# Biological Inspired Resource Allocation for Distributed Multi Agent System with Limited Knowledge


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## Abstract


Resource allocation in scenarios involving uncertainty, limited information, and potential threats can pose significant challenges and difficulties. Swarm intelligence, characterized by the cooperative dynamics of individuals could enhance community resilience. This is particularly true for scenarios that involve the allocation of finite resources. This study examines a new biologically inspired distributed resource allocation algorithm, drawing inspiration from the snapping shrimp colonies. Operating within environments with uncertainty and resource limitations, snapping shrimp colonies exhibit distributed resource allocation when they allocate a limited number of defenders to protect the nest. The hypothesis of the paper is if inspiration is drawn from the snapping shrimp colonies, then the distributed resource allocation can be improved. The result is a new Snapping Shrimp Resource Allocation Algorithm (SSRAA), which is developed and applied to an Agent-Based Model of a wildfire scenario. At the same time, it was noticed that agents with global knowledge and limited communication end up adopting similar resource allocation strategies. Our goal is that future use of this algorithm will result in a long-term, smarter, and more sustainable world by providing an approach for distributed resource allocation the role of limited knowledge within dynamically evolving landscapes.


## Research Question

How can the intruder response behavior of a snapping shrimp colony can be applied to model distributed resource allocation to show how factors such as local vs global knowledge and peer-to-peer communication can impact the threat elimination

## Purpose

A new, validated distributed resource allocation algorithm for agents with limited situational awareness (SSRAA); in many applications limited individual situational awareness impacts system response.

## Hypothesis

Inspiration is drawn from the snapping shrimp colonies for wildfire response optimization, then the distributed resource allocation can be examined, because of its potential performance improvement in agents with a focus on communication compared to those with advanced capabilities but limited communication.


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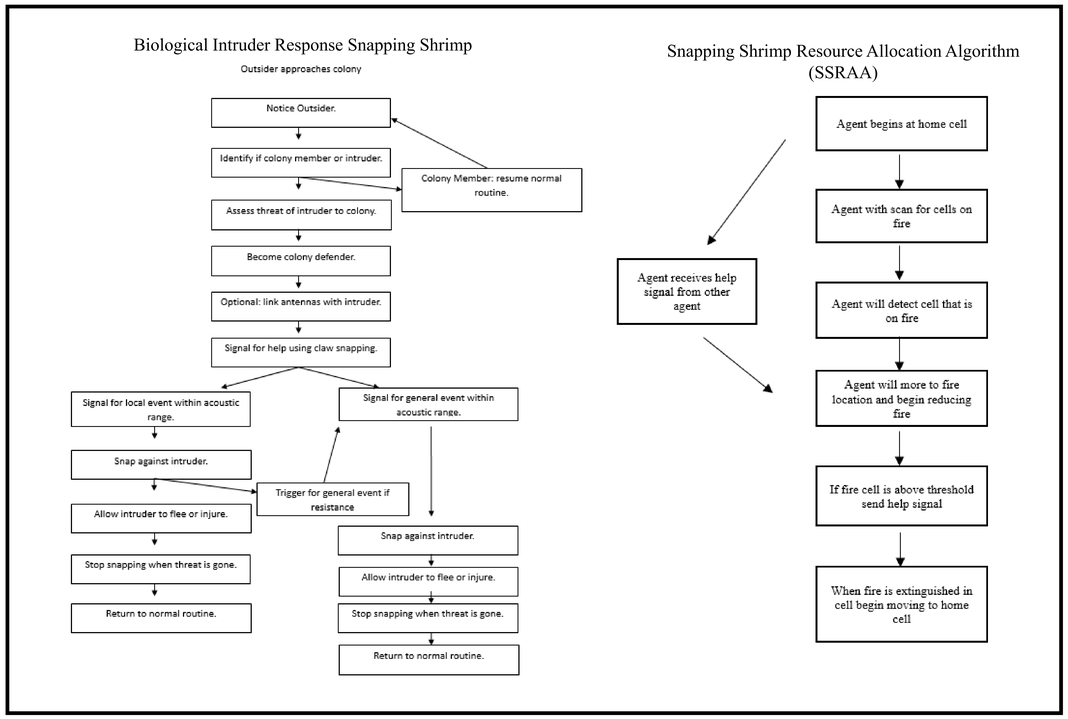
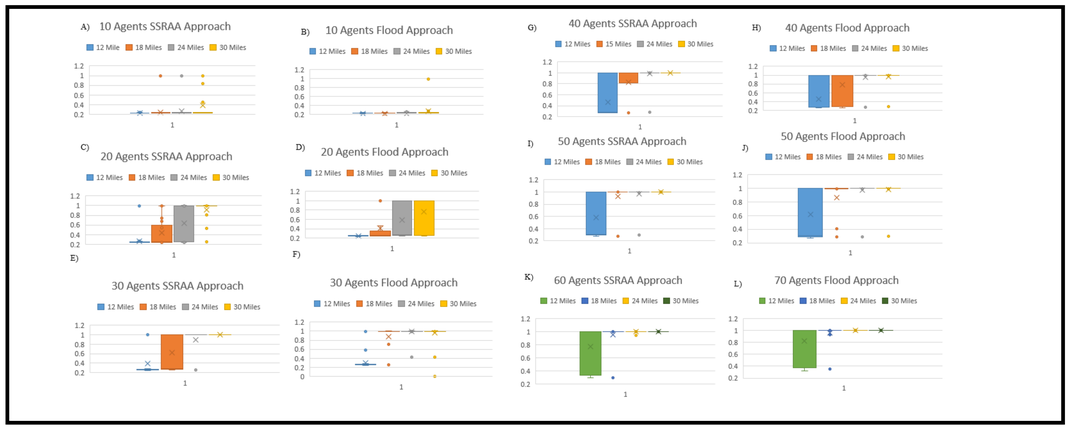
Biologically Inspired Design-for-Resilience Lab

