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Massive Self-Organized Shape Formation in Grid Environments

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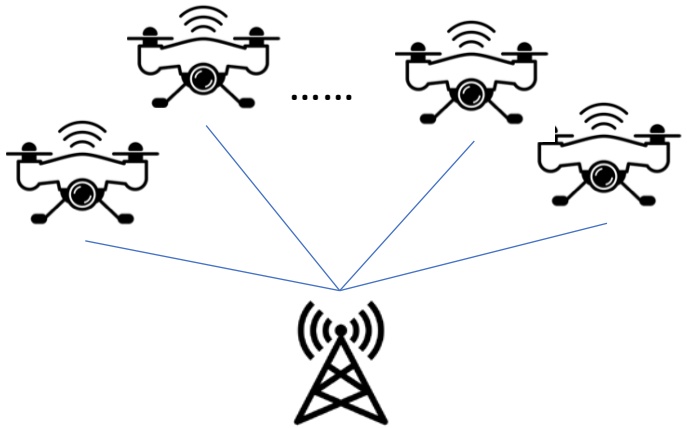
Overview

- ***Introduction***
  - ***Our Approach***
    - ***Preliminary Results***

Introduction



Increasingly *Large-scale* Collaborative Tasks in the Connected World with *Autonomous Agents*.

Specifically

Smart Warehouse

Drone Delivery

Intelligent Transportation

Light Show with Drones

Introduction

In multi-agent collaboration scenarios, integrated task assignment and path planning is the core task, and this task is also referred to as a shape formation task.

Current Approaches' Demerits:

- Centralized approaches based on task assignment and path planning suffer from poor scalability concerning the number of involved agents due to the high computational cost;
- Edge-following based approach manifests low efficiency due to the low parallelism among agents;
- Artificial potential field (APF) based approaches exhibits poor stability due to the high risk of an agent's falling in local minima.

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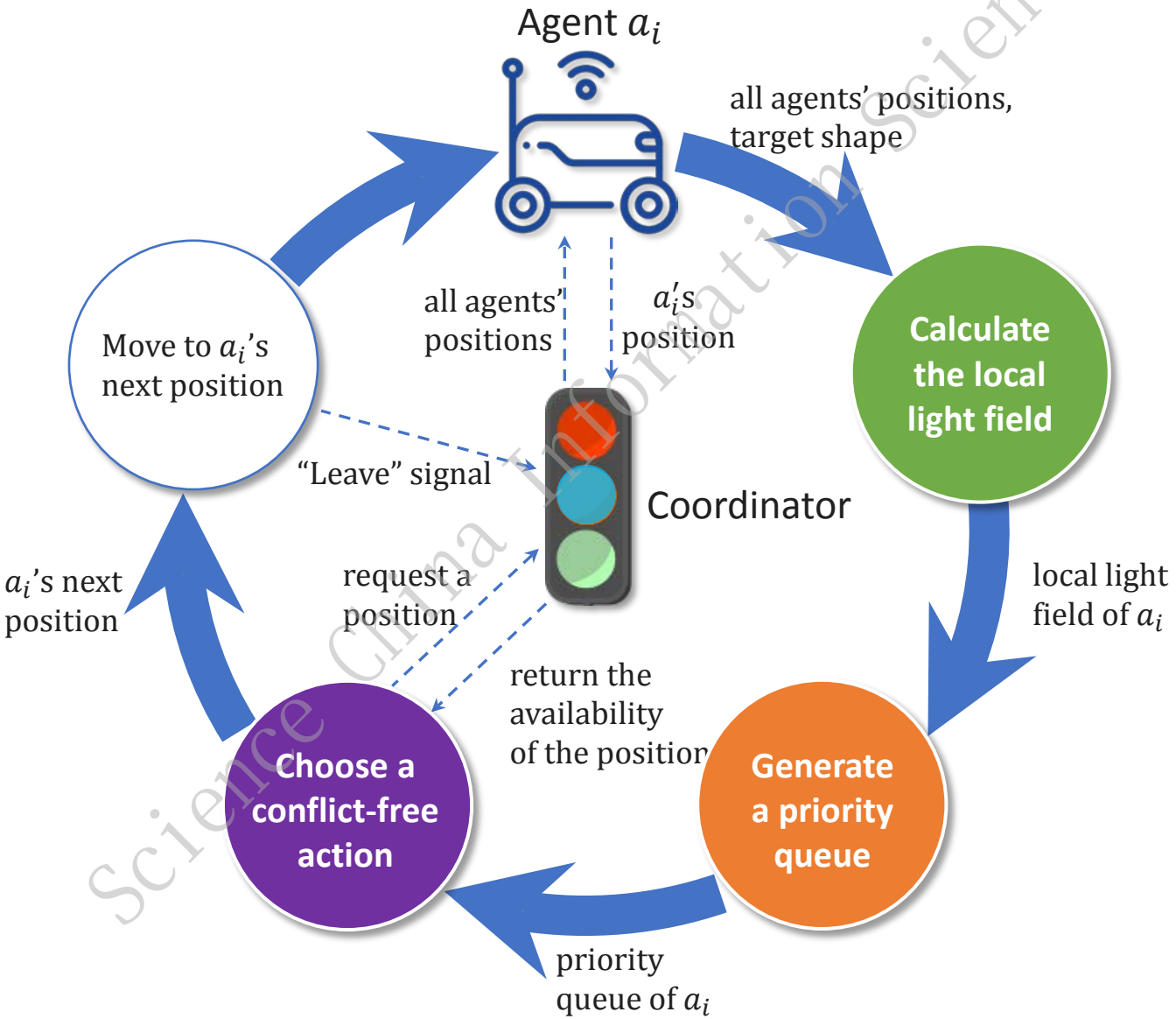
lacking an efficient, scalable, and stable mechanism for shape formation !

