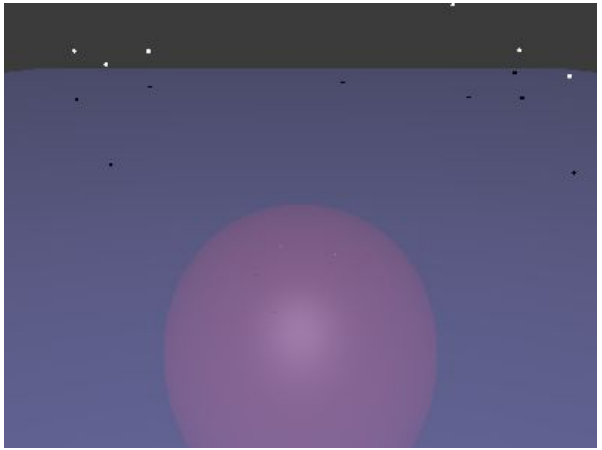
- A video was created of cuts being generated in a block within the ice sheet
  - Ray tracing while the cut is happening
- Resolution was dropped to 300 x 400 because of how long the video took to create
  - It still took a long time
- Shot at 10 frames per second
- Renders can be made from the program pretty easily
  - Parameters are:
    - Number of cuts to be made in the ice
      - -1 for the mode I will be demoing
      - Any other number
    - Number of snow particles to fall down
      - Larger number looks cooler but will take longer to render
    - Number of frames to create
      - I chose 250 for the video demo
      - If the number is 0, a photo will be made instead

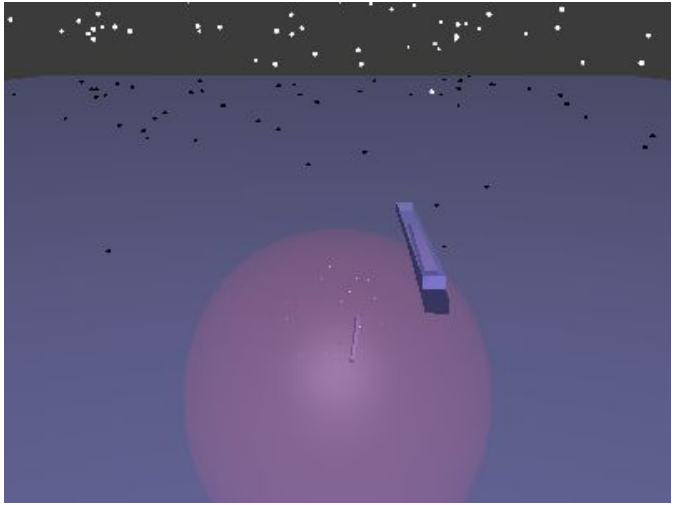
Interim Videos

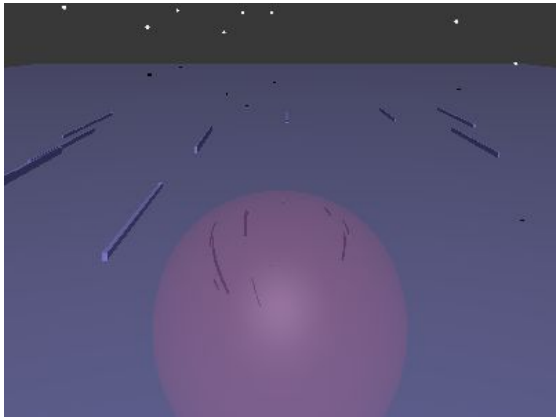


Final Video - 10 fps, 250 frames, cut = -1, snow = 100

Some Stills With Cut #1







Future Work

- Fog
  - I tried adding a basic fog effect through calculating distance from camera to point and blending in some ‘fog’ color with the current color
  - This wasn’t as easy as I thought it would be and I had to push this effect back
- Kd-Trees
  - Would greatly speed up the ray-tracing process because there are so many objects in the field
  - Should’ve done earlier and would’ve helped with the whole project
- Extend cutting mode #1
  - Have randomized cuts work better
  - Focused more on cutting a block after realizing how hard it is to set up randomized cutting scenes
  - Right now, only vertical cuts working: horizontal would be nice too
    - Creating area around intersections of horizontal and vertical would be really tough

Comments/Questions?