



# **Traversability Analysis For Highly Maneuverable Wheeled Robots**

### Motivation

- Highly maneuverable outdoor robots have many applications, such as field rescue, oil prospecting and desertification monitoring.
- Most navigation algorithms are designed for robots working in structured environments.
- For uneven terrain, traversability analysis is crucial for collision avoidance  $\bullet$ and efficient traverse.
- Some negative objects, such as holes and grooves, are small compared to the robot's wheel, and the robot could pass over them easily; however, they are easy diagnosed as untraversable.

Grooves

Robot's Wheel Color Norm





Traversability

### System Architecture





Hardware:

- The platform is a self-designed, highly maneuverable wheeled robot.
- The robot has a ZED stereo camera.
- The motion pattern is special, which is like a rear-wheel steering car.



Software:

- It uses Robotic Operating System(ROS) as the software platform.
- It has some hardware driven nodes, such as the camera driver, joystick driver
- It has some traversability analysis nodes for elevation map generation and calculate traversability.
- In the future, it will have some nodes for navigation.

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## Method

### "Wheel Dropping" Model

• Compared to the raw terrain surface, the surface consisting of the actual location of the robot's wheel as it would sit on the ground is much smoother.



• We developed a method to "fill" small negative objects by considering the actual location of the robot's wheel as it is dropped on the terrain.



smoothed(P) = max  $terrain(P) + \sqrt{r^2 - distance(P, P_i)^2}$  $P_i \in C(P,r)$ 

### Pipeline

- Convert 3D point cloud to 2D elevation map for efficient data processing. • "Fill" small negative objects, using the "wheel dropping" model. • Extract geometry features, such as slopes and roughness, and compute the
- traversability.
- Convert the traversability map to grid map for navigation.



Point Cloud









traversability map











- Refine the traversability calculation model.
- grid map.

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## Results

## Future Work

• Design a local planer that is given our robot's dynamics and the traversability