AMR Final Project Presentation

Jackal Robot Moving Obstacle Avoidance Strategy with Lidar

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Contents

Introduction

In this project, we simulate situations when moving obstacles are approaching our jackal robot and realize an obstacle avoidance behavior

The Jackal robot’s behavior strategy combines what we learnt from previous labs with a newly implemented method in order to detect and avoid different obstacles

Its moving behavior includes three methods to deal with go-to-goal, static obstacle avoidance and mobile obstacle avoidance respectively

Introduction

Environment Setup:

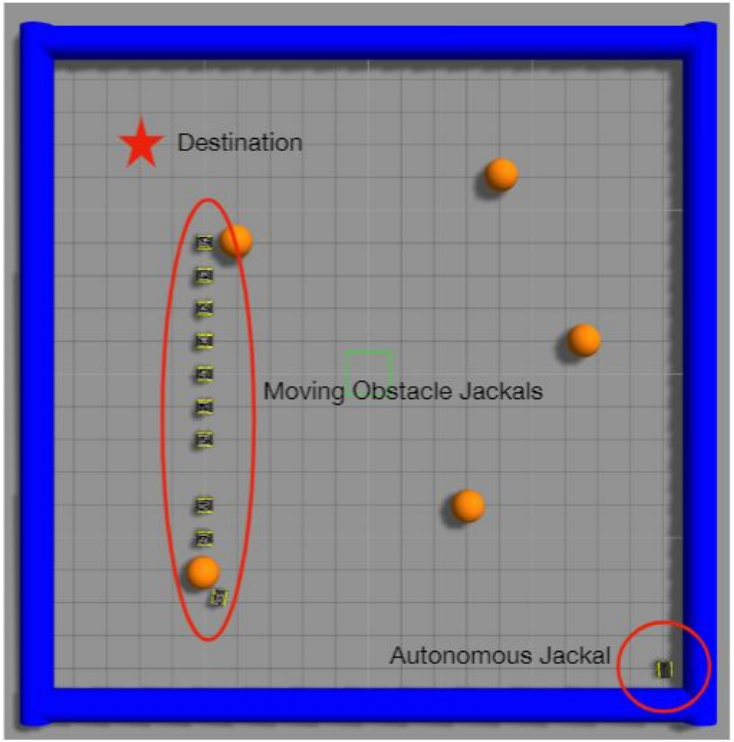
A closed square region:

1 Jackal robot

5 static sphere obstacles

Another 10 moving obstacle Jackals

We try to navigate Jackal robot to move along the diagonal line of the square



Introduction

To determine which situation Jackal robot is facing with, we use the lidar data to obtain the distance between Jackal robot and the closest obstacle

1. If the distance is not small enough: go to goal

2. If the distance is below a certain threshold: we calculate the relative velocity between Jackal robot and the closest obstacle and compare with Jackal robot’s own linear velocity to decide whether the obstacle is static or mobile

Methodology

Three modes

Mode 0	Static obstacle avoidance
Mode 1	Go-to-goal
Mode 2	Mobile obstacle avoidance

