

## Autonomous Robotics: Action, Perception, and Cognition

### 1 Introduction

organization of the lectures

introduction to autonomous robotics

- the variety of autonomous robotic systems being studied
  - what is autonomous robotics, concept of autonomy
  - why is autonomous robotics being studied
  - where does autonomous robotics stand as a field
  - the key problems of autonomous robotics
  - neurally/human inspired autonomous robotics
- exercise session: dynamical systems tutorial

### 2 Attractor dynamics approach to vehicle motion planning

attractor dynamics approach

- behavioral variