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Navigation Resilience for robotics and autonomous systems

Objectives of Report

- Investigate resilience of autonomous mission in harsh environment
- Implementation of use of FMCW for ground inspection to support the navigation resilience
- Simulate and create autonomous mission using navigation stack in ROS and Gazebo

Project background

- Robotic platforms are feasible solutions for nuclear power sectors in radiation contaminated waste disposal and routine Operation and Maintenance.

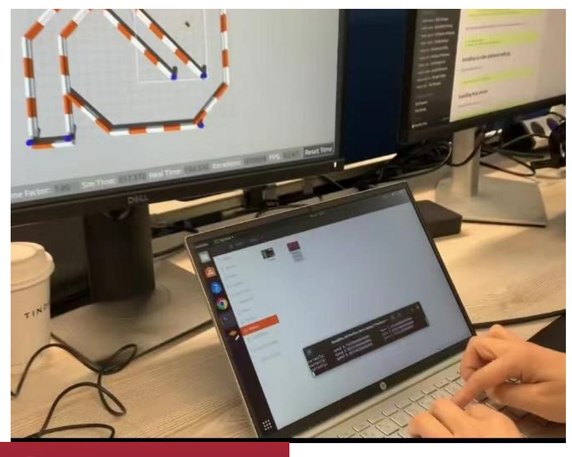
Challenges posed by hash environment for navigation resilience

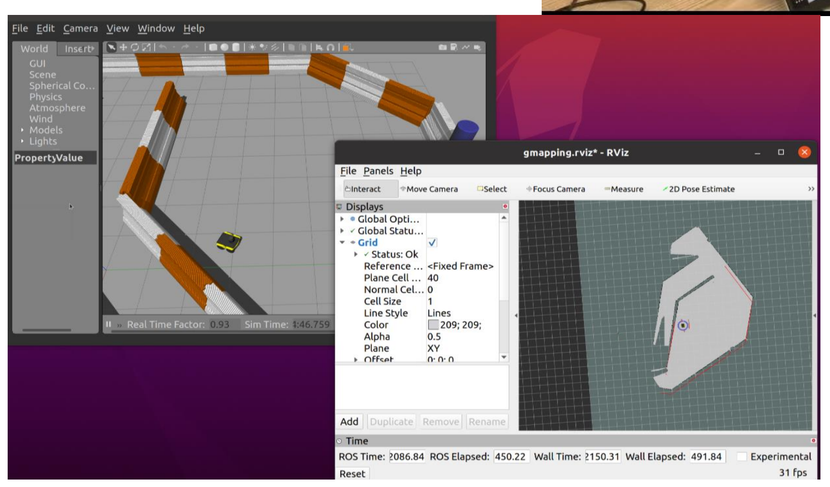
Radiation | Ground collapse | Cliff face

- Resilience represents the ability of robot to adapt to and self-verification in run time during autonomous mission, which ensures the safety and reliability of robot system and mission completion.

Methodology

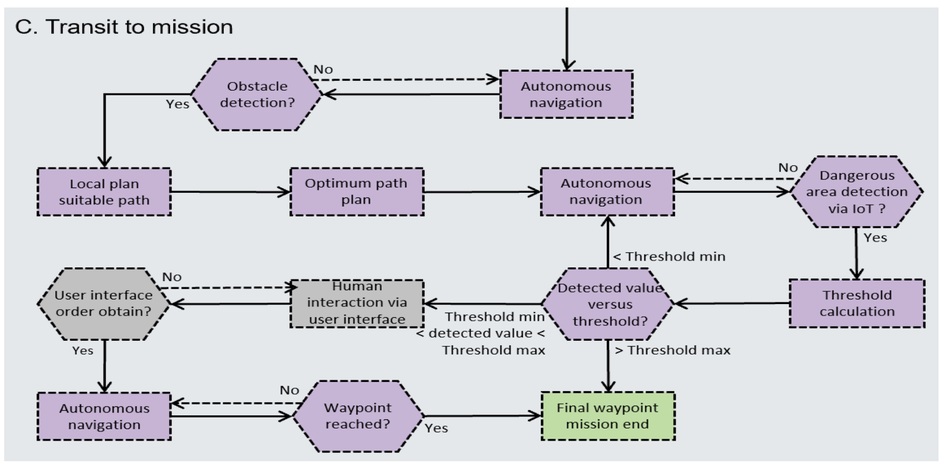
- Using navigation stack in ROS and Gazebo to map and localize simultaneously. Navigate autonomously and avoid obstacle via the user interface.



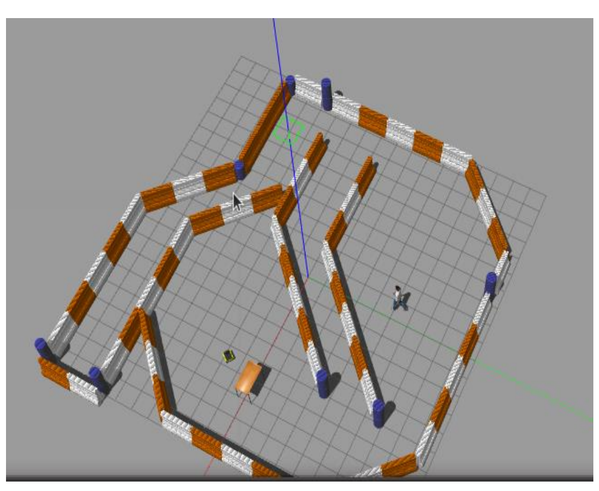


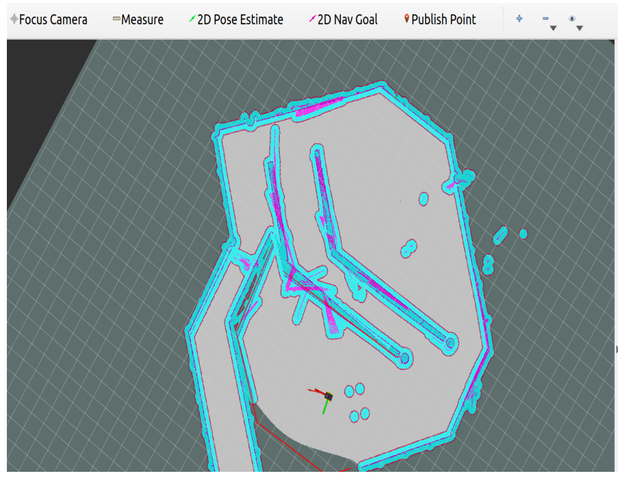
Results

1. Flowchart of decision making, where navigation resilience happens in radiation.



2. Jackal robot can avoid visible obstacle and unseen obstacle via user interface in the created map of environment autonomously





- FMCW help distinguish the collapse of ground with different material in the situation that robot may have the overloaded weight.

Future work

1. Integrate IoT sensors together and model non-physical voxel obstacle for self-verification.
2. Self-verification in run-time via DT onboard real robot

Conclusion

1. Method via IoT increases the ability of unseen obstacle avoidance
2. Method via IoT increases safety , reliability of the mission by reducing the risk of robot rollover