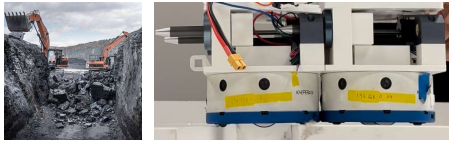


### Project Description

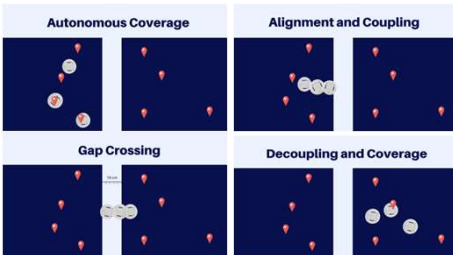
Inspection and coverage of hostile environments is an area of robotics and autonomy that has grown incredibly over the last few years. A key challenge faced by any such solution is the rough, often discontinuous terrain encountered by the robots.

Our system uses a robot swarm that can autonomously couple together when required to allow for crossing gaps in the terrain and split up to explore/cover points of interest individually to remain efficient.



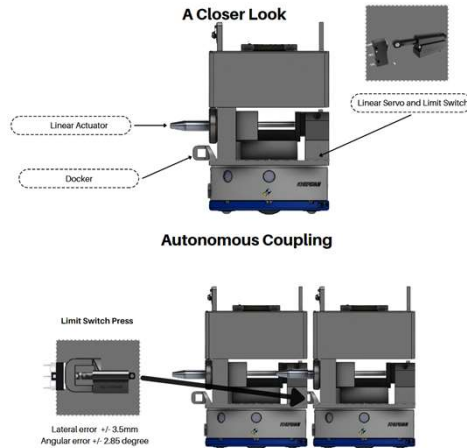
### Use Case

1. Autonomously cover Point of Interests
2. If needed, align and couple in crossing configuration
3. Cross the gap as a unit
4. Decouple and cover Point of Interests



### Methodology

#### Electro-Mechanical System

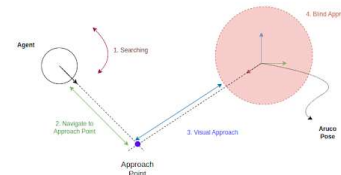


#### Controller

##### 1. Neighborhood Grouping-Based Controller

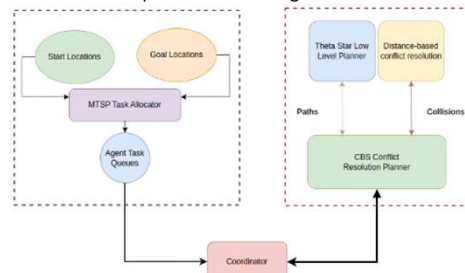


##### 2. Servoing for Alignment



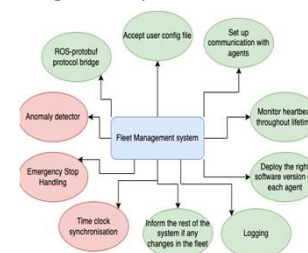
#### Planning

1. **High Level Planner** – State machine deciding between coupling, decoupling and coverage of points of interest
2. **Task Allocator** – Determines task queues for agents, number of agents and location for crossing the gap to **minimize overall system time**
3. **CBS + Theta\* Planner** – Determines optimal, collision-free paths between agents

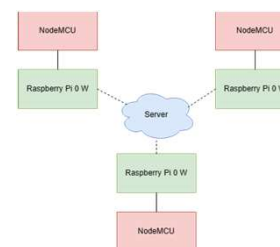


#### Communications

##### 1. Fleet Management System



##### 2. Embedded Systems



### Results

Coupling Success Rate	Points of Interest
<b>75%</b>	<b>10</b>
Average Time Taken	Num of Agents
<b>15 min</b>	<b>3</b>
Max Agent Velocity	Tolerances
<b>0.8 m/s</b>	<b>± 3.5 mm</b> <b>± 2.85 deg</b>

### Conclusion



Across three semesters of collaborative effort, our team achieved a significant milestone by developing a highly resilient autonomous system.

This technology excelled in navigating and covering points of interest, even in challenging scenarios where these points were dispersed across various regions, interrupted by terrain discontinuities. Notably, our system demonstrated exceptional reliability, successfully traversing discontinuities as substantial as 190 mm, all while being operated by three agents.

This accomplishment stands as a testament to our team's ingenuity and dedication to pushing the boundaries of autonomous navigation technology.