SREU 2013

Biomorphic Control of a Swimming Robot Fish

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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.
- An 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.
Repair and Design Process

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

- Next thing we did was redesign the vortex generator
- From six paddles, it was reduced to two paddles.
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.
SREU is fun
Special Thanks to:
- SREU Committee
- Dr. Peter Tkacik
- Dr. Scott Kelly
- Peter Hassing
- Dr. Conrad
- Swapnil Patil
- Eric Fleischhauer
- Jerry Dahlberg
- Sam

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