Applied Autonomous Robots II

Last updated: 2/23/2014

Author Information

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Course Details

Description

This course addresses the problems of controlling and motivating robots to act intelligently in dynamic, unpredictable environments. In this second installment, the course will focus on the robot perception problem. Major topics will include robot vision, visual servoing, and state estimation techniques. To demonstrate these concepts, we will be looking at mobile robots. Lectures will be complemented by projects, discussions, and in-class presentations by students. The projects will focus on programming actual robots to perceive and react to their environment.

Prerequisites

- Fundamental Robotics I
- Linear Algebra
- Ordinary Differential Equations

Original Course Documents

Source file URL

Course Contents

Week 1

- Introduction
- App Autonomous Robots I Review
- Coordinate Transformations

Reading

- Ch. 1 Siegwart & Nourbakhsh

Problem Set

- Coordinate Transformations and MATLAB Programming

Week 2

MATLAB Workspace

- Intro to Computer Vision
  - Basic Masking
  - Connected Components
  - Binary Image Morphology

Reading

- Ch. 4 Siegwart & Nourbakhsh
- Ch. 1 Forsythe & Ponce
- Ch. 3 Shapiro & Stockman

Problem Set

- MATLAB Programming and Connected Components
- Image Files

Week 3

- Physics of Color
- Color Calibration
- Color Blob Extraction

Reading

- Ch. 6 Shapiro & Stockman

Problem Set

- Color Blob Extraction
- Image Files and Starter Code

Week 4

- Blob Following Project
- Visual Servoing
- Filtering and Enhacing Images
  - Smoothing
  - Median Filtering
  - Detecting Edges

Reading

- Ch. 5 Shapiro & Stockman

Problem Set

- Robot Calibration
- MATLAB files

- SRV-1

Week 5

- Calibrating a Camera
- Homogeneous Transformations

Problem Set

- Midterm Guidelines
- MATLAB files
- Demo Guidelines

Week 6

- Projective Geometry
- K-Means
- Color Blob Following Demo
- MEM800 Students: Take Home Midterm

Problem Set

- Written Midterm exam

Week 7

- Probability Theory Review
- Bayesian Filtering

Reading

- Ch. 2-3 Thrun et al.

Problem Set

- Assignment
- Image Files

Week 8

- Recursive State Estimation
- Kalman Filtering

Problem Set

- Assignment

Week 9

- Extended Kalman Filters

Reading

- Ch. 3 Thrun et al.

Week 10

- Final Exam Demo

Project

Relevant Documents

- Sample Image Files
- Workspace Image
- Workspace Dimensions: 300cm x 300cm with 4cm wall

Deliverables

- Report
  - Abstract (500 words max.)
  - Intro (1 page max.)
- Methodology
- Results (Simulation and/or Experimental)
- Conclusions (1 page max.)
- Appendices

Textbooks

Introduction to Autonomous Mobile Robots *
by Roland Siegwart and Illah R. Nourbakhsh
ISBN-10:026219502X
ISBN-13: 978-0262195027

Probabilistic Robotics ₸
by Sebastian Thrun, Wolfram Burgard and Dieter Fox
ISBN-10: 0262201623
ISBN-13: 978-0262201629

Computer Vision: A Modern Approach ₸
by David A. Forsyth and Jean Ponce
ISBN-10: 0130851981
ISBN-13: 978-0130851987

Computer Vision ₸
by Linda G. Shapiro and George C. Stockman
ISBN-10: 0130307963
ISBN-13: 978-0130307965

* *Required Text*
Ŧ *Supplemental Text*

Resources

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