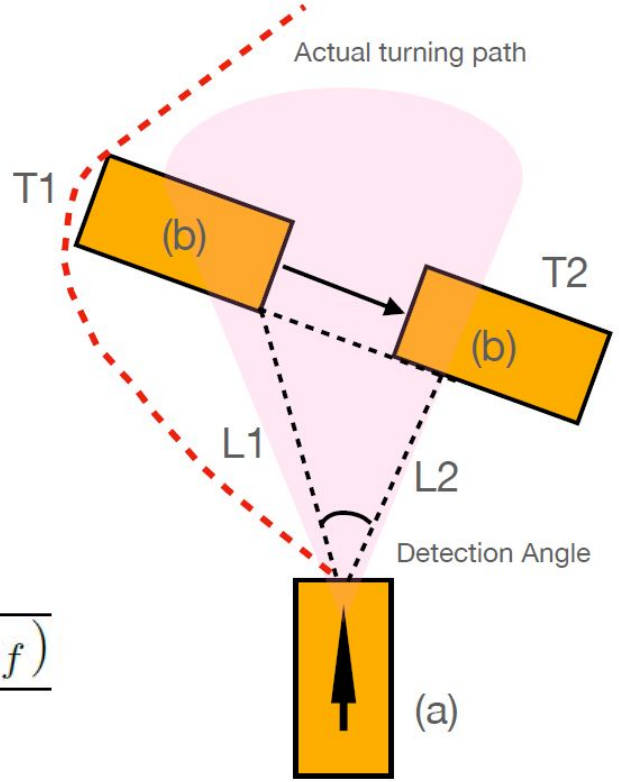
Methodology

Calculate relative velocity

- To detect mobile object
- To decide avoidance strategy

$$\theta_{diff} = \theta_1 - \theta_2$$

$$v_{rel} = \frac{\sqrt{L1^2 + L2^2 - 2L1 * L2 * cos(\theta_{diff})}}{T2 - T1}$$



Methodology

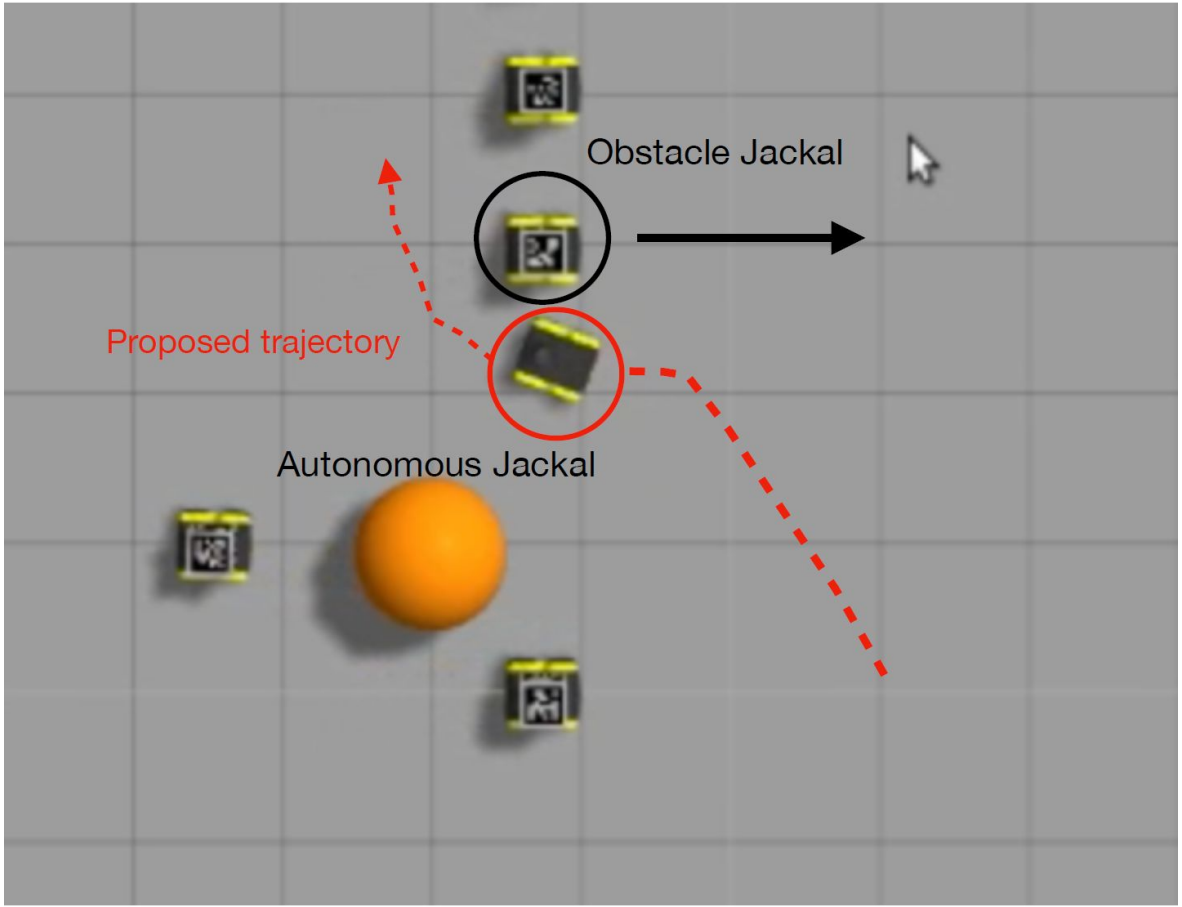
Possible outcomes

	$\lvert\mathcal{V}_{rel} - \mathcal{V}_{jackal}\rvert \leq \delta$	$\lvert\mathcal{V}_{rel} - \mathcal{V}_{jackal}\rvert > \delta$
$\Theta_{diff} < 0$	Obstacle is considered static, relatively moving from left to right, switch to mode 0	Obstacle is considered mobile, moving from left to right, switch to mode 2: lower down velocity and turn left
$\Theta_{diff} > 0$	Obstacle is considered static, relatively moving from right to left, switch to mode 0	Obstacle is considered mobile, moving from right to left, switch to mode 2: lower down velocity and turn right
$\Theta_{diff} = 0$	Check obstacle distance, switch to mode 0 or stay mode 1	Obstacle is considered mobile, chased by target jackal, check obstacle distance, switch to mode 2 or stay mode 1

