Stair Recognition and Automatic Alignment for a Stair Climbing Wheelchair

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Bachelor Thesis

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Abstract

Autonomous stair climbing vehicles require a safe way to climb stairs. By detecting the stairs and adjusting driving of the vehicle accordingly can the robot climb stairs safer and faster. A stair recognition and alignment algorithm for a tracked robot was implemented in this bachelor thesis. This algorithm works on both straight and curved stairs. It was tested and developed specifically for the stair climbing wheelchair Scalevo which uses two separately powered tracks to climb and descend stairs. Two laser range finders provide data to determine the geometry of the stairs and the wheelchairs location on the stairs. A parameterized stair pattern is matched on top of the point cloud by solving a nonlinear optimization problem. The optimized results represent the geometry of the stairs. An algorithm which enables smooth and continuous alignment on a curved stairway has been implemented and tested. The presented method has been tested on a variety of different stair profiles using the Scalevo wheelchair. The stair recognition algorithm is able to determine the geometry of a staircase with up to 99% precision. The localization has been verified by testing automatic alignment on both straight and curved stairways. The proposed methods for stair recognition and alignment on curved stairs proved to be robust and accurate.