SYNC or Swim

A Particle Model of the Interaction within Fish Schools

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Synchronization

The coordination of events to operate a system in unison.
Some natural physical examples:

- Circadian Rhythms
- Round of Applause (WHAT?!?! - Let's try it!)

Coupling

One object influencing another by providing feedback.
Real life examples

- Animal Swarming
- Human Imitation (Memes/Trends)

Coupled oscillators are systems of masses that are connected by springs.

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- For mathematical purposes, consider a swarm as an emergent behavior with no central coordination that arises due to several simple instinctual rule that animals of a given species follow.
- Other terms we will be using interchangeably with "collective behavior": swarm, school(specific to fish)

Why Do We Care?

- Learning C/CUDA
- Applying mathematical models to real life phenomenon
- How will environmental factors affect the animal aggregate
- How animal aggregates will affect the environment

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- Move in the same direction as your neighbors
- Remain close to neighbors
- Avoid collisions with neighbors

The Mathematics

- Lagrangian Algorithm
  - Agent Based Model following individual particles in school
- Metric distance model - calculate forces on individual particles based on distance to other particles

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$$p_i = p_i + v_i dt$$

Simulations

Where Do We Go From Here?

- Add initial conditions for species-specific parameters
  - Density of swarms, how they behave towards targets and obstacles, etc.
- Move calculations from CPU to GPU to speed calculation time

References

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THANK YOU

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QUESTIONS?