Previous Research Experience

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Previous Research in Experimental Fluids Lab

In my previous research experience, I have worked in the Experimental Fluids Research Lab (EFRL) on campus during the summer of 2025, under Dr. Sarah Morris. During this experience, I learned how to run blade tests in a tank and capture this motion using PIV (Particle image velocimetry). This goal of my research was to gather data on Randall rowing blades compared to normal blades. During this process I conducted PIV testing with the RANDALLfoil attachment compared to a normal rowing blade, over 5 takes. This was 3-4 positions per blade type with the Randall foil at 2 angles, and normal at 2 angles. After each test run the tank had to quiesce to allow the added particles to settle, which took 15 minutes per run. After this was completed, these results were processed on the computer program DaVis, which was used to collect and edit this PIV data. Each blade set, having 3-4 positions, needed to be calibrated with a consistent (0,0) point being the base of the first position.

PIV was used to illuminate particles in the tank with a continuous 532nm laser wave sheet. The PIV camera (LaVision MX-2m 160) measured the change in particle velocity of each particle in “interrogation windows”, with 2 snapshots separated by dt, or a change in time. These were used to create velocity fields of the blade as it moved through the particles in the water, measuring vorticity for each time step. This data was then plotted into Matlab, where a frame-by-frame video was created that illustrates the vorticity from this data.

The issue of time synchronization was presented; however, I was able to find a helpful solution. Tests were conducted on each run to determine how long the motion lasted in a number of frames. This was effective because either the stop/start was visible within the camera's frame, giving a clear view into the length of the motion. From preliminary testing it was found that each run took 245 frames of full motion. With 3-4 different camera positions, a method was necessary to stitch all of the frames together, which needed to create a unified image that was able to plot the vorticity of the blade. This was where calibration on the DaVis software was used, as this sets the first position in the motion at a (0,0) point, or origin, and effectively sets up the data to be spliced together using Matlab. In Matlab, the code looped through each time step or "frame", and x, y, u, and v were extracted from the CSV data. Each of these were averaged to give the average data per position. After the code concatenated the data, they were combined vertically. Meshgrid was then used to find minimum and maximum x and y coordinates, "meshgrid(min(x_coords), and griddata plotted these on the uniform mesh, which created the final image. This stitching was needed because the camera's field of view was not wide enough to completely show the whole blade motion, so different positions had to be put together, which is why this process was needed.

Overall, this previous research in the fluids lab over the summer has helped me see how I could further my research this semester, and I am excited to have an opportunity to perform new tests and gather data. I know there will be challenges as I embrace all the novel parts of this proposal, but I am excited to learn in this process and understand more about the research world.