DLA Report 11

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1 Description of what was done

1.1 Summary

For these two weeks, I worked on my SIAM FRAMSC presentation, resolved a quick MATLAB bug, and worked on the water table. We made significant progress on the water table, by buying various parts, but also ran into various hurdles that we need to overcome.

1.2 SIAM FRAMSC

I registered for SIAM FRAMSC using the registration form found here. I submitted my abstract (reviewed by Mark) and title for a presentation I will be doing via email. There is also a $10 registration fee that I'm supposed to pay but can't figure out where.

1.3 `fsolve` bug

I was getting problems running MATLAB's fsolve function when doing the first example in their documentation. Turns out, the problem was that my own `split` function in my FSSS code was being used instead of a built-in `split` function that fsolve used somewhere in its execution. Renaming my function to `splitmat` solved the problem.

1.4 Water Table Setup

1.4.1 Camera Mount

We discussed as a group that we'll make a new camera mount using an angle bracket attached to the uni-strut. Here's what I envision the mounting apparatus to look like:

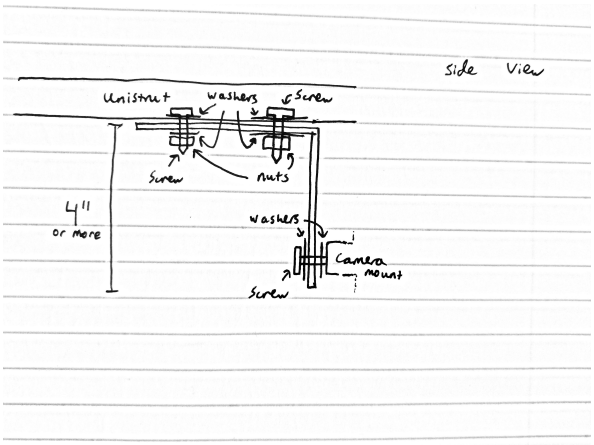

Figure 1: Camera Mount Schematic

The parts we need to get are:

- One 4"x4" angle bracket (larger is OK too) (90 degrees angle)
- Six $\frac{3}{4}$" outer diameter washers (inner diameter just needs to fit the screws)
- Three $\frac{3}{8}$" screws (the screws need to fit the tripod bit that will hold the camera, might be wise to bring it with you when you buy everything) (the mount screw needs to be long enough to go through the bracket, both washers, and enter the mount)
- Two nuts that fit the screws (if no nuts fit the screws, you can change two of the previous screws to any size that fits in the washers and the nuts) (note that I'm using screws to mount to the uni-strut since it'll be easier to tighten than bolts)

1.4.2 Larger Tub

We want a larger tub for the water table so that we don't have a wedge at the end of the table compressing the flow, resulting in a change of upstream water behavior. The current tub's interior is about 41 inches across at its largest point. This is a problem since the water table's interior is just under $45\frac{1}{2}$ inches length and about $21\frac{1}{2}$ inches in width. There was no plastic bucket I could find online at Home Depot, Lowes, Amazon, The Container Store, and McGuckin. I was, however, able to find a stock tank that's five feet across, which is perfect for our needs.

Searching for where we can buy stock tanks in person, I find that Lowes, Home Depot, and Tractor Supply Co have 4' and 6' stock tanks listed online, but no 5' stock tanks. 4' could work, but we'd need to measure it in person since the dimensions can vary by 4". I'd prefer if we can get 5' just to be safe,

they are likely available in person. If no 5' can be found we will need to buy a 4' or 6' stock tank.

Another option is to order two smaller bins to put on top of the ends of the current bin and put holes in those to drain into the main bin. An example of two bins to buy would be two of these plastic bins. We can then have two supports running across both ends of the plastic bin and place the two clear ones linked in the previous sentence placed on top.

