# Local Navigation for the Inspection of Steel Structures

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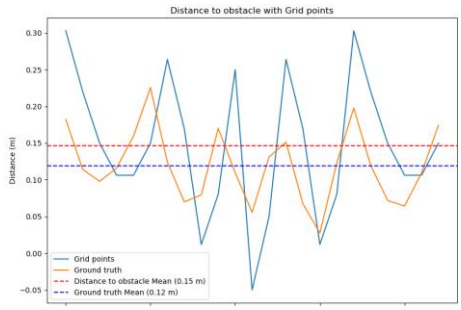
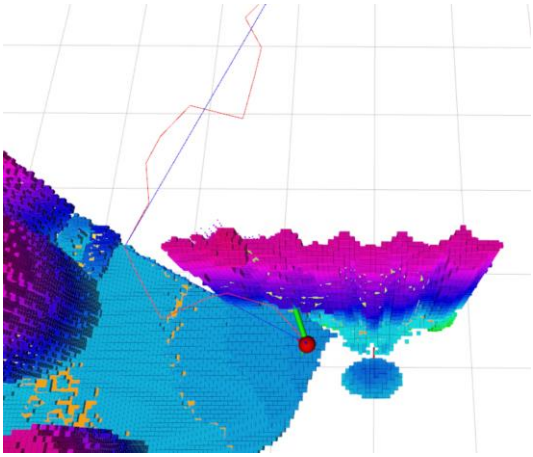
This project contributes to the broader topic of inspection of infrastructures with the help of Micro Aerial Vehicles (MAVs) to inspect steel structures like bridges and energy transmission lines. Traditional inspection methods usually involve heavy machinery and skilled technicians, leading to safety risks for workers and generating high costs. To address these challenges, the project aims to develop a robust navigation system for autonomous MAVs, overcoming obstacles in cluttered environments. The drone is equipped with a Time-of-Flight (ToF) camera to whose measurements are used to construct a map using Voxblox. Paths are found using the RRT* algorithm in 3D. The Robot Operating System (ROS) combined with C++ and Python is used. We use the Webots simulator to test the implementation across a diverse range of environments, ensuring robustness.

Challenges encountered in this project concern obstacle detection, particularly in cases where the drone flies high over the ground, the detection performance of obstacles is clearly affected. Strategies such as flying at low altitude and performing pre-mapping orbits have been explored, but limitations remain when applying to a general case. The distance to obstacles estimated by Voxblox has also been verified, revealing a consistent overestimation. This discrepancy is a crucial factor to consider in path planning for the drone.




*Comparison of distances to obstacles*

Path planning implementation is based on RRT* algorithm and has shown promising results, with successful navigation even in challenging environments. Overall, performances are good. To mitigate the risk of collisions, obstacles have been enlarged by modifying the point clouds sent to Voxblox and a heading controller has been integrated to ensure the drone's camera consistently aligns with its direction of travel. The trajectory generated by RRT* has been refined through smoothing techniques to eliminate intermediate redundant waypoints, ensuring the drone navigates directly towards its goal. However, occasional challenges, such as difficulty in finding a path to the goal or collisions with undetected obstacles in rare instances, were encountered.



*Navigation in the environment*

Despite the encountered challenges, ongoing research and development efforts promise to further refine and optimize the MAV-based inspection paradigm.