

LIDAR-BASED AUTONOMOUS NAVIGATION FOR MOBILE ROBOTS

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This article presents an autonomous safety layer for mobile robot operation in indoor and outdoor environments. The proposed method relies on LiDAR-based sensing and edge-level control[1]. The system processes a two-dimensional laser scan obtained from a 3D LiDAR sensor and transforms the surrounding environment into a sector-based clearance representation. This representation is then used to determine the most suitable direction of motion and to provide obstacle-avoidance capabilities.

When the control algorithm detects a critical obstacle[2] in front of the robot, it applies distance-limited speed regulation, emergency braking, reverse motion, and forced-turning strategies. To determine feasible angular velocities, a modified Dynamic Window Approach is employed as a lightweight local planning method that accounts for clearance, heading-direction preference, and turning penalties. Another feature of the proposed safety controller is a memory module, which improves stability under sensor-noise conditions.

The solution was implemented as a ROS 2[3] node and tested as an edge-level safety controller on a mobile robotic platform. The proposed approach enables the robot to respond rapidly to nearby obstacles without relying on external computation or global path planning. As a result, the system improves operational safety and robustness during autonomous navigation in constrained environments.

References

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