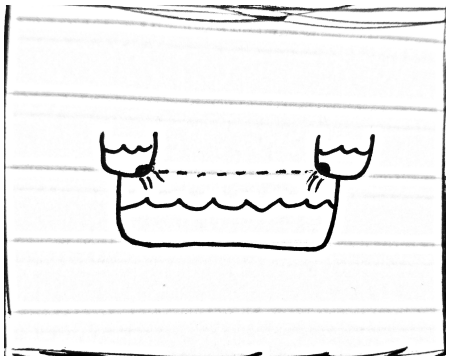

Figure 2: Bin Option Diagram

I think that the first option of buying a stock tank is the most aesthetically pleasing and structurally sound option.

1.4.3 Second Pump Pipes

Below is an image of what I envision the pipes for the water table to be when using a new tank with the second pump.

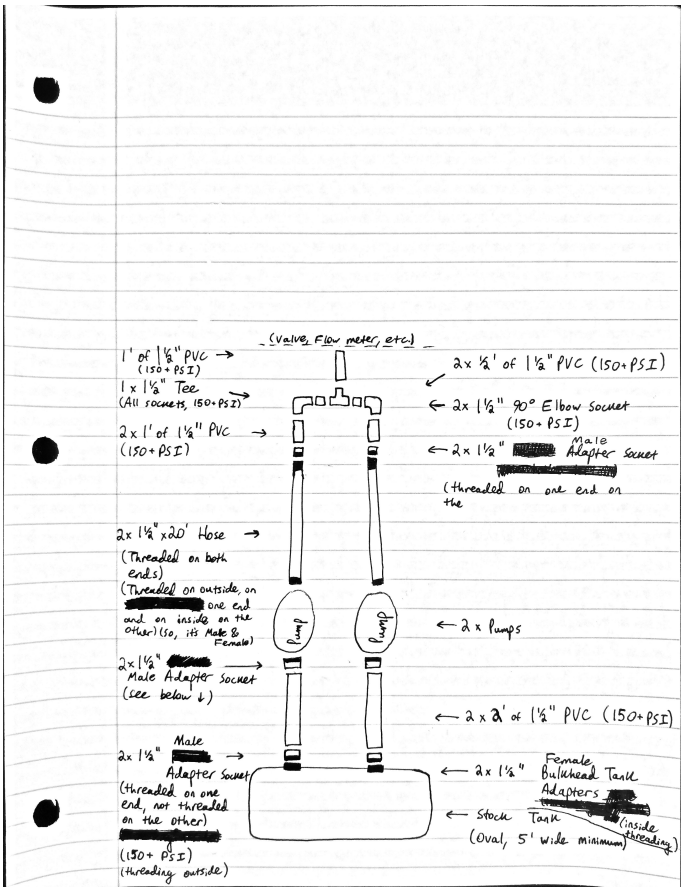

Figure 3: Water Table Pipes Schematic

Below is a list of parts we can re-use:

- 2 feet of $1\frac{1}{2}$" inch PVC (note that this already has a male adapter socket glued on one end)
- Three $1\frac{1}{2}$" Male Adapter Sockets (threaded on the outside on one end, not threaded on the other) (note that one of these adapters is already glued to PVC)
- One $1\frac{1}{2}$" diameter hose 15+' in length (threaded on both ends, one threaded inside and the other threaded outside)
- Two pumps

Below is a list of parts we need to buy (note that all parts should be able to handle water of 150+ PSI due to the pumps combined pressure output of about 140 PSI):

- 10 feet of $1\frac{1}{2}$" inch PVC (extra couple of feet included in case the 2' of PVC from the tank don't align and for errors)
- One $1\frac{1}{2}$" Tee (all sockets)
- Two $1\frac{1}{2}$" 90 Degree Elbow (all sockets)
- Three $1\frac{1}{2}$" Male Adapter Socket (threaded on the outside on one end, not threaded on the other)
- Two $1\frac{1}{2}$" bulkhead female tank adapters (threaded on the inside)
- One $1\frac{1}{2}$" diameter hose 20' in length (threaded on both ends, one threaded inside and the other threaded outside)
- One oval stock tank (5' wide) (see above section on tanks)
- Thread tape (for sealing the threaded connections)
- PVC Primer (for prepping the PVC for the PVC glue)
- PVC Glue (for sealing non-threaded connections)

I don't think we can re-use the existing bulkhead tank adapter since it is already glued into the existing tank. Note also that the flows from the pumps combine so that we can use the existing flow rate meter set up.

