Human-Coordination Inspired Robotic Control

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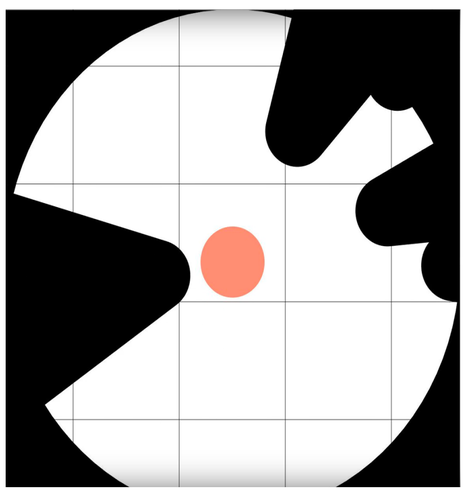
Introduction

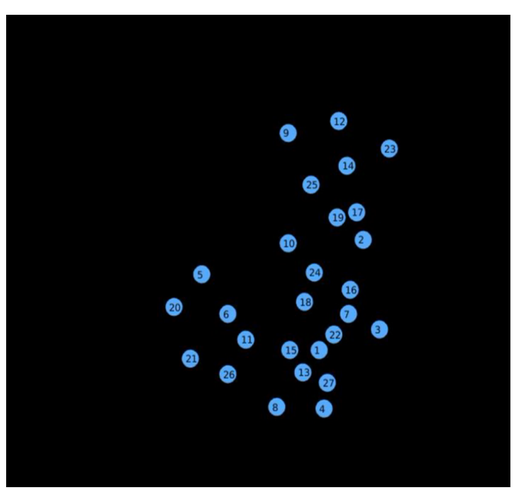
- Decentralized problems with many agents, which require tight coordination are difficult to solve in multi-robot systems
- Humans (and other animals) solve these types of problems every day
- We have designed a multi-player game to study the way humans coordinate and complete tasks
- We will use these insights to design robust controllers for multi-robot systems

Fictional Fish solving a tightly coupled shape formation task. bit.ly/3adgmxU

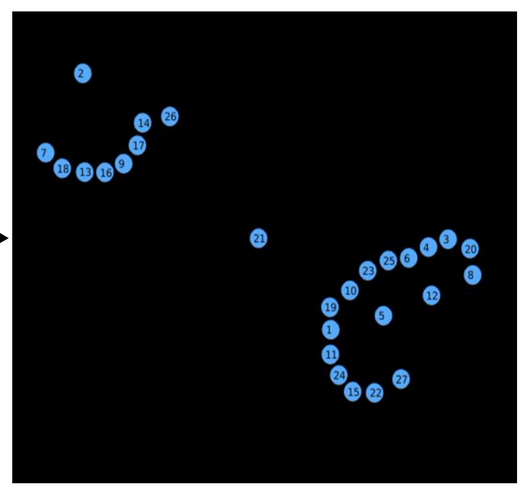
Multi-Player Coordination Game



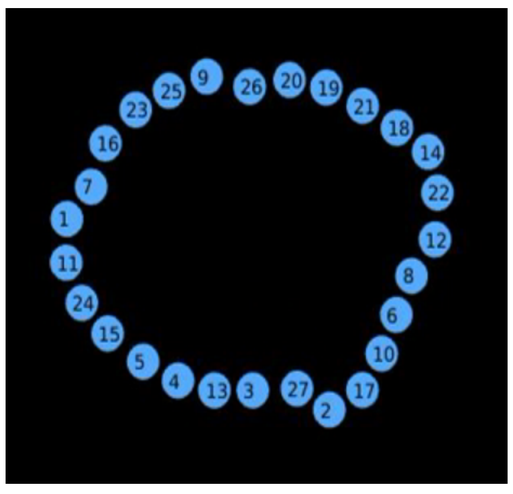
- The players only have access to a local view
- Sensing radius is limited
- Occlusion is included for robotic realism



- Players begin randomly distributed
- Players move with their arrow keys
- Players cannot communicate outside of the game



- Players attempt to form a single circle
- Limited sensing leads to wrong initial solutions



