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Biomorphic Control of a Swimming Robot Fish

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Contents

- Project Scope
- Theory/Background
- Previous Work
- Repair and Design Process
- Experimental Procedure
- Results and Conclusions
- Special Thanks and References

Project Scope

- The objective of this project focus on experimentally representing the propulsive efficiency gains of a robot fish by taking benefit of a complex vortex field. To do this, following needed to be done first:

1. reconfiguring the Opti-Track system
2. new voltage regulator to be made
3. repairing and troubleshooting Dory the robot fish
4. rewiring of Dory
5. redesigning the vortex field generator
6. checking the pool for leaks

Theory/Background

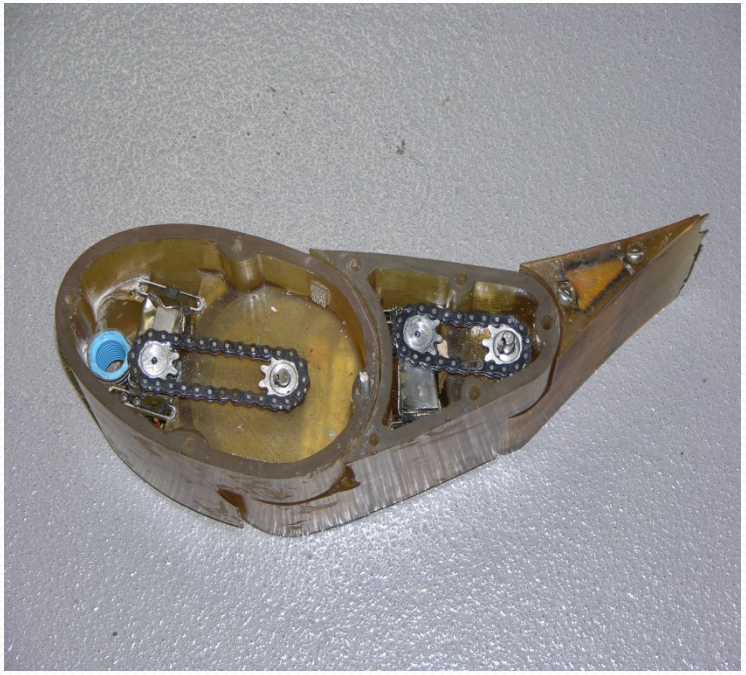
- A vortex is a fluid flow field where the fluid flows in circular motion around its imaginary axis. This pattern of motion is known as vortical flow (see Figure 1).
- However, there is been increasing interest in collecting the energy stored in them. As with schooling fish or when a goose flies in the wing tip vortex of the bird in front of it, animals have instinctively found the energy advantages of using natural vortices.
- A object in vortex field experience less friction and due to this it can travel spending less energy.

Figure 1: Water flow due to vortex

Previous Work

- Dory the robot fish was designed.
- A Pool and Opti-track cameras were provided.
- Peter Hassing programmed the software to communicate with Dory the robot fish.