1.5 Flow Straightener

The flow straightener we currently have is an aluminum honeycomb core. This material is commonly available due to its many applications.

I E-Mailed Paris for what the flow straightener he ordered was and have not gotten back a response. Turns out, Patrick ordered the flow straightener from a seller on Amazon who made a custom size for him and sold it to him through Ebay. I reached out to the seller on Amazon and asked them what the maximum thickness of the cores they can sell us are, since they list 1" as the thickest, and if they could give a quote for how much it would cost. Since Pat bought from them before, I know they can make 3" thick aluminum cores. We would want 47"x7"x3" with a cell size of 1/8" (the smallest the seller offers) to make the flow straight across the whole table, and we can cut down the edges to fit perfectly in the water table. They did not respond to me

I also reached out to various companies and list their quetes below:

- DMCRF

  $98/p, $520 shipping for 1200mmx200mmx70mm at 3.2mm cell size. They have a 25 piece MOQ (Minimum Order Quantity).

- Kerrpanel

  Sent an email and called, no response

- Plascore

  3mm cell size, and 1200*200mm, 3inches thick, they said it will be a couple thousand dollars.

- RelCore

  47"x7"x2.75" for $3,000-$4,000 since they'd need to cut from a 60"x120" block of materials.

- Alucrown

  $184.38/p, $373 shipping+packing, 1200x200x76.2mm at 1/8" cell size 3003 aluminum.

- FlatironPanelProducts

  Must order full size 48"x96"x3" can be cut down to size and picked up locally. 3.1 1/8 5052 48" x 96" x 3.00" (qty. 1) Expanded Aluminum Honeycomb Core Lead time: 4-5 weeks @$4,329.543

- Huarui

  $85/p, $145 shipping for 1200x200x25.4mm 5052 honeycomb core with cell size 3.17mm

McMasterCarr has aluminum honeycomb cores, but the smallest cell size is 1/2", which is too large for our application.

It looks like our best option cost and time wise would be to cut the existing aluminum honeycomb down to size.

1.5.1 Water Table Work

On Friday, February 25, Sam, Pat, and I met up at the lab to work on the water table. We found that the water table was very turbulent. Part of the problem was that the metal sluice gate did not fit into the grooves for the water table, forcing us to DIY a solution with an acrylic slab and some clamps. Another problem was that the water table had lots of leaks, from the reservoir to down the legs of the water table near where the stock tank will be.

Sam bought parts to get the camera mount set up and functional, along with PVC parts for the second pump. All that's left to buy is the bulkhead tank connectors and the hose connected to the second pump's output. We considered cutting the hose we already have into two and buying two hose end-pieces instead of getting an entire second hose. Sam also bought a 6 foot long stock tank.

2 Description of Next Steps

The water table is still our main priority, so we need to get various things in order:

- Figure out the sluice gate. We either need to machine a new sluice gate machined or figure out a better, permanent solution for the current sluice gate being too small.
- Patch up all the leaks for the water table. I think the caulk we have in the lab will be sufficient in sealing up the leaks from the reservoir. We need to somehow make sure that the water running off the water table doesn't stick to the underside of the table and leak down the legs of the table.
- We need to discuss the flow straightener, whether we will buy something or re-use the existing one.
- When Pat and I used the valve for the water table to limit how much water was coming out of the pump, the PVC fitting disconnected due to the pressure. I think that we need a way for the excess water to flow back into the stock tank by adding a PVC junction connected to a hose so that pressure doesn't build up in the pipes, causing an explosion.
- Once the above problems are resolved we can look into using the cylinder in the lab for flow straightening further.

3 Questions

- Nothing not mentioned in the paper. See Description of Next Steps for talking points.