Our Approach

The shape formation phenomenon in nature, e.g. ants build a bridge, is a collective intelligence (CI) phenomenon, which indicates that shape formation problem can be solved in highly self-organized ways based on the CI theory.

- The essence of our approach is a continuously executing loop of information exploration, integration, and feedback among agents in a collective, following a constructive model for collective intelligence.
- An artificial light eld (ALF) is introduced and superimposed on the grid environment, serving as a carrier for information integration and feedback.
- A mutual feedback process emerges between the ALF and the agent collective: the current positions of all agents in the grid environment determine the current state of the ALF, which in turn drives agents to change their current positions.

Our Approach



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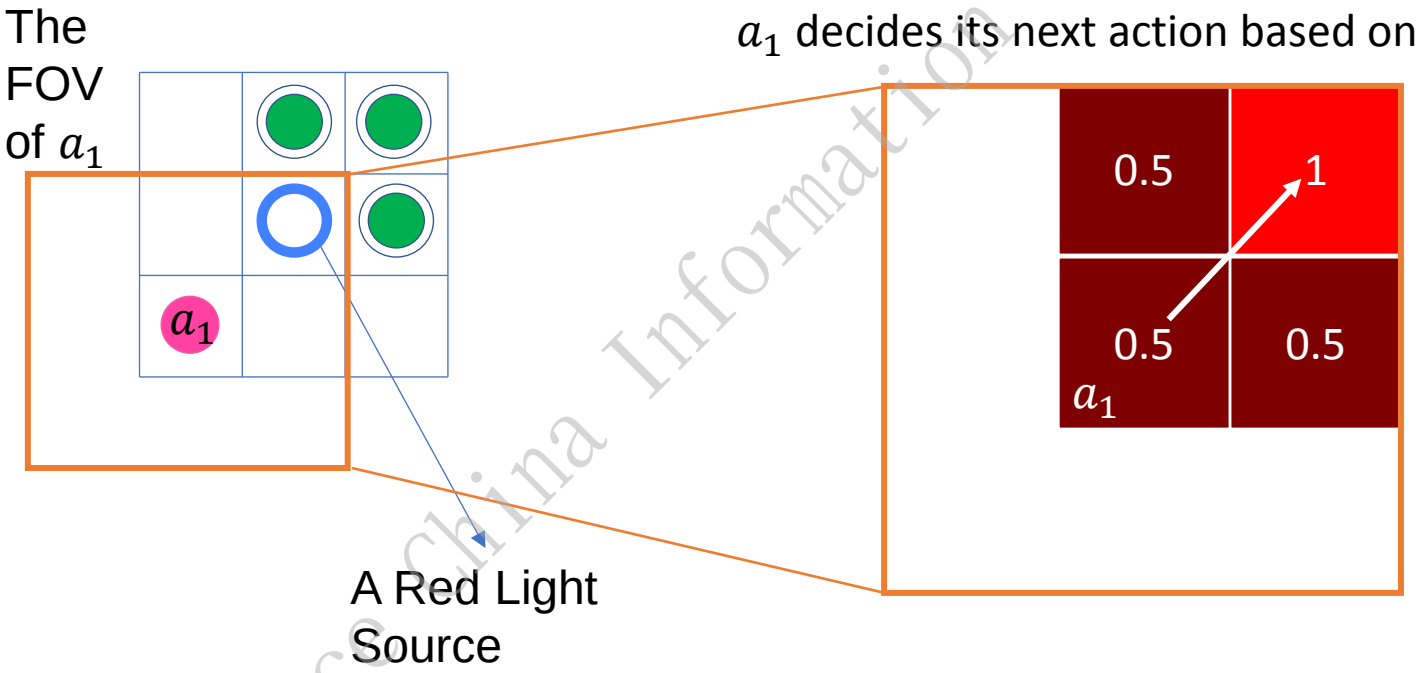
Our Approach