## Biological Inspired Algorithms



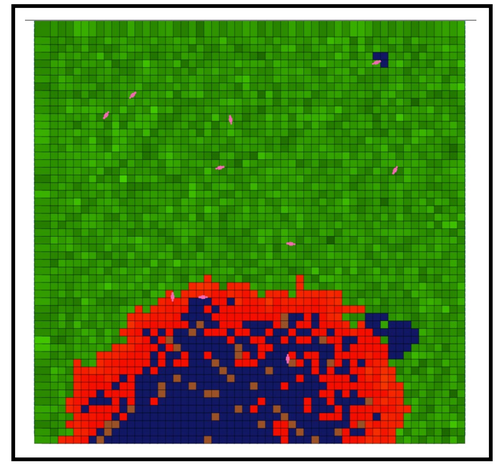

*Biological Intruder Response Snapping Shrimp Algorithm vs Snapping Shrimp Resource Allocation Algorithm (SSRAA)*

## Results




*Plots show how the flood vs SSRAA approach by the model. The SSRAA approach shows improve the performance with less advanced agents.*

## Distributed Resource Response Model



*Anylogic Model depicting the simulated resource allocation with wildfire expansion and firefighter agents*

## Conclusion

- The research question this article examines is how the intruder response behavior of a snapping shrimp colony can be applied to improve distributed resource allocation
- This research presents a new biological inspired distributed resource allocation algorithm.
- Future work will focus on other swarm intelligence species and how their behaviors can be applied to similar human activities
- By presenting a new BID distributed resource algorithm, this article provides a key step towards further utilizing biologically inspired designs which can provide insight into optimization problems society faces today
- Evidence of improved or equal performance of flood vs SSRAA approach 40 agents specifically shows lower range of 15 miles

## Citations


- Full Paper will be submitted to CSER 2024
- This work would not be possible without would the support of Embry-Riddle Aeronautical University's the Office of Undergraduate Research and the Summer Undergraduate Research Fellowship (SURF) program