

# ROS2 implementation of an optimal local path planner using Interval B-splines

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## Introduction

Heavy autonomous wheeled robots navigating in unstructured environments require a robust navigation architecture [6]. This involves: (i) a global planning strategy to avoid danger zones and dead-ends; (ii) a robust, admissible, guarantee safe and real-time local planning approach allowing to consider any unforeseen environmental constraints; (iii) an accurate tracking algorithm minimizing errors for various linear velocities. We used Robot Operating System 2 (ROS 2) to connect: an A\* which returns the shortest path between a list of crossing points; our optimal local planner using an Interval Branch and Bound (IB&B) algorithm to optimize successive connected interval B-Spline Curves (BSCs) [7]; and a constrained linearized model based predictive controller [2]. Such BSCs are widely used in computer aided design, computer graphics, and robotics [1, 3]. These polynomial curves have powerful properties: a local modification; a definition of the entire curve only with several control points; a setting of the degree of continuity of the curve. An intuitive way to extend BSCs to the interval

arithmetic is to consider control points as boxes [4, 5]. Thus, BSCs can be optimized using an IB&B. Our local path planner requires a pre-processing of the costmap to model obstacles as circles and boxes. Then, it returns a path built from successive connected interval BSCs (Figure 1 illustrates the process of path generation). In case of a new

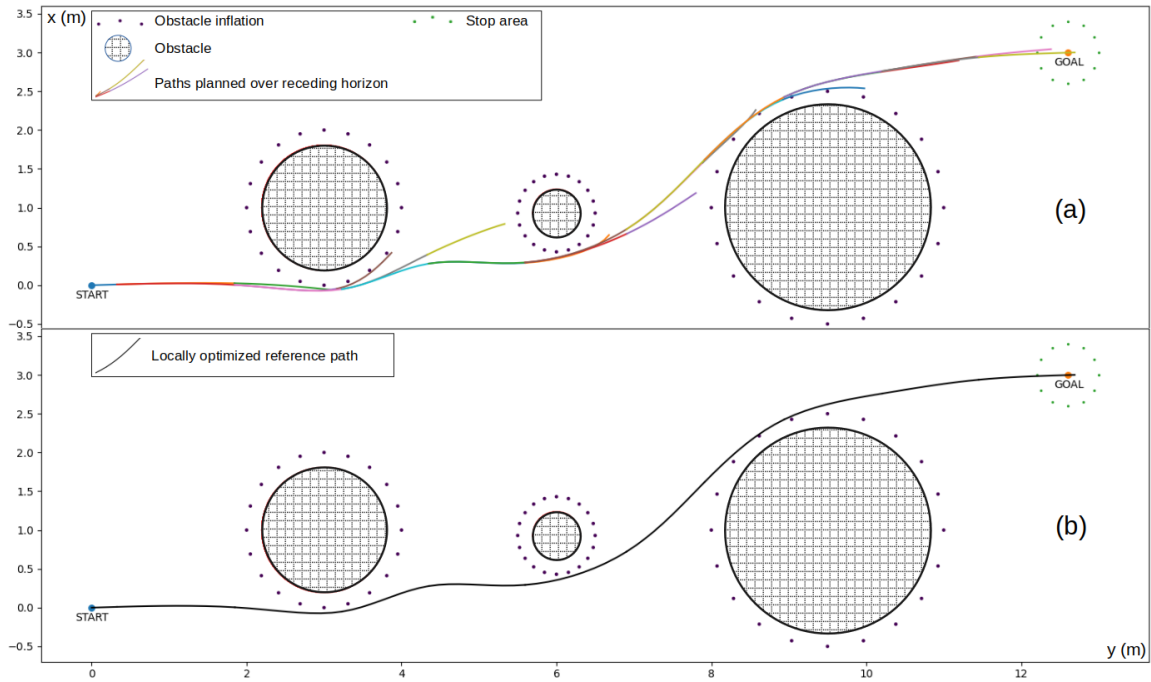


Figure 1: (a) Detailed view of all paths generated over successive horizons. Each color corresponds to a B-spline arc. (b) View of the resulting optimized path.

obstacle detected in the vicinity of the robot, an update of the path is made from a previous BSC segment to ensure its avoidance. Both the costmap pre-processing and the IB&B optimization times are taken into account in our implementation.

## Contributions

We propose: (i) improvements and the ROS2 implementation of our optimal local path planner using interval methods; (ii) demonstrations

in simulation under ROS Gazebo and indoor real-life experiments with a wheeled differential robot, see Figure 2.



Figure 2: Wheeled differential robot

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