Calculate the local Light Field.

a_1 is an un-target agent.
a_1 decides its next action based on local red light field.



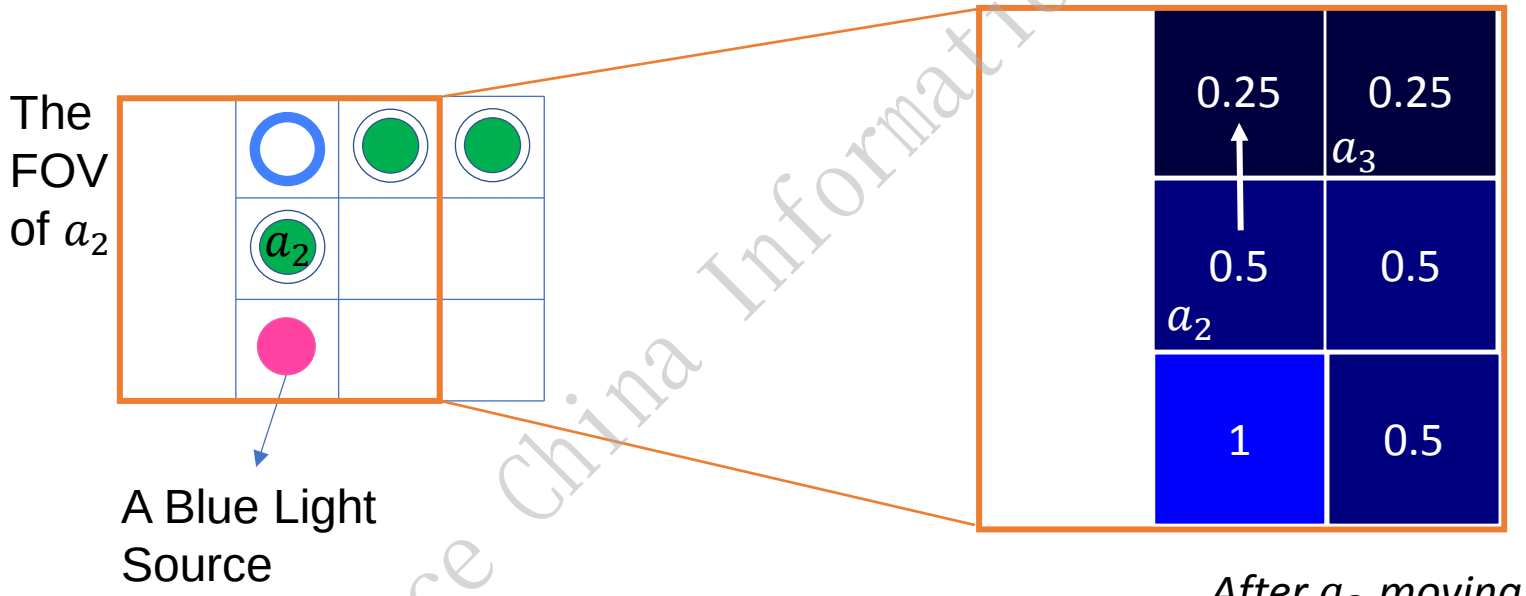
Move towards a neighbor grid with the highest red light intensity.

Upper Right

Our Approach

Calculate the local Light Field.

a_2 has occupied a grid.
a_2 decides its next action based on local blue light field.