Opti-track camera



Dory the robot fish

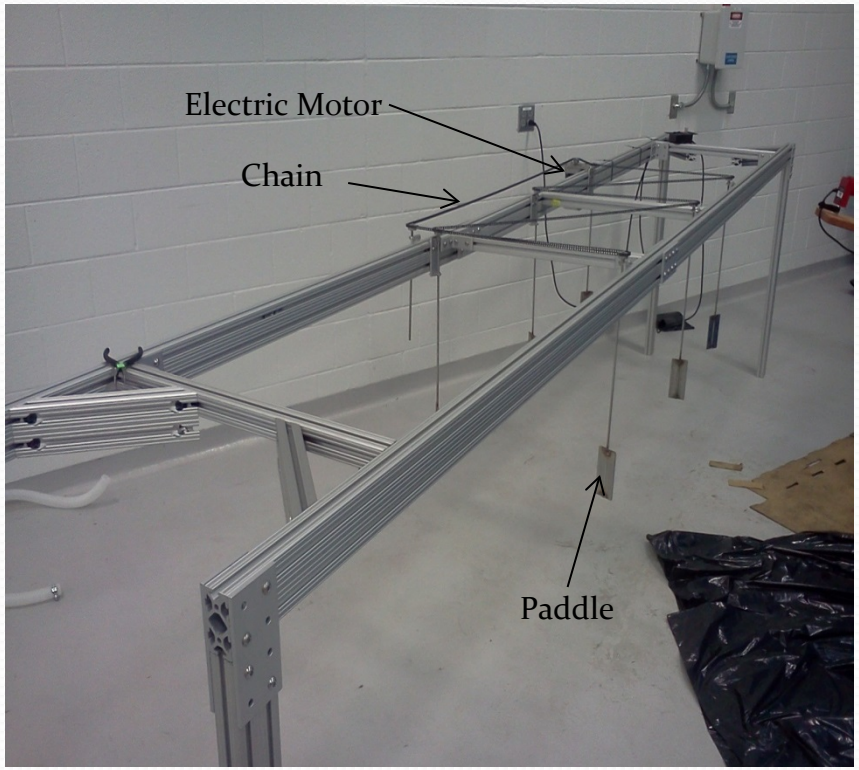
Repair and Design Process

- First job was to fix pool leaks
- Cable system was made to hoist the pool.

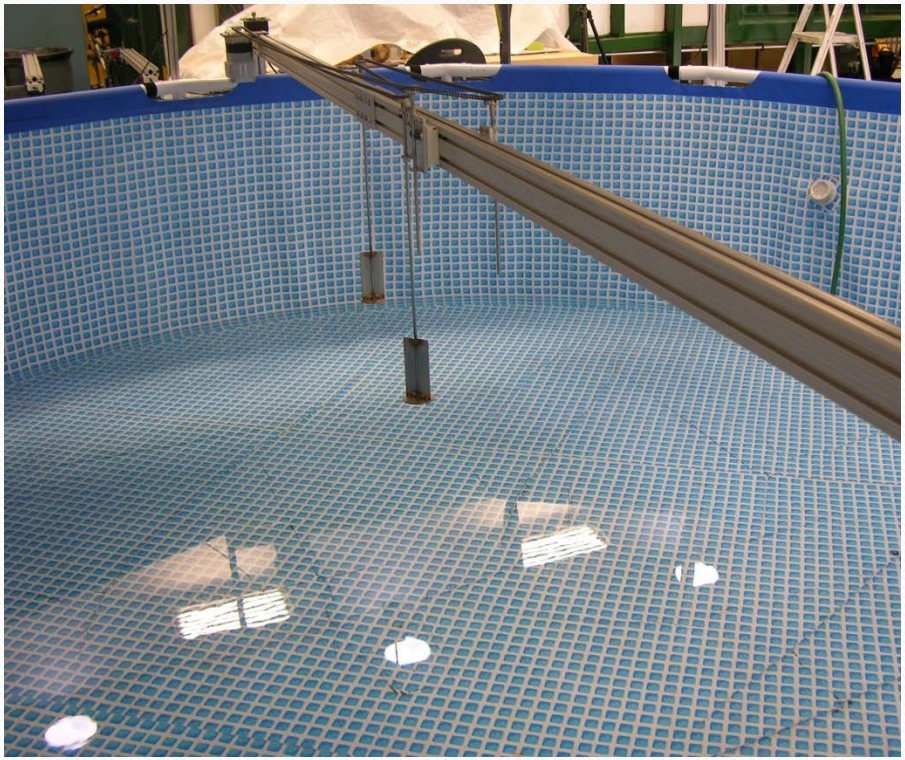
Fixing pool leaks

Redesigning the Vortex Generator

- Next thing we did was redesign the vortex generator
- From six paddles, it was reduced to two paddles.



