DLA Report 15

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1 Summary

For this report I imaged a gravity-capillary wave. This was done by adjusting the water table, modifying my experimental procedure, and taking experimental data.

2 Description of what was done

2.1 Water Table Modifications

AFter the adjustments made after Mark and I took data (mentioned in the last report), Pat and I went into the lab to try to get less noisy data. Pat discovered a new way to use the water table that significantly reduces noise in the collected data:

- Using one or two pumps (I have been using one), let the reservoir in the water table fill up
- Once the reservoir reaches a constant height, disconnect the water pump(s)
- Take images a fixed amount of time after disconnecting the pump(s) where the water surface is not noisy, but before water waves from downstream reach the imaging area (so, the water is still past critical velocity)

This method resulted in incredibly low-noise images. Despite this, we need to manually verify that the water waves we've imaged aren't too steep.

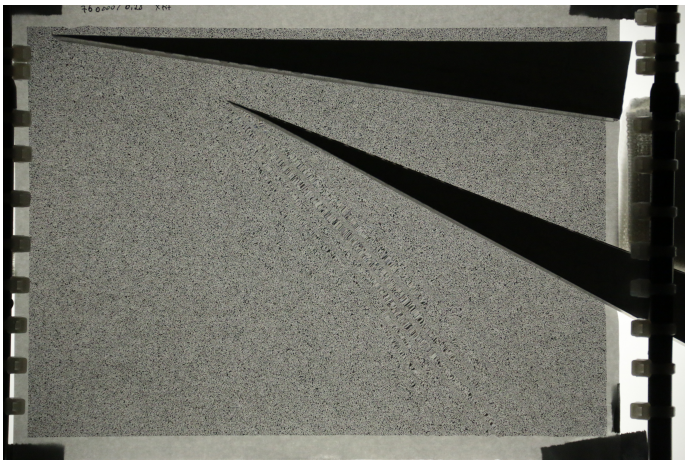

Figure 1: Raw moving water image where water waves are too steep, resulting in significant distortion, causing FSSS to fail.

Figure 2: Raw moving water image where water waves are appropriate for FSSS to succeed.

I also realized that image registration is necessary for producing high-quality data.

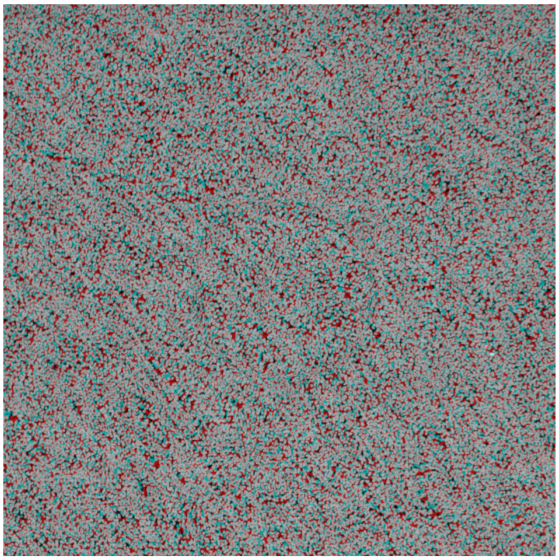

Figure 3: Water Droplet without image cyan-red overlap image.

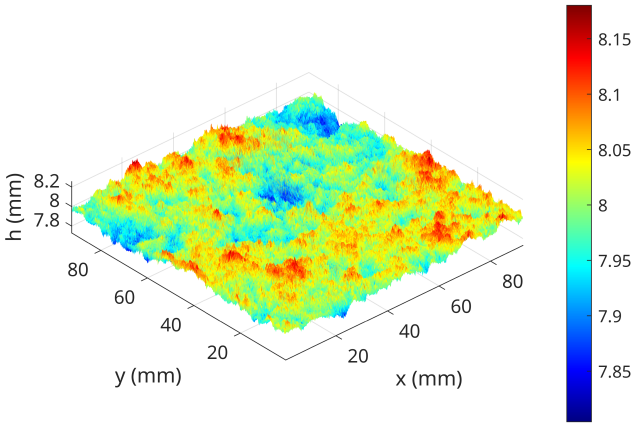

Figure 4: Water Droplet without image registration.

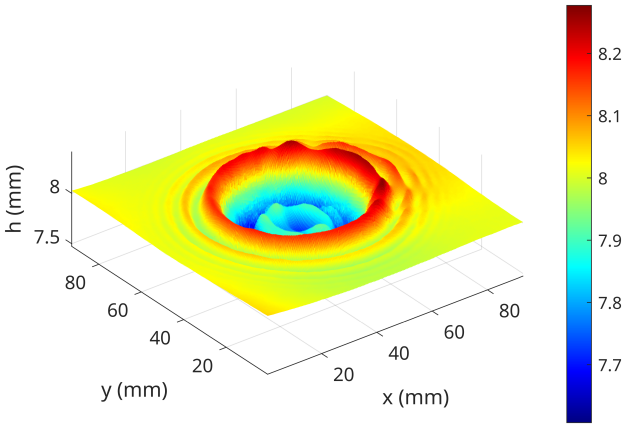

Figure 5: Water Droplet with image registration.

So, I bought rods and put zip-ties on them to assist with image registration on the water table. The rods allow us to bring the zip ties (which we use as control points) closer to the surface of the table, making them more in-focus.

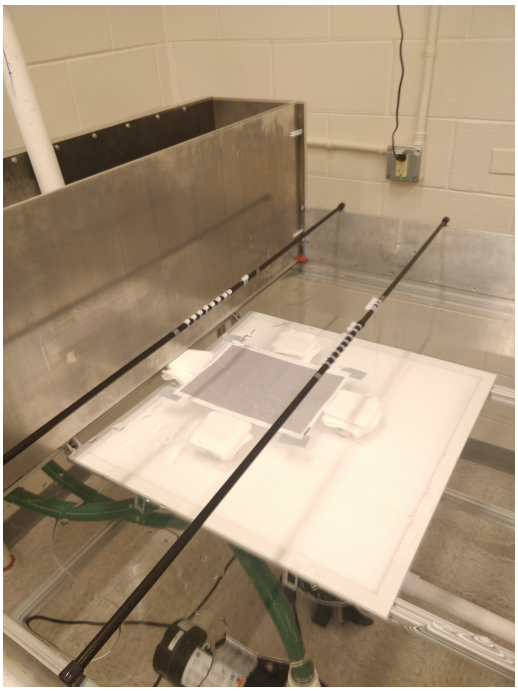

Figure 6: Rods with zip ties on them. Note we can bring the rods closer to the surface of the table since the rods are spring-loaded and have adjustable lengths.

I also attempted to reduce a single pump's flow rate so that the reservoir water head was much shallower in the hopes of having steady water flow, but it was still very noisy. See the two videos below:

video 1

video 2

2.2 Water Table Data

I took lots of on April 25th of various water table configurations, however, I was only able to process one set of images so far due to fixing some bugs in my code and using new FSSS pre and post techniques.

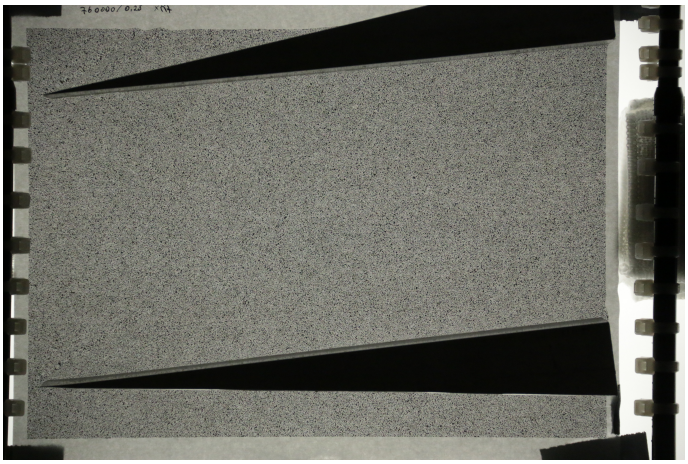

Figure 7: Moving water raw image.

In wanting to use the entirety of the dot pattern in FSSS, I realized I could blacken out the area with the wedge in both the still and moving water image. Then, PIV will see those areas as having still water and we can include the wedges in our cropped images. Thus, FSSS will include the wedges in the final reconstruction. Further work will need to be done to identify exactly where the wedges are in the displacement field so we can have them stand out more clearly in the surface height reconstructions.

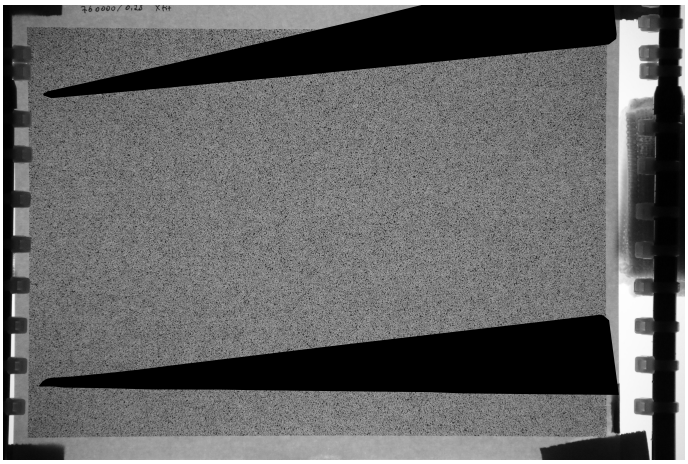

Figure 8: Still water with blackened wedges. The blackened wedges are identical to the ones in the moving water image, allowing for us to include the wedges in our surface height reconstruction.

Figure 9: FSSS cropped area.

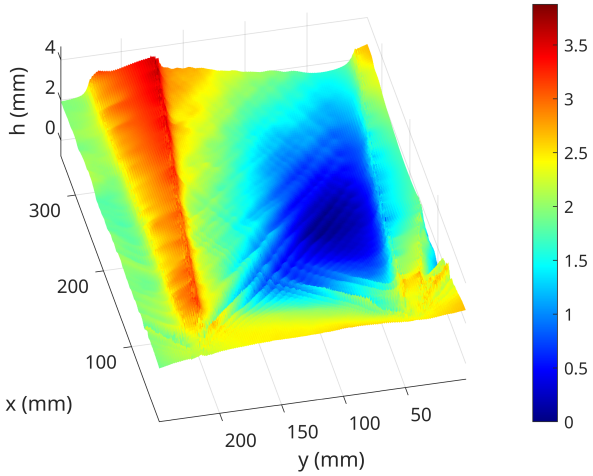

Figure 10: FSSS reconstruction.

This is a wave interaction! I modified the FSSS code to make sure the minimum water height was at least 0mm and the upstream water height was what was measured. Note that FSSS doesn't seem to reliably reproduce water height without some post processing. Note also that I didn't use the flow straightener for these images.

3 Description of Next Steps

Work that still needs to be done:

- Fix the leakiness in the water table
- Be able to clearly show where the wedges are located in the FSSS reconstruction
- Take data
- Process data
- Detail my process for FSSS, from data taking to getting a surface reconstruction (for posterity)

4 Questions

- What else would you all like to have me do before the end of the semester?