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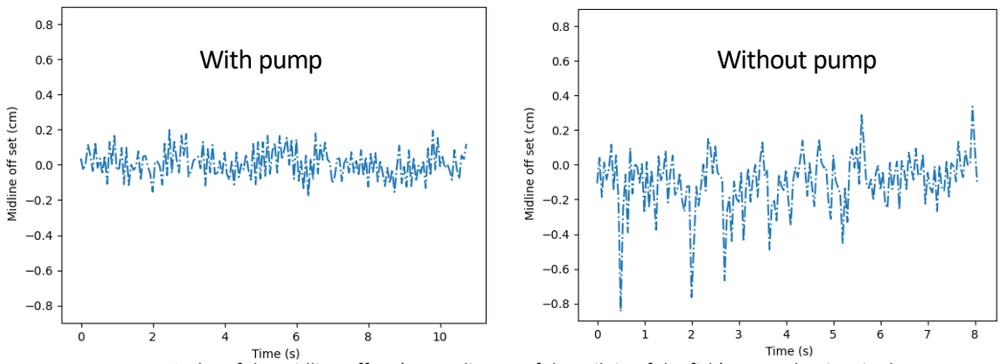
Active Matter In Complex Environment
MOTION OF FISH IN FLOW

The fluid dynamics of underwater propulsion is an area of research that has stimulated vigorous collaborations between biologists and engineers, and fostered numerous mathematical treatments, experimental investigations and numerical simulations.

1.Introduction

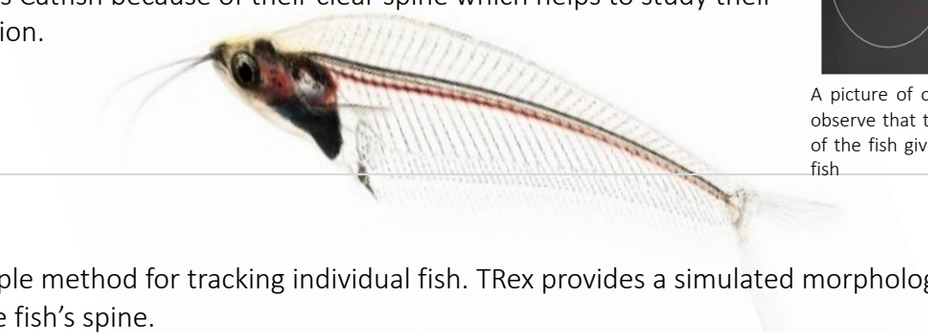
The biology is evidently rich with complexity, encompassing a vast range of body morphologies and swimming styles. A primary sorting can be made on the basis of Reynolds number. We want to understand how the frequency of the oscillation changes as a function of the speed of the current.

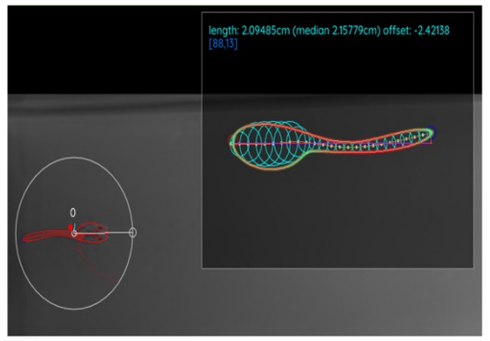


A plot of the midline offset (y-coordinates of the tail tip of the fish) versus the time in the situation where there is a pump (flow) and there is no pump.

2.Methods

We place the camera over the aquarium to record videos of the fish movement .The background should be clear and net for better recorded videos and thus accurate data. We manage the flow to have laminar flow to simplify our work. We choose to work with Glass Catfish because of their clear spine which helps to study their motion.

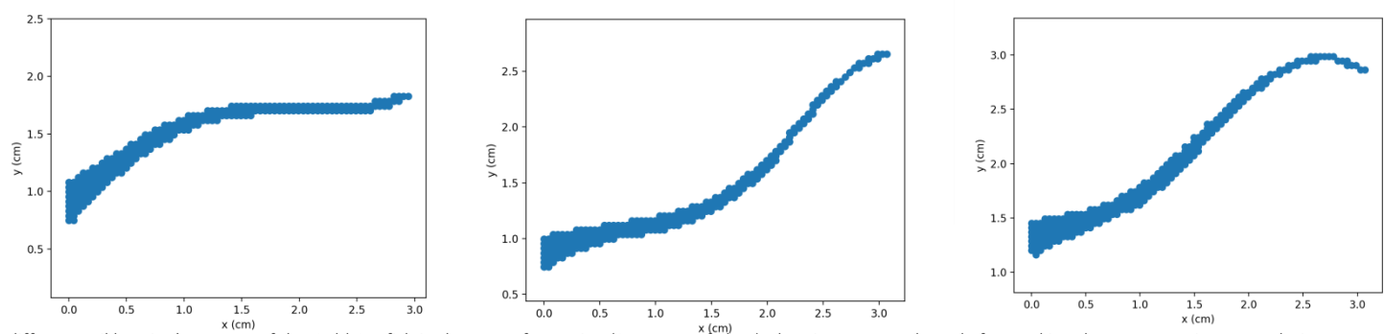




A picture of one of the tracks that we've done, we can observe that the software TREx can simulate the posture of the fish giving some parameters like the length of the fish

3.Analysis

We use TRex software which is a quick and simple method for tracking individual fish. TRex provides a simulated morphology of each raw image , thus we can find the coordinates of each point of the fish's spine.



Three different tail beating's pattern of the Gold Cat fish in the case of pumping (Presence of Flow), the pictures are plotted after making the necessary image analysis on Image J.

4.Results

The frequency without flow is lower than that with the flow because for the fish to resist the coming current flow, it should move its tail faster per unit of time to generate more power that enhances its stability facing this current, so when the frequency is much higher the tail don't have enough time to elongate freely, thus the amplitude of the oscillation was smaller in this case.

5.Conclusion

The Mechanics of fish locomotion in a flow was the basic topic of our work. From these mechanics that a fish undergoes during swimming and especially facing a flow, the transverse oscillatory movements that the fish make to gain a high Froude propulsive efficiency.

6.References

Lighthill, M. J. "Note on the swimming of slender fish." *Journal of fluid Mechanics* 9.2 (1960): 305-317.
Smits, Alexander J. "Undulatory and oscillatory swimming." *Journal of Fluid Mechanics* 874 (2019): P1.