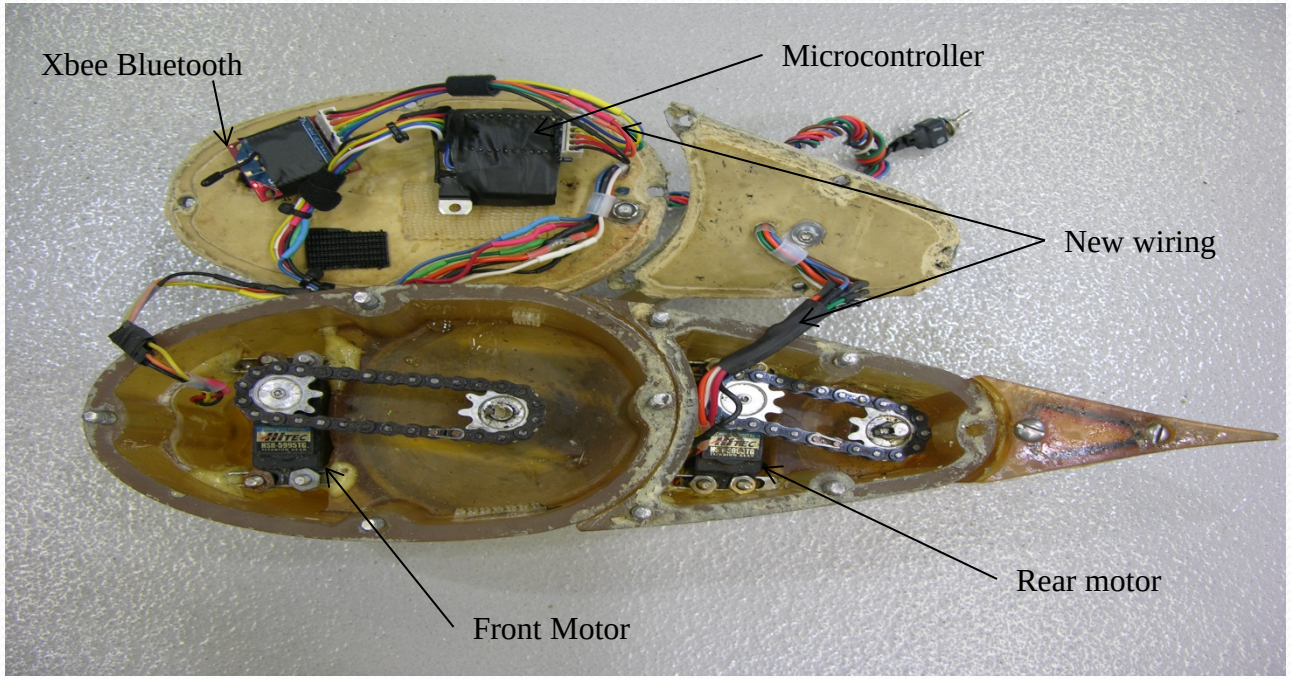
Previously vortex generator made



Redesigned the Vortex generator

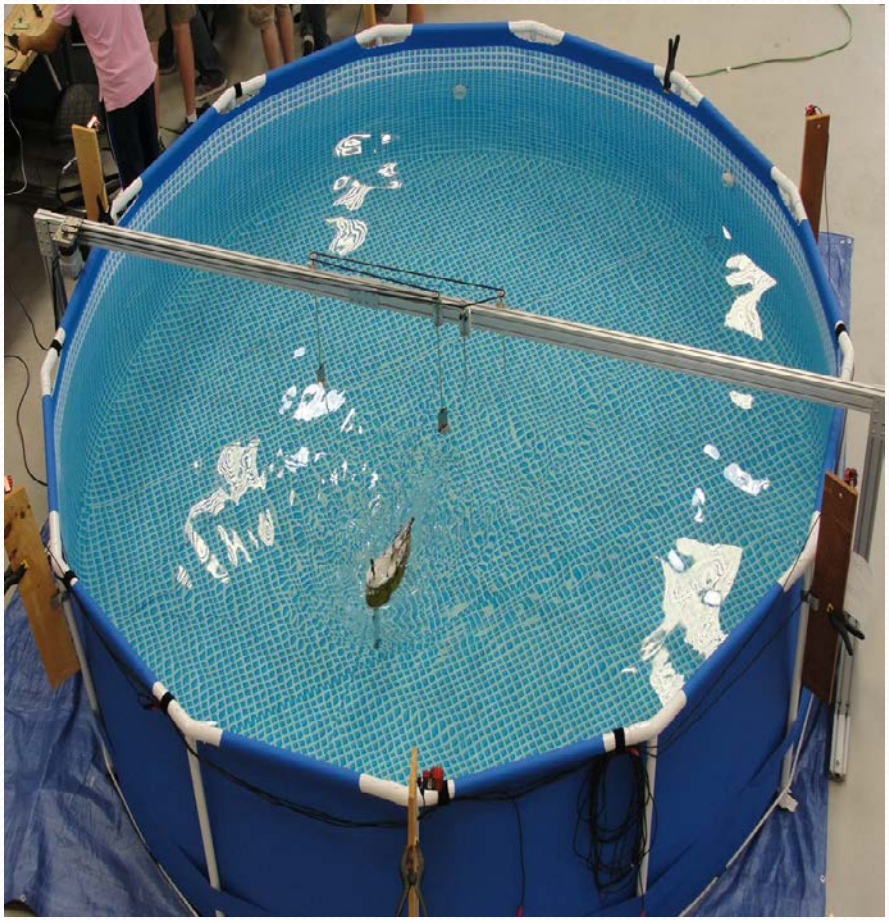
Rewiring of Dory

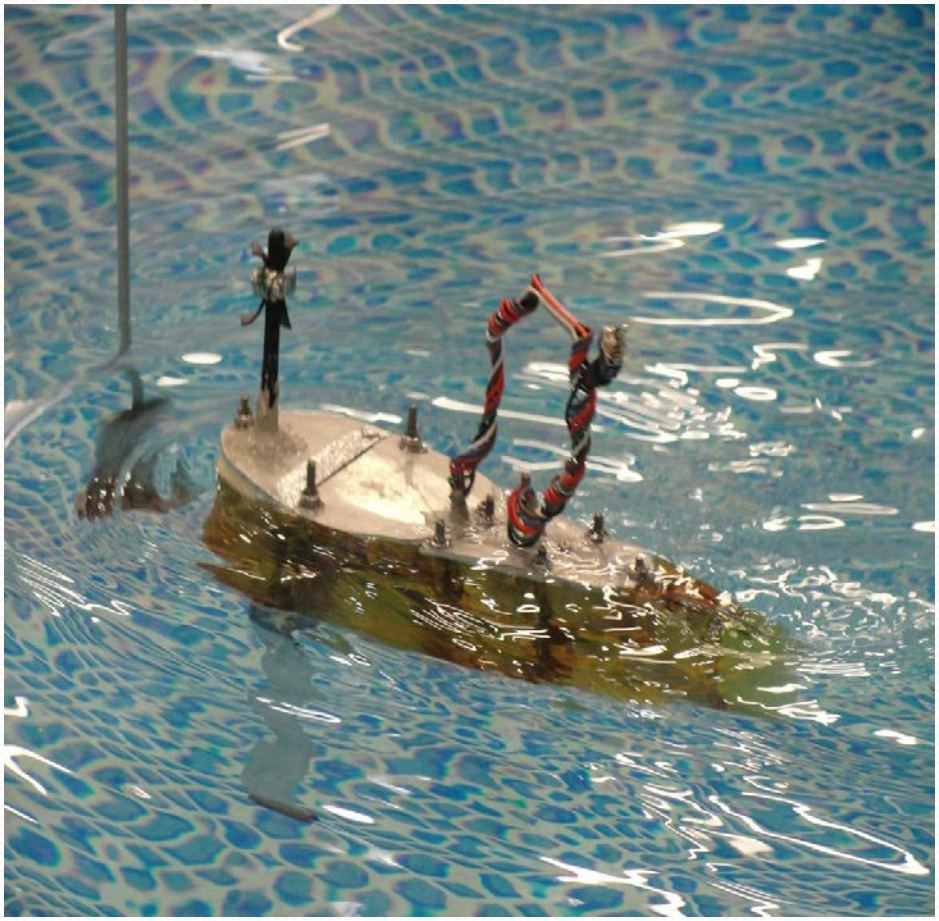
- Dory, the robot fish has had issues with waterproofing and leaks which caused water puddles around the pool, corrosion on wiring connectors, the motor chain, and internal damage to the electronics



Problems Faced:

- Floatation problems.
- Opti-track cameras struggle to calibrate properly.

