Research Proposal:
Modeling Predator-Prey Effects in Swarms
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1 Introduction
Swarming behavior is observed among a variety of different animals. It is beneficial for some groups of animals due to the advantages they gain from social interactions. These can occur from a variety of factors such as the updraft that birds get when flying in a Vee formation which requires the birds to use less energy. In addition to this, swarming is also used as a mechanism for avoiding predation. There are multiple models being developed to try to model the swarming behavior that is observed.

2 Proposed Research
I intend to work on a model that incorporates the effect of predator-prey relations into swarming behavior. In particular, I plan on looking at how fish behave around a predator such as a shark. This is influenced by three important factors which are to be able to watch the predator, minimize the amount of energy they need to get away, and maximize their ability to escape the predator [3]. In addition to this, there are social interaction forces that govern a swarms behavior. This includes an attraction force at longer distances since mutual interactions are beneficial for the swarm, and a repulsion force at short distances to prevent crowding. These mutual interactions include mating and predator avoidance which are advantageous traits for an animal from a biological standpoint [5].
3 Prior Research

This subject was studied by Andrew Bernoff, [1, 4], Chad Topaz [1, 4], and Andy Leverentz [4]. They have done research in constructing continuum model for swarming in the presence of an external potential. This type of potential could be adapted to model a predator. Research has also been done by A. Mogilner, L. Edelstein-Keshet, L. Bent, and A. Spiros to study the spacing between individuals in a swarm [5].

My relevant courses for this research include Applied Analysis, Partial Differential Equations, Mathematical Biology, Analysis (Real and Complex), Algorithms, and Fluid Dynamics. I also am planning on taking Numerical Analysis next semester which will help me for doing numerical simulations.

References


