SYNC or Swim

A Particle Model of the Interaction within Fish Schools

David Ebert and Mikaela Jordan

Tarleton State University

May 4^{th}, 2017

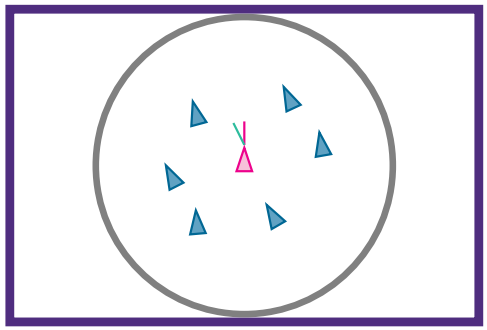
Motivation

Schooling Model

Our model represents each fish adhering to the following three rules:

Schooling Model

Our model represents each fish adhering to the following three rules:

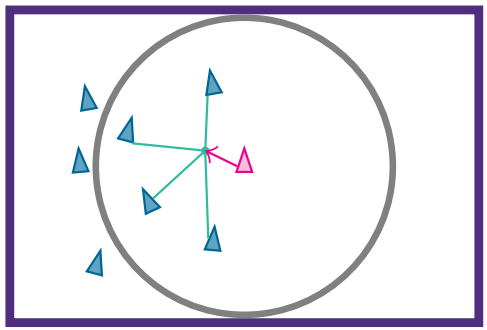


- **Alignment**

Schooling Model

Our model represents each fish adhering to the following three rules:

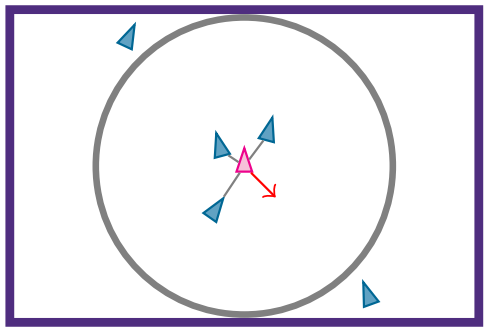
- **Alignment**
- **Cohesion**



Schooling Model

Our model represents each fish adhering to the following three rules:

- **Alignment**
- **Cohesion**
- **Separation**



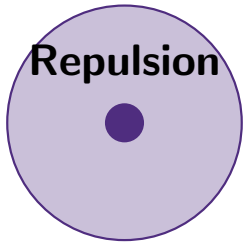
General Mathematics

- Lagrangian Algorithm

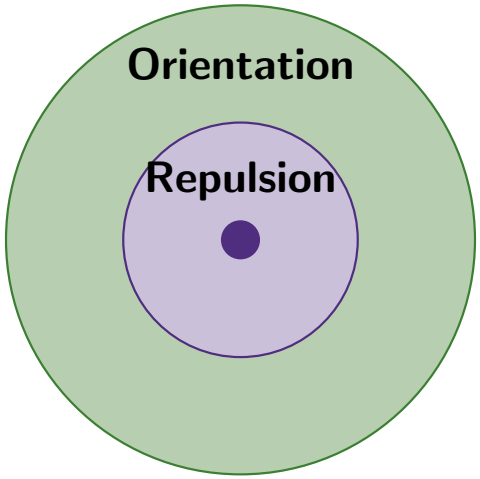
General Mathematics

- Metric distance model

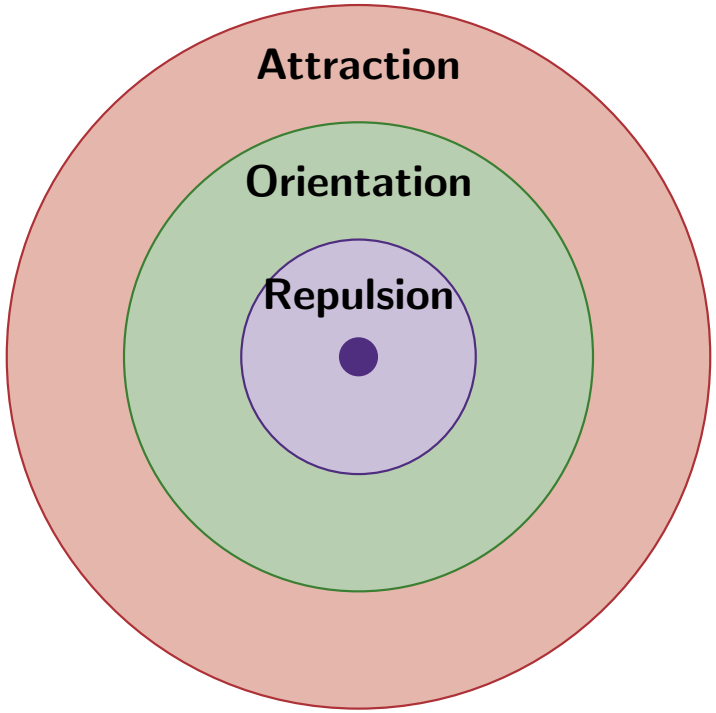
- Metric distance model



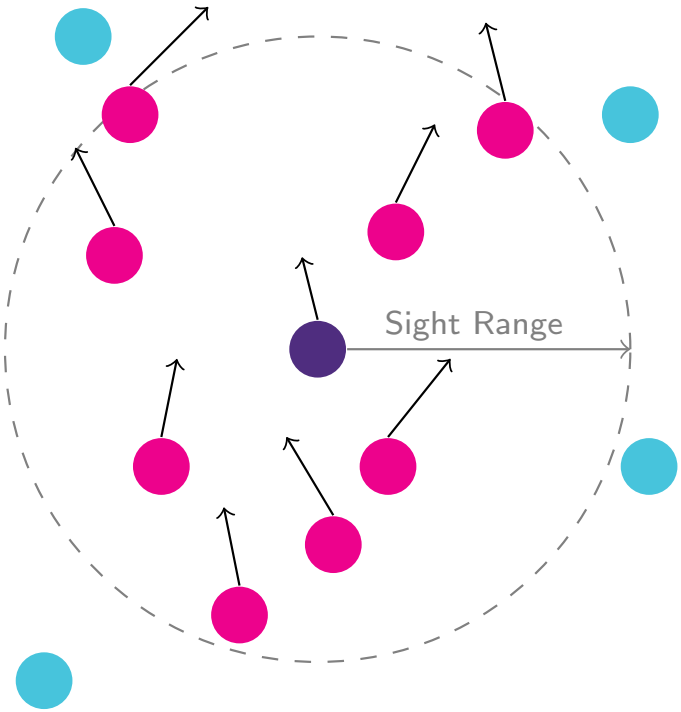
- Metric distance model



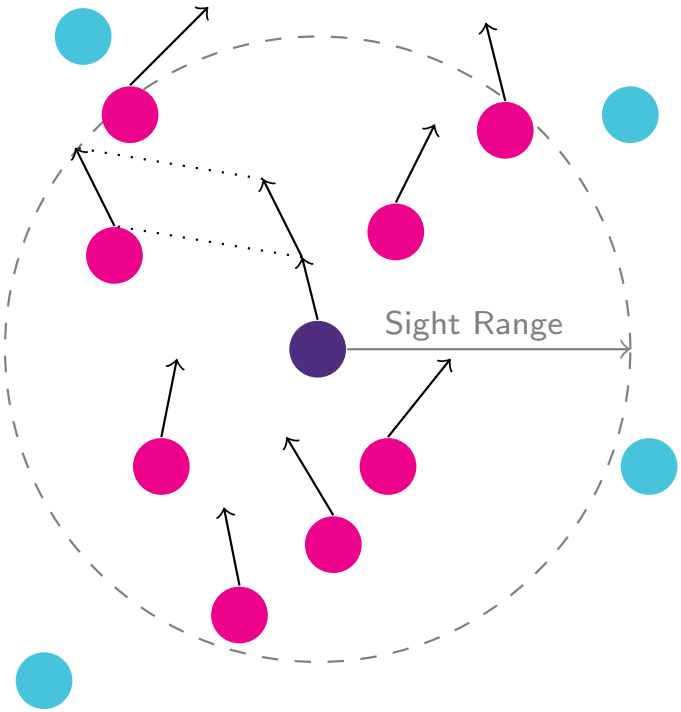
- Metric distance model



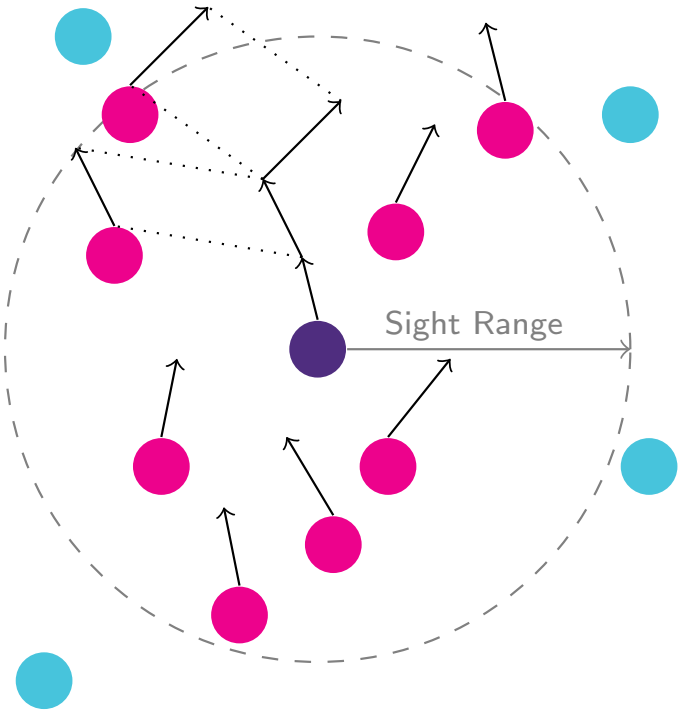
Directional Alignment of Fish



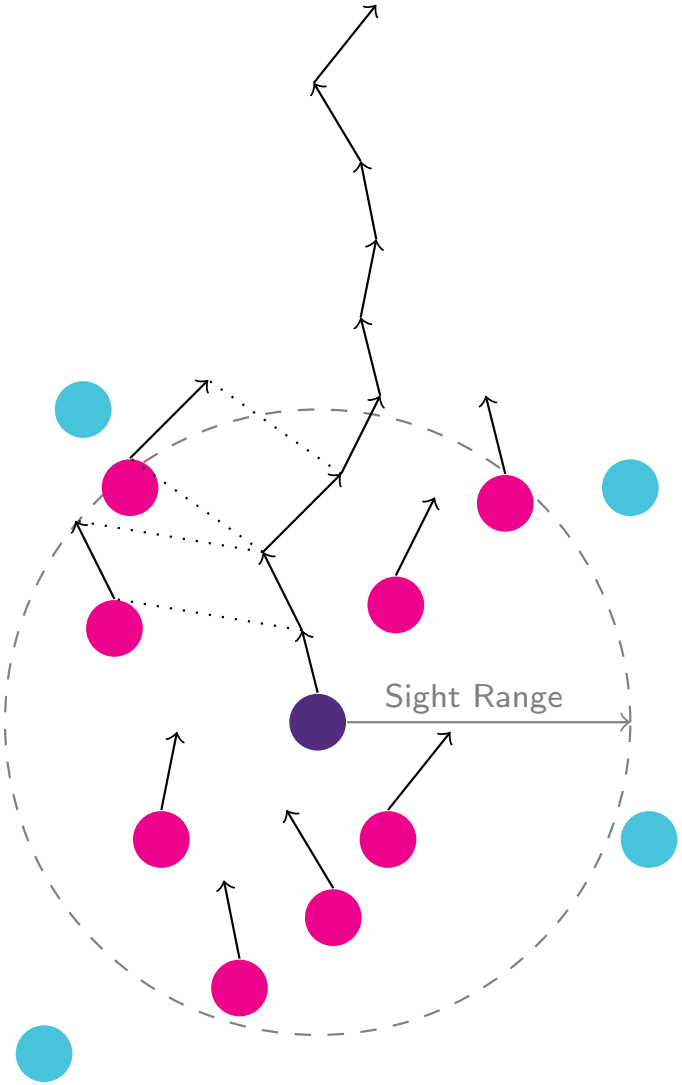
Directional Alignment of Fish



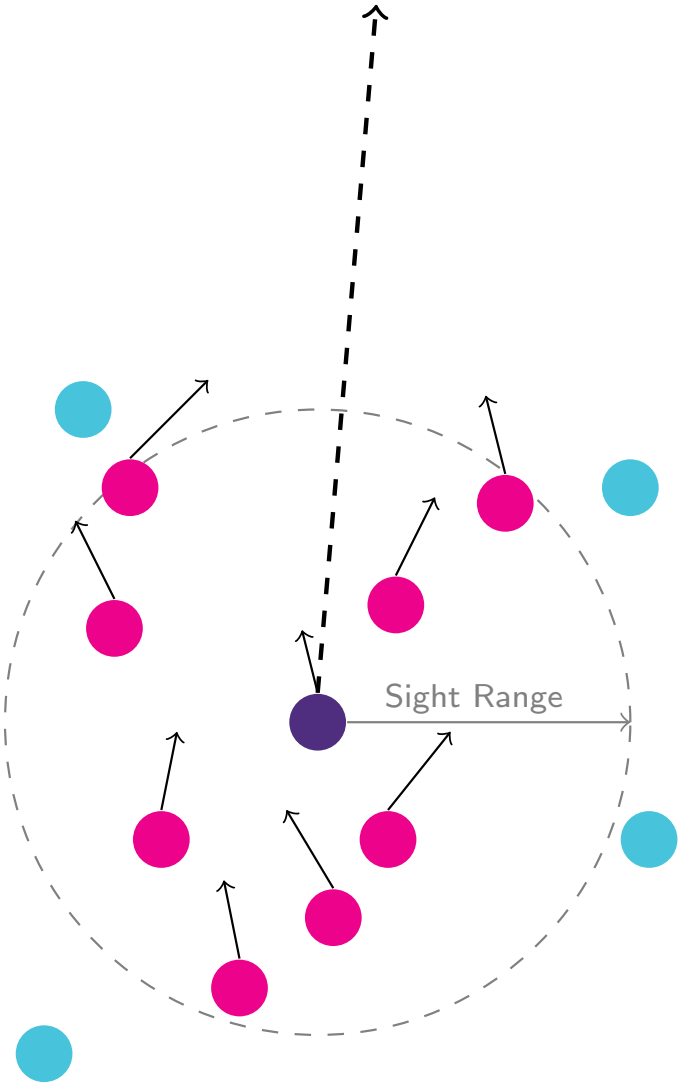
Directional Alignment of Fish



Directional Alignment of Fish



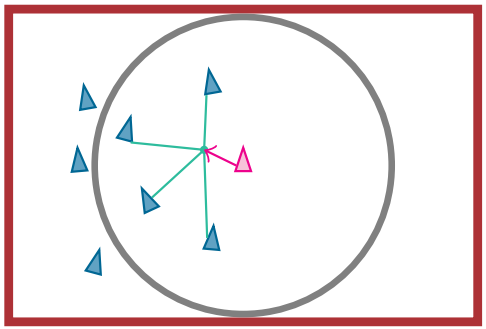
Directional Alignment of Fish



Forces

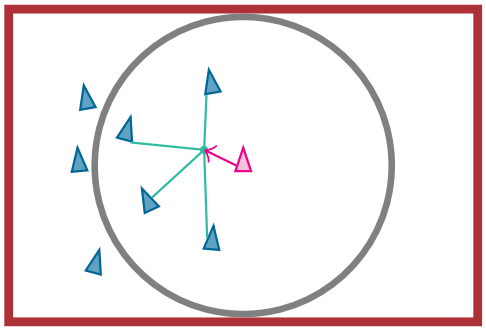
$$F_{i_N} = \sum_{j=1}^{N} \left(\qquad (1)$$

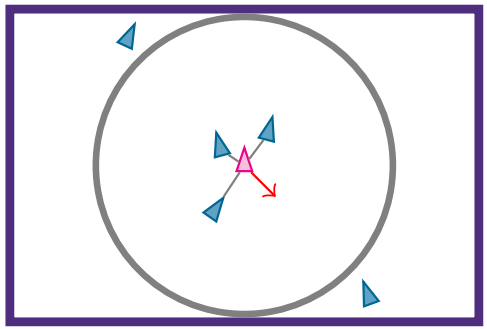
Forces



$$F_{i_N} = \sum_{j=1}^{N} \left(W_a \left(C_a \frac{p_j - p_i}{d^2} \right. \right. \tag{1}$$

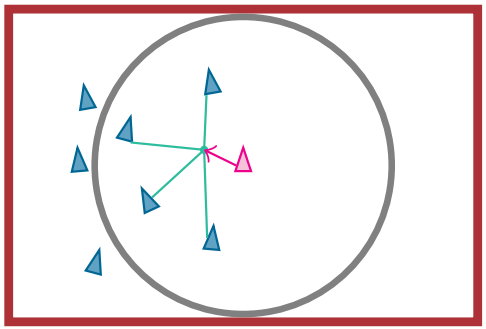
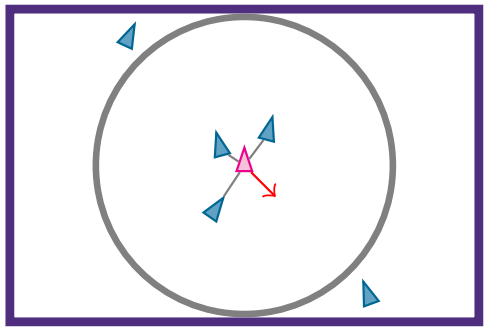
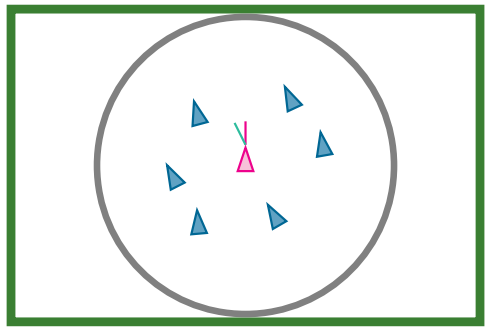
Forces





$$F_{i_N} = \sum_{j=1}^{N} \left(W_a \left(C_a \frac{p_j - p_i}{d^2} - C_r \frac{p_j - p_i}{d^4} \right) \right. \tag{1}$$

Forces

$$F_{i_N} = \sum_{j=1}^{N} \left(W_a\left(C_a \frac{p_j - p_i}{d^2} - C_r \frac{p_j - p_i}{d^4}\right) + W_d\left(\frac{v_j}{||p_i - p_j||}\right)\right) \quad (1)$$

Simulations

Simulations