GPS Simulation Project

ECE 495/595 Lecture Slides

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Summary and Quick Links

These slides contain the following concepts:

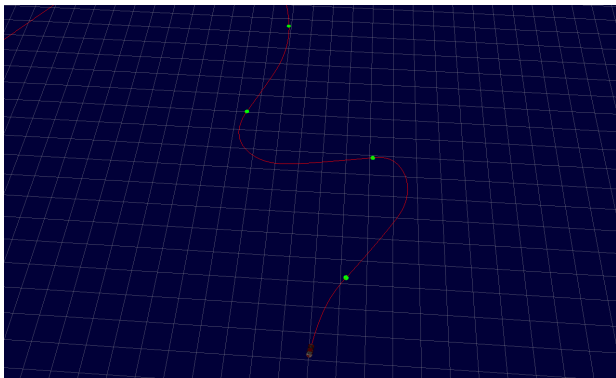## Introduction

▷ Control Audibot to navigate to 8 GPS waypoints in order.

▷ Pass within 1 meter of each waypoint.

▷ Complete the waypoints within a particular time.

Introduction

▷ Display waypoint locations using markers.

▷ Display robot model.

▷ Display path of the vehicle.

Simple Steering Control Method

▷ The most basic method of waypoint navigation involves simply controlling the steering to drive heading error to zero.

Waypoint Position
(T_x, T_y)

Heading
Error

Vehicle Position
(V_x, V_y)

ψ

x_{GPS}
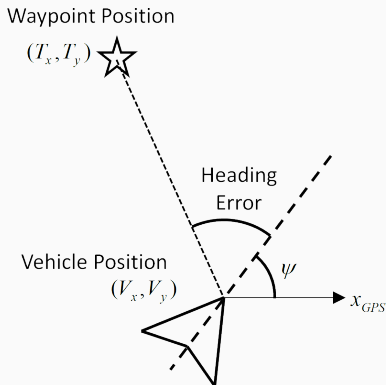
Simple Steering Control Method

▷ Compute angle to waypoint in GPS frame:

$$\theta = \mathrm{atan2}(T_y - V_y, \ T_x - V_x)$$

▷ Heading error is the difference between angle to waypoint and current vehicle heading:

$$\epsilon = \theta - \psi$$

▷ Apply common sense at discontinuities!

Waypoint Position
(T_x, T_y)

Heading Error

Vehicle Position
(V_x, V_y)

ψ

x_{GPS}

Simple Steering Control Method

> ⊳ Gazebo simulation provides the following information at 50 Hz:
>> \> GPS position in geodetic coordinates
>>
>> \> Heading in standard format (0 degrees North, clockwise positive)
>>
>> \> Current speed and yaw rate.
>
> ⊳ Audibot responds to a *geometry_msgs/Twist* message on the */audibot/cmd_vel* topic.

Limiting Lateral Acceleration

 ▷ At high speeds, Audibot will roll over if too much steering input is applied.

 ▷ This can be prevented by limiting the lateral acceleration.
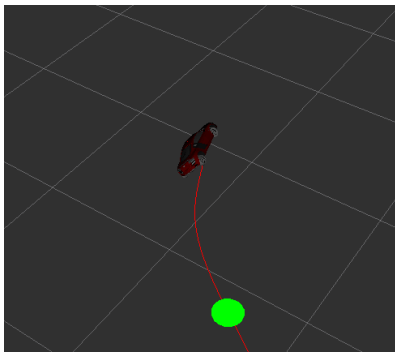
Limiting Lateral Acceleration

Lateral Acceleration

$$a_l = \frac{v^2}{R}$$

Speed/Yaw Rate Relationship

$$v = R\dot{\psi}$$

$$a_l = \frac{v(R\dot{\psi})}{R} \quad \Rightarrow \quad a_l = v\dot{\psi}$$