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Team First
Flow Visualization 4151-003
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Water Caustics

For my Team Second Project, I wanted to see if I could make a decent replication of the water caustic effects that are evident in Blade Runner 2049, shown in **Figure 1**. During the Wallace Headquarters scene in this movie, the director of photography, Roger Deakins, projected light through a pool that was above the set. The pool was lit from several different angles, so that all of the walls on the set had shimmering water on them. I took a slightly different approach because I thought that I could get a similar effect with less effort. I decided to only light a toy car and have the background around it be invisible. I think the car's curved surface recreates some of the visual interest that is present in the movie when the water effect plays across the actors' faces and clothing.

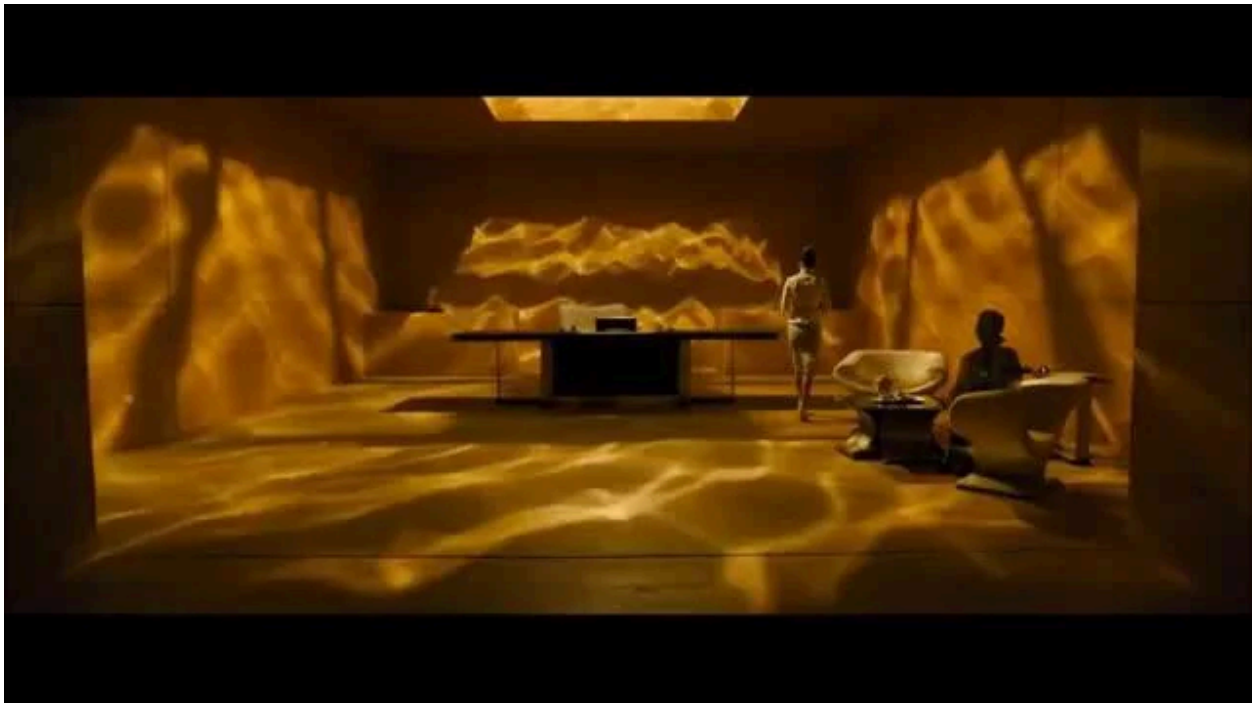


Figure 1: Water caustic effect in Blade Runner 2049 (Villeneuve, 2017)

The apparatus that we used to recreate this effect, shown in **Figure 2**, was a simplified, scaled down version of what was used in the movie. We filled a tub with water and held it above the toy car. We shined an LED work light through the water and onto the car. We shook the tub a bit to agitate the water. This made the effect more pronounced and interesting. I placed the car on top of flat black mouse pads. These did not reflect any light, so that only the car was visible. In one of my two versions, I dyed the water yellow, which combined with the shiny blue surface of the car to make green. The optical effect that we showed in our project is called caustics. These are the “envelope of light rays that have been reflected or refracted from a curved surface and projected onto a surface where they can be visualized” (Beven, 2019). In our case, the light is refracted through the water and projected onto the car.

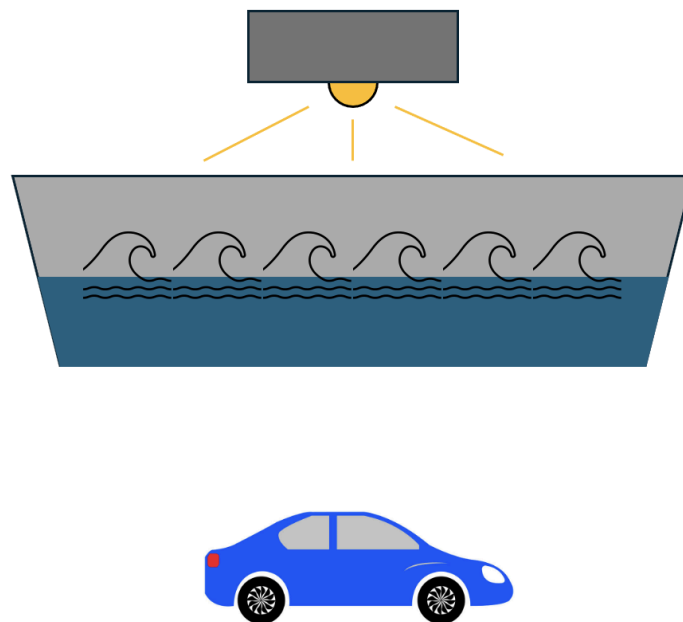


Figure 2: our apparatus for projecting water caustics onto the car

The visualization techniques that we used were simple but took some time to hone in. As I mentioned earlier, I dyed the water yellow in one of my videos so that the car would turn slightly green. I also made sure that the background behind the car was a very flat black, so that only the car would be visible, and there were no distracting reflections behind it. Initially, the car was sitting on a shiny black stool which made for a less than adequate image. The lighting that we used was a battery-powered LED work light from Home Depot. This was the light shining through the liquid. We used no other light sources.

I shot my video using the slow-motion feature on my iPhone 14 Pro. I was shooting at 238.6 frames per second with a f stop of 2.8. The video is 1280 by 720 pixels. The video is zoomed in which simulates a 77 mm lens, but the resolution is slightly worse than an actual zoom lens would be. The car was about 2 feet away from the camera, and the field of view was about 8 inches.

My video is a good representation of the effect from Blade Runner 2049 for the equipment that I had access to. Just out of my own nerdyness, I'd love to try to do a large scale recreation of this at some point, but that would probably require a pretty large budget. The refraction physics are shown very well. The water caustics are clearly visible on the surface of the car and look very beautiful. I think I could improve my current setup by using a different camera that has better zoom capabilities.

Works Cited

Villeneuve, D. 2017, *Blade Runner 2049* [Film], Warner Bros.

Beven, K. 2019, *On the Physics of Caustic Light in Water*, On Landscape,
<https://www.onlandscape.co.uk/2019/01/physics-of-caustic-light-in-water/>