Control of Mobile Robots

Course organization

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Course Aim

- Kinematics of mobile robots
- Dynamics of mobile robots
- Path and trajectory planning
- Regulation and trajectory tracking
- Mobile Manipulation
- A case study

Course Organization

- lectures
- exercises and labs

Course Evaluation

- homeworks (additional points)
- project work (more details in the following lectures…)
- written exam (exercises and theoretical questions)
- oral examination (upon teacher's request only)

Teachers

- course teacher
    - Prof. Luca Bascetta (luca.bascetta@polimi.it)
    - Dipartimento di Elettronica, Informazione e Bioingegneria (Campus Leonardo)
    - Tel. 02 2399 3440
- teaching assistant (exercises and labs)
    - Prof. Luca Bascetta (luca.bascetta@polimi.it)

Course web page

bascetta.deib.polimi.it/index.php/CMR-Aut

Thesis proposals

Unmanned Autonomous Vehicles

Robotics

Teacher's web page
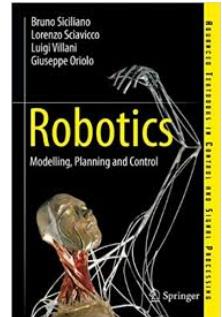
bascetta.deib.polimi.it
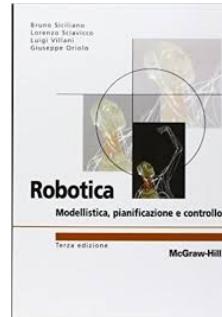
Do not forget the WeBeep channel!

Teaching Material

1. Lecture slides and notes (on the website and WeBeep channel)

2. B. Siciliano, L. Sciavicco, L. Villani, G. Oriolo
   Robotics: Modelling, Planning and Control, Springer 3rd Edition
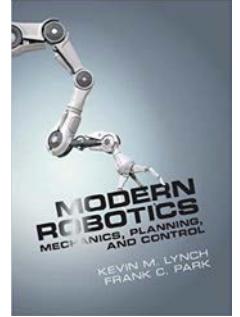
3. B. Siciliano, L. Sciavicco, L. Villani, G. Oriolo
   Robotica: modellistica, pianificazione e controllo, McGraw-Hill Italia, 3° Edizione
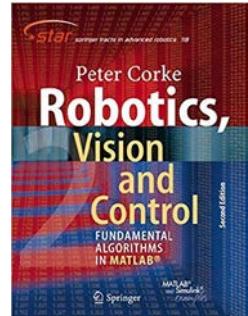
Additional Teaching Material

1. K. M. Lynch, F. C. Park
   Modern Robotics – Mechanics, Planning, and Control, Cambridge University Press

2. P. Corke
   Robotics, vision and control, Springer

Introduction

- Applications of mobile and autonomous robots: indoor, outdoor and off-road
- Ground and aerial mobile manipulation
- Classical problems in mobile robotics
- Fundamentals of hardware, software and control architectures

Kinematics of mobile robots

- Kinematic configurations for indoor, outdoor, and off-road mobile robots
- Holonomic and nonholonomic configurations
- Kinematic models of mobile robots

Dynamics of mobile robots
- Fundamentals of dynamic modelling for mobile robotics
- Wheel-ground interaction modelling for indoor, outdoor, and off-road applications
- Fundamentals of mobile robot multi-body simulation

Path and trajectory planning
- Planning and control, a global and local perspective
- Fundamentals of search based, sampling based, and model based planners
- Planning in Cartesian and configuration space with sampling based techniques
- Introducing robot kinodynamic and actuation constraints in the planning problem

Regulation and trajectory tracking
- Control of omnidirectional robots
- A canonical model for nonholonomic robots
- Controllability, regulation and trajectory tracking of the canonical model
- Exact linearization and flatness form of classical mobile robot models
- Fundamentals of odometric localization

Mobile manipulation
- Controlling a mobile robot and a manipulator as a whole system
- Navigation and task execution: planning and control approaches
- Fundamentals of coordination strategies for a fleet of mobile manipulators

Case study
- A personal mobility device, a mobile manipulator, an autonomous drifting car