Best practices in marine hitchhiking: bow riding or wake drafting?

Training virtual swimmers to find optimal strategies to minimize their effort when swimming near bluff bodies.

Fish live their lives in a perpetually unsteady environment, where flow is set into motion and interacts with a multitude of natural and human processes. Since their birth, fish must learn to cope with this environment, to stabilize their posture and maintain their swimming trajectory. At the same time fish learn to identify situations where swimming effort can be reduced by exploiting pressure differences or shear forces in the flow.

In this project we propose employing machine learning algorithms to simulate this learning process and teach virtual swimmers to reduce their swimming effort by exploiting bluff moving bodies in the flow. We envision the swimmers employing two behaviors observed in nature: bow riding and wake drafting. This would lead to interesting comparison of swimming strategies. The project will provide experience in massively parallel interaction of fluid dynamics solvers and distributed machine learning algorithms.

PREREQUISITES
- Programming in C/C++
- Basic Fluid mechanics
- Understanding of Machine Learning

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In the CSE Lab, we combine computational methods, computer science tools and domain specific knowledge to solve scientific and engineering problems in areas such as Fluid Mechanics, Nanotechnology and Life Sciences. The core computational competences of our group are in particle methods and in stochastic optimization techniques. Motivated by challenges in application fields, we focus on identifying the common elements among computational techniques and on formulating common methodological, algorithmic and software structures that facilitate their further development.