Aalto University
School of Electrical
Engineering

ELEC-E8740 — Project work information

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Aalto University

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Practicality

- The project has two parts. (7 tasks)
- **First part (tasks 1-4):**
  It should be done individually, we will give you the data
- **Second part (tasks 5-7):**
  1. It can be done either individually or in a group of maximum 3 students.
  2. Sign up for a team by Sunday, October 30, 2022, 23:59.
  3. You can choose to either take measurements yourselves or use available data.
  4. You need to book time for coming to the lab by Sunday, October 30, 2022, 23:59.
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Objective

- The aim of this project is to develop an algorithm for tracking an autonomous robot (diddyBorg) by using a set of sensors.
- Sensors available: IMU, infra red detector, a motor controller, and a camera module.
- Track predefined lines (black) in a confined space.
- All handled by Raspberry PI.

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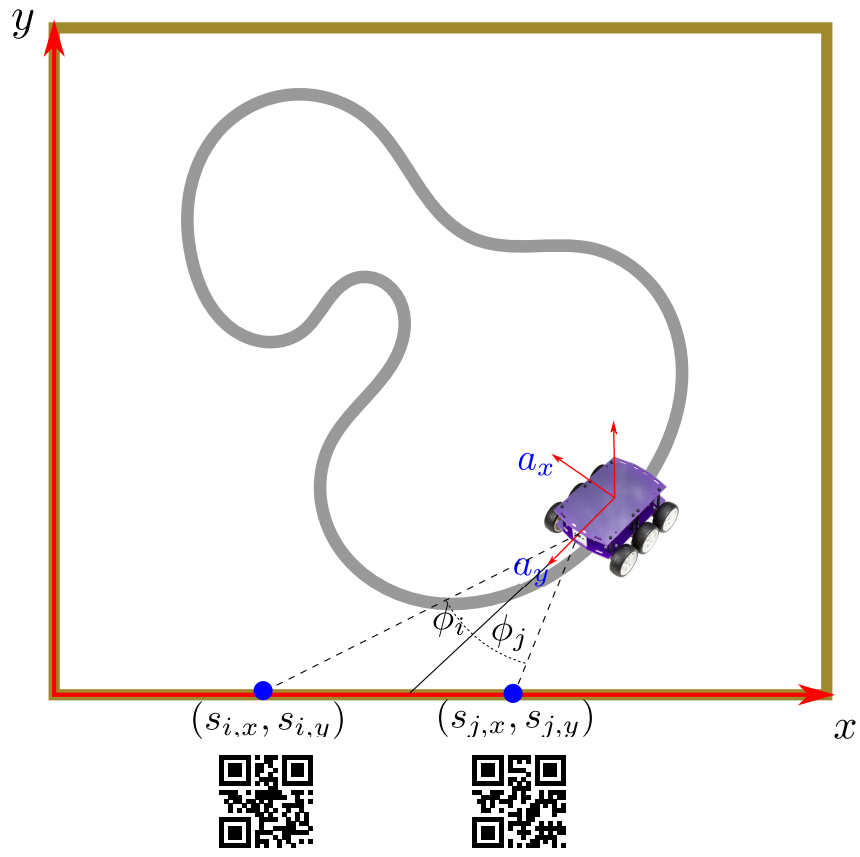

Figure: Illustration of the global coordinate system, QR-codes with known positions in global coordinate, and the robot local accerelation. When the robot camera heads to the *y* axis, the global angle of the robot equal to zero.

Contents

First part

- Derivation of the sensor model: IMU and Camera system.
- estimation of the model parameters $\rightarrow$ this includes calibration.

Second part

- Localization using camera measurements.
- Tracking: using IMU only and both IMU-Camera.
  1. develop a dynamic model,
  2. adjust the sensor model,
  3. implement a filtering algorithm,

Tasks

No.	Task	File location	Notes
Part I			
1	Static IMU experiment	data/task1/	To check the static bias and the covariance.
2	IMU calibration	data/task2/	To determine the gain and the bias of the accelerometers.
3	Camera module calibration	data/task3/	To determine the focal length and bias.
4	Motor control	data/task4/	To determine the speed of the robot.
Part II			
5	Localization	data/task5/	To estimate the position and attitude of the robot.
6	Tracking with IMU	data/task6/	To develop a tracking algorithm.
7	Tracking with IMU and camera	data/task6/	To develop a tracking algorithm.

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demonstration

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Report

- **DL for part I:** Sunday, November 20, 2022, 23:59
- **DL for part II:** Sunday, December 18, 2022, 23:59

First Report

- Your student number and the number of the dataset you used.
- A brief description of the robot and sensor models,
- Explanatory data analysis of the log files
- Plans to implement localization and tracking algorithms.

Final Report

- An abstract
- a brief introduction to the project and the problem that you are solving,
- derivation of the model,
- calibration procedures that are used (if any).
- description of the estimation method(s) used for parameter estimation, validation, and tracking,
- the results, and algorithm(s) used,
- conclusions and/or a summary,
- references (if applicable).