- Players eventually come together to form a solution

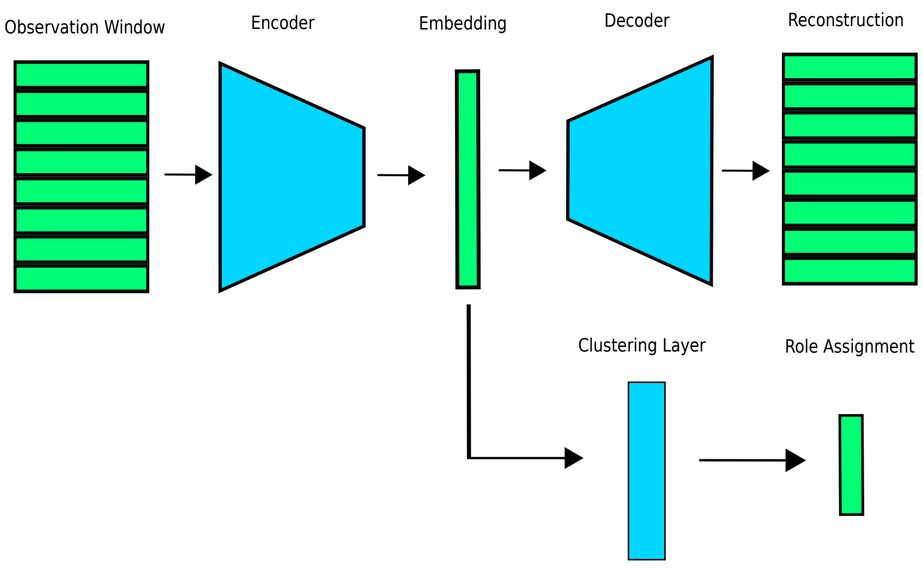
Insights from Human Problem Solving

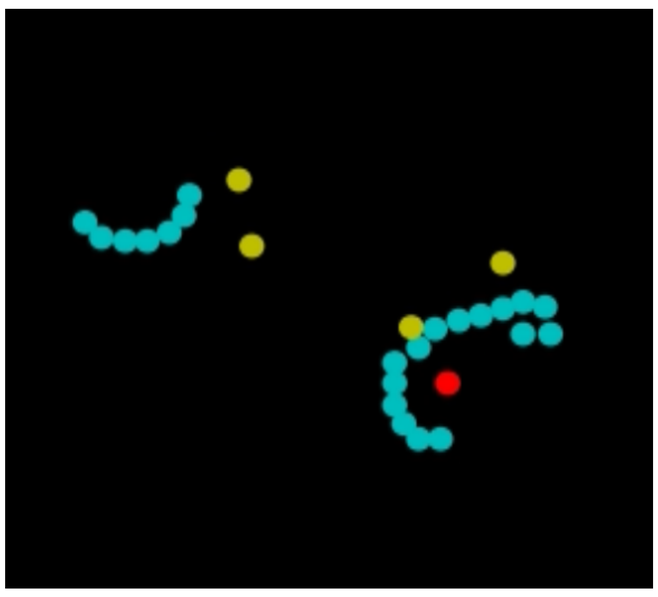
- Humans approach problems with a diverse set of strategies, and the diversity of these strategies is important.
- Humans Developed implicit communication strategies, such as "nudging" to communicate out of place agents that they must move

- Most of the time is spent with all agents in a single shape, making small adjustments to try and improve the quality of the shape.

Unsupervised Role Discovery

- We adapted an unsupervised role detection algorithm from [1] to detect differing strategies utilized by different players at different times.





Samples of Labels produced by our unsupervised DEC algorithm
- The gold agents are moving between the disjoint shapes
- The cyan agents are stationary and in the shapes
- The red agent is correcting deformations

Future Work

- Given the roles of agents at particular times, we will seek to learn policies for those roles.
- Then we will develop a high level controller that can to switch between low level roles
- Complete the shape formation task robustly with a team of robots

[1] Silva, Andrew, and Sonia Chernova. "Unsupervised Role Discovery Using Temporal Observations of Agents." AAMAS 2019.