Visual Navigation for Flying Robots
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Sheet 1

Topic: Motion Models and Robot Odometry

Submission deadline: Tue, 01.05.2012, 10:15 a.m.
Hand-in via email to visnav2012@cvpr.in.tum.de

General Notice

To be admitted to the final exam, every student has to submit solutions for at least three of the six exercises and present one of the solutions in class. One bonus point is granted for every reasonable solution of a complete exercise sheet. All exercises (and the lab course) should be done in teams of two to three students. If you have not yet done so, please register yourself together your team members on the team list in room 02.09.38 (the student lab).

Introduction

The goal of this exercise is to familiarize you with the concept of the motion model of a quadrocopter. In the theoretical part of the exercise, you will have to define the state space and motion model of an Ardrone quadrocopter. In the practical part, you will have to apply these models to compute the odometry and plot the trajectory taken by the robot.

Exercise 1:

(a) What is the state space of the quadrocopter? (hint: the state space has six dimensions).

(b) What are the observations? (hint: the odometry observation vector has also six dimensions).

(c) Specify the motion model, i.e., the function that computes the current state $\mathbf{x}_t$ from the previous state $\mathbf{x}_{t-1}$ and the odometry observation $\mathbf{u}_t$.

Exercise 2:

(a) Set up ROS on your machine[1], download and compile the solution- and the `ardrone_brown`-stub and bag files[2] provided for this sheet.

[1] `http://www.ros.org/wiki/electric/Installation/Ubuntu`
[2] `https://cvpr.in.tum.de/teaching/ss2012/visnav2012`

(b) Replay the bag files and inspect the topics. (`rosbag play`, `rostopic list`, `rostopic echo`). Which topics are there? What data does the `/cmd_vel` and the `/ardrone/navdata` topics contain?

(c) Use `rxplot` to visualize vx and vy from `/cmd_vel` and from `/ardrone/navdata`. What is the relation between `/cmd_vel/x` and `/ardrone/navdata/vx`? Estimate (roughly) the delay between steering commands and the onset of the motion.

(d) Visualize the images using `image_view` and/or `RVIZ`.

(e) Write a ROS node that receives the `navdata` messages and prints the x and y velocities, yaw angle, and height to the screen. You may use the framework provided on the course website. In which coordinate system are these values given?

(f) Implement the position update in the `navdata`-callback function according to your answers from Exercise 1.

(g) Publish the trajectory taken by the quadrocopter (using a VisualizationMarker message) and then use RVIZ to visualize this trajectory. Take a screen shot of RVIZ from the `square.bag` sequence and attach it to your report.

(h) Compute the distance traveled by the quadrocopter for the `rect_oriented.bag` sequence and the mean height for `altitude.bag`.

Submission instructions

A complete submission consists both of a PDF file with the solutions/answers to the questions on the exercise sheet and a TGZ (or ZIP) file containing the source code that you used to solve the given problems. Make sure that your TGZ file contains all files necessary to compile and run your code, but it should not contain any build files or binaries. Please submit your solution via email to `visnav2012@cvpr.in.tum.de`.