Team Third Report

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MCEN 5151 Flow Visualization

December 6, 2023

University of Colorado Boulder

Introduction

This assignment was the second team assignment of MCEN 5151. My team consisted of myself, Sierra Greeley, and Ari Matrajt Frit. This experiment was done to showcase the normal-field instabilities that happen when a ferrofluid is exposed to a magnet. The normal-field instabilities manifest physically through the peaks and valleys visible in the video.

Flow Apparatus

The flow apparatus for included a mirror, ferrofluid, a magnet, and a phone secured in a tripod. Ferrofluid was poured onto the surface of the compact mirror. Then, the magnet was placed underneath the mirror. An LED light strip was placed around the mirror for lighting. Then, the mirror was moved over the top of the magnet. A simplified diagram is shown below.

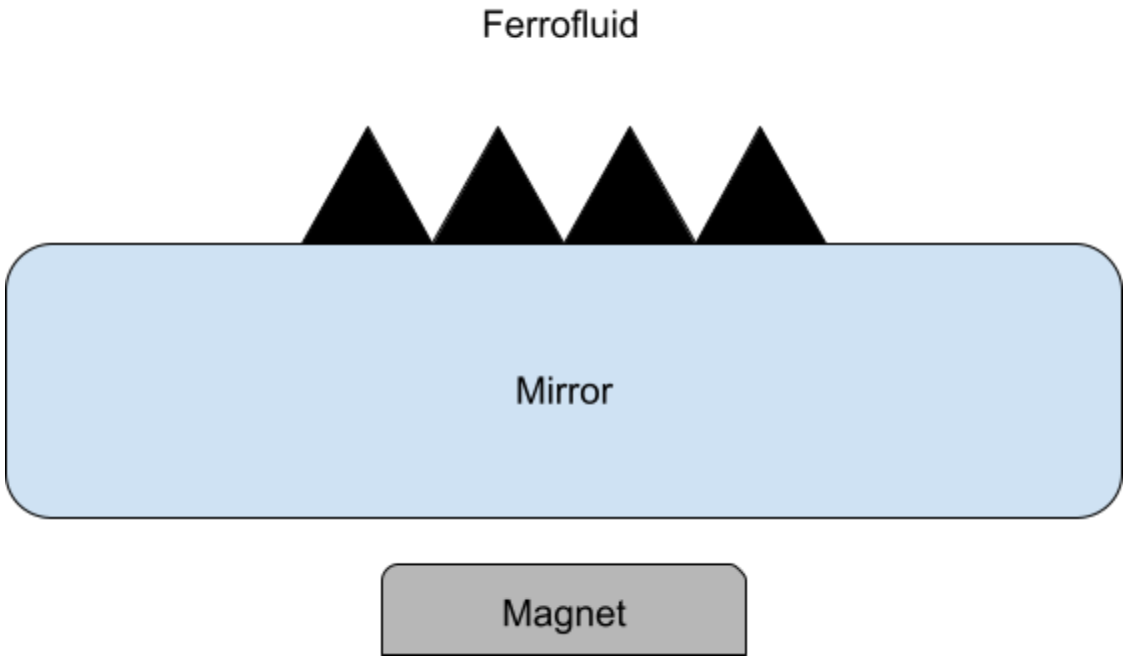


Figure 1: Diagram of experimental set up

Fluid Dynamics

The fluid dynamics in this video are a result of the composition of the ferrofluid. Ferrofluid is a colloidal fluid, which is a mixture in which microscopic or smaller particles are suspended in another substance.[1] Ferrofluid specifically is composed of ferromagnetic particles suspended in a carrier fluid, and the particles are coated in a surfactant. In the presence of a magnetic field, the ferromagnetic particles become magnetized and begin to exhibit the normal-field instability.[2]

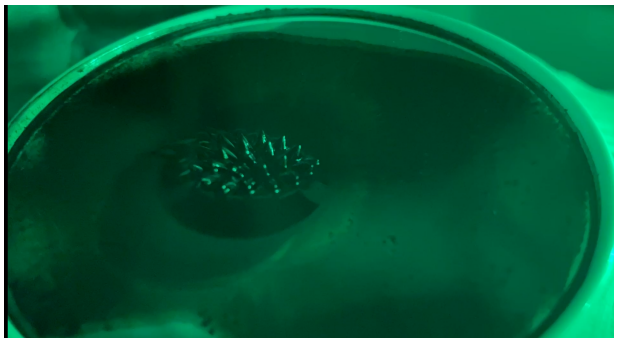
Normal-field instability is shown through the peaks and valleys or spikes in the ferrofluid. This is a result of the fluid settling in the most energetically stable form.

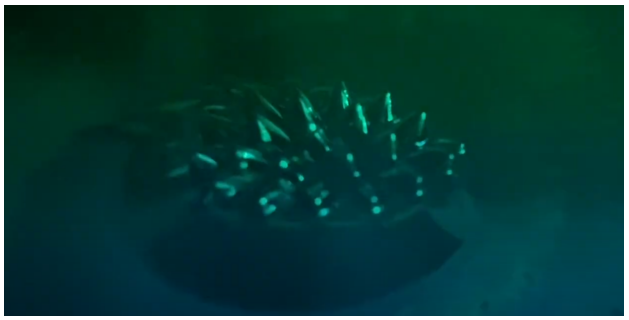
Visualization Technique

The visualization technique for this experiment was to record a video in a dark room, with LED lights bouncing off of the surface of the ferrofluid. The fluid was placed onto a mirror to create a thin layer of the fluid. The mirror was placed over a magnet, and gently moved around. We aimed the light strip at the surface of the fluid to achieve the best reflection.

Photographic Technique

The video was captured on an iPhone 12 with the wide-angle lens. The distance from the phone to the object was about 3 inches and had a FOV of 1.5 inches. The focal length was 22 mm, the exposure was 1/50 sec, the ISO was 3000, and the aperture was f/1.6. The resolution of the video was 4K and had a frame rate of 30 fps. The original video had a width of 1200px and a height of 720 px. The final video has the same dimensions. Shown below are screenshots from the original and edited videos





Figures 2 and 3: Screenshots from original and edited videos

I used iMovie to edit my image. I mostly focused on decrease the length of the video and also zooming in as best I could. That was done to help decrease distracting elements in the background. I also added an electronic song from the Glitch Mob as the audio. I thought that it fit the video well.

Conclusion

Overall, I am happy with my project. I have absolutely no experience taking or editing videos, so this was quite a challenge. I think that the lighting for this project could have been improved and maybe the strobe could have been toned down.I think that the videos is slightly grainy even

though it was recorded at such a high resolution. If I were to further develop this, I would check out a high speed camera from the ITLL in order to better visualize the spikes forming as the magnet moved.