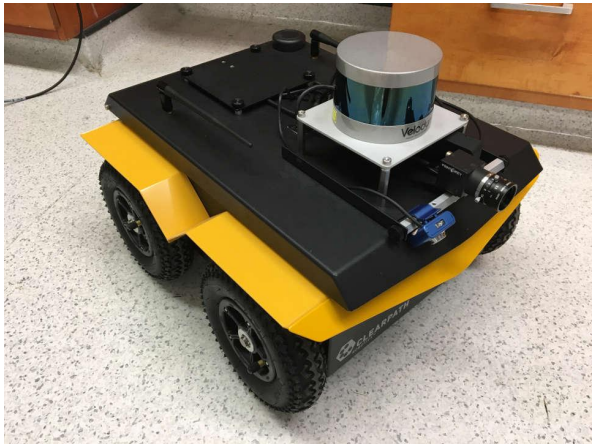
Methodology

An example of case:

- $|v_{rel} - v_{jackal}| > \delta$
- Mobile object detected
- $\Theta_{diff} < 0$
- Target jackal switch to mode 2: slow down and turn left
- Target jackal switch back to mode 1: go to goal



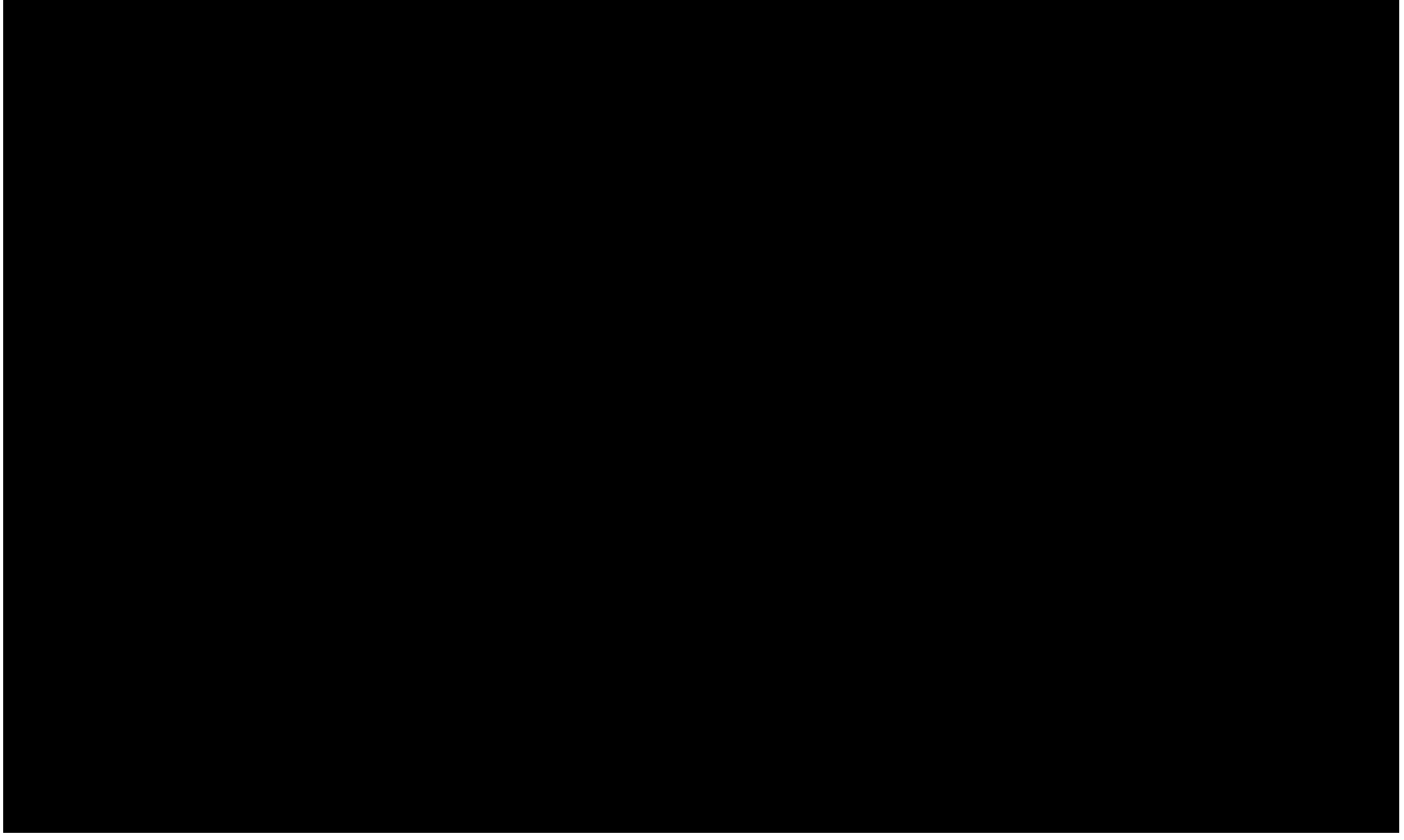
Implementation



1. Lidar data partition
2. Relative speed measurement loop
3. Avoidance mode decision

Co

Avoid



Thank You!