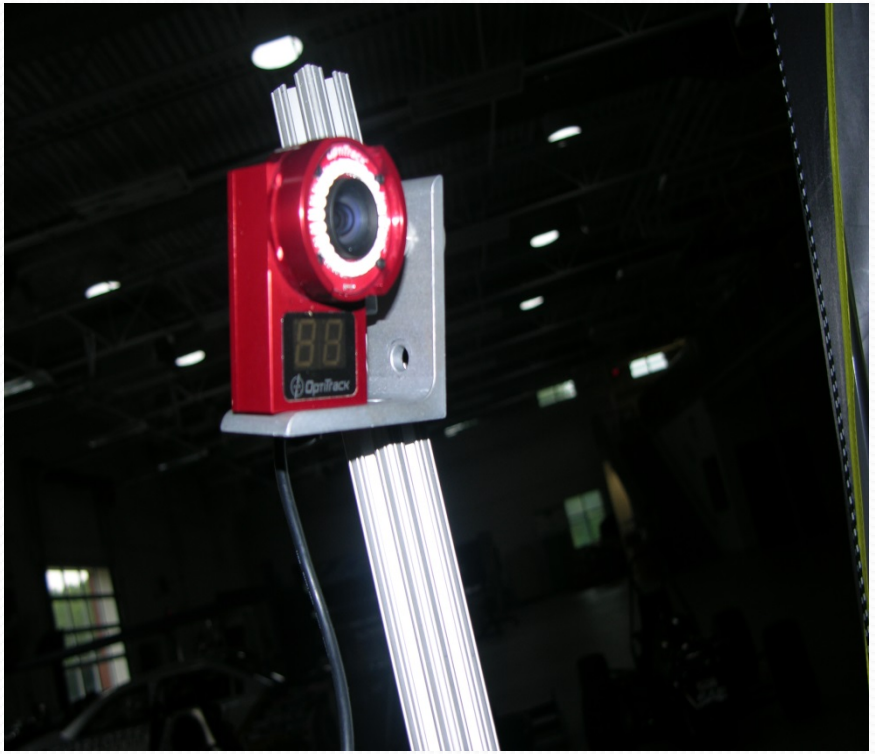




Opti-Track camera

- Orientation of Cameras

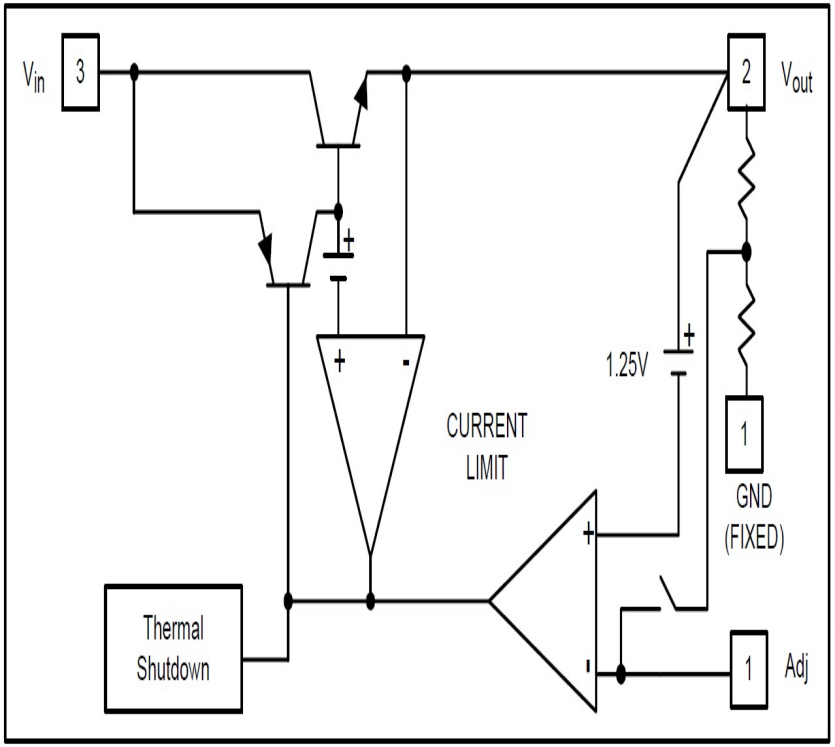
Portrait View
Camera sensors are 480x640