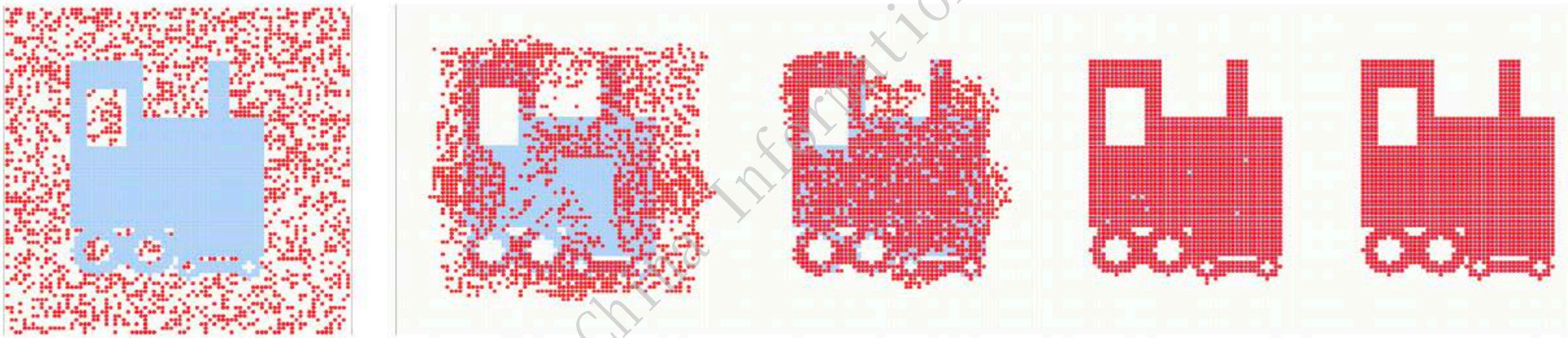
Move towards a neighbor grid with the lowest blue light intensity (and unoccupied).

Up

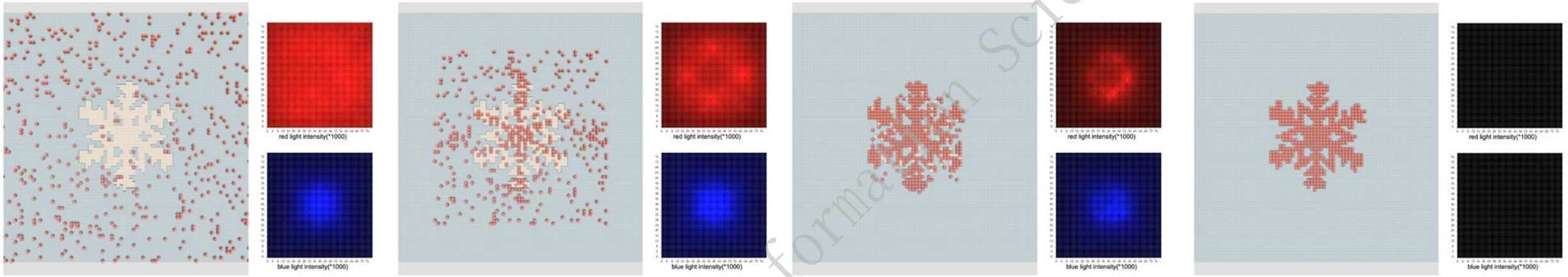
After a_2 moving up, the edge node of the connected target area is vacated

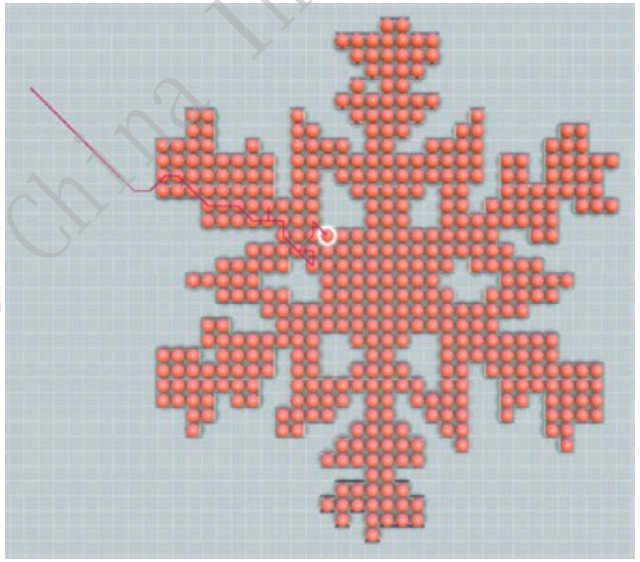
Un-target Agents | Occupied Target Grids | Unoccupied Target Grids

Preliminary Results



Preliminary Results





The trajectory of an agent

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Thank You !

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