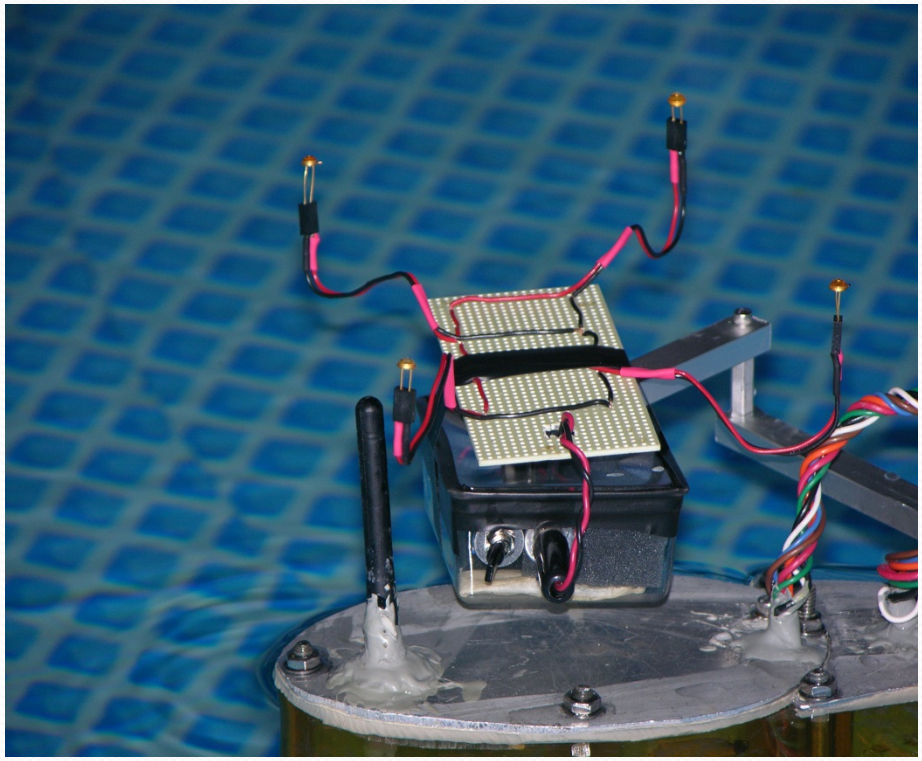


Landscape View
Camera sensors are 640x480

Voltage regulator circuit

- Voltage regulator for the IR LED which goes on the top of Dory the robot fish was made.





Experimental Procedure

1. Calibrate the Opti-track system (see Figure 1)
2. Trigger the vortex generator and direct Dory to swim across it
3. Run the lab view program on laptop and desktop at same time to record the track of Dory the robot fish and motor power respectively
4. Repeat the step 2&3 to three-four times
5. Analyze and compare the results to see efficiency gains

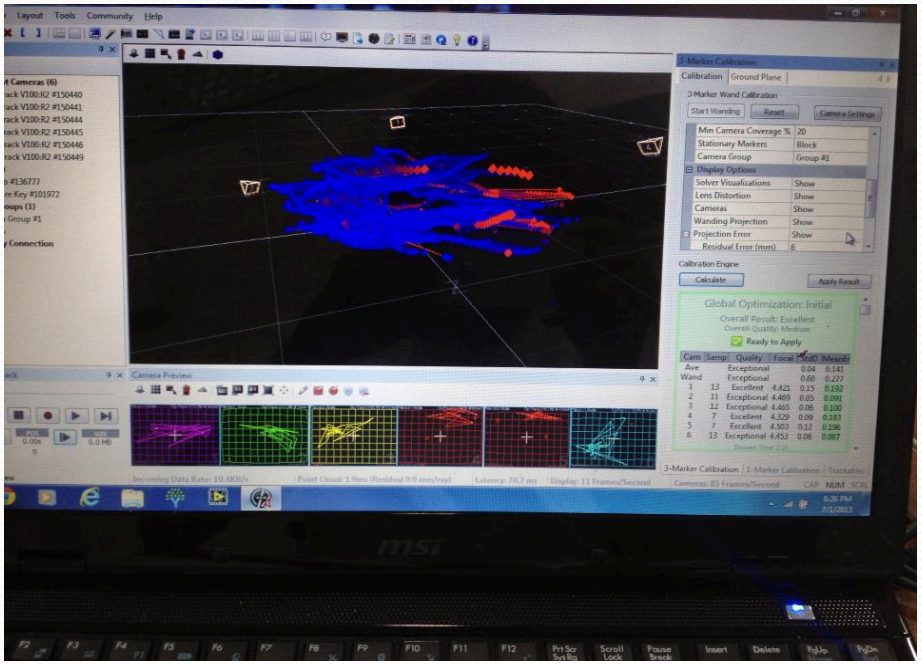
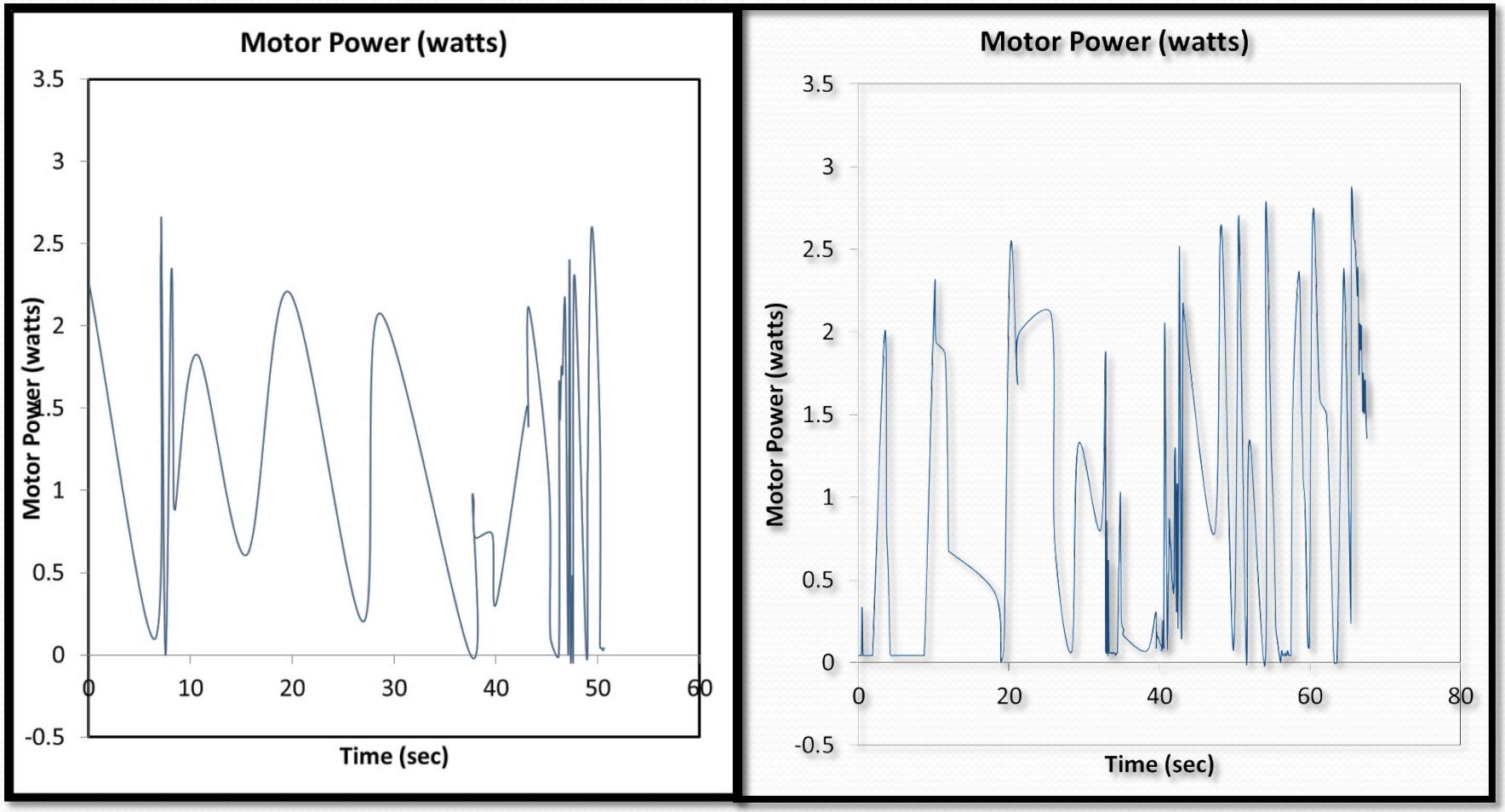


Figure 1: Calibration

Results and Conclusion

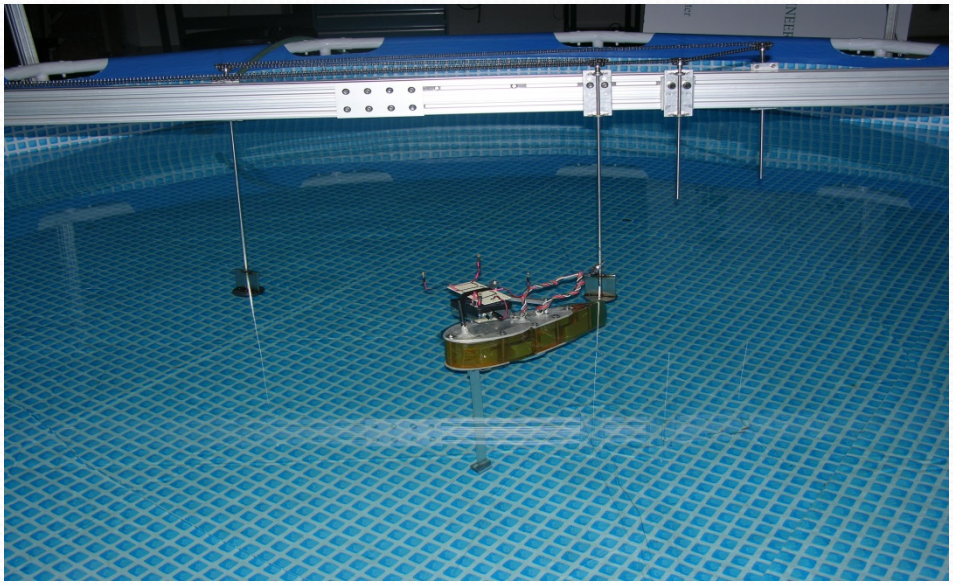
- We found that she (Dory the robot fish) was could move more efficiently with the vortex field than without it (lower overall power consumption).
- We also found that when unpowered, she would drift off and away from the vortex field.
- We accomplished all of our experimental objectives and are waiting for Peter Hassing to analyze the data (his dissertation project).
- Our predictions from this experiment would be useful to the US Navy possibly opening up new design concepts for many autonomous robots.

- Power Consumption by Dory the robot fish with vortex field and without.



Motor Power vs. swimming time in the vortex field (left) and without (right)

SREU is fun



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- Eric Fleischhauer
- Jerry Dahlberg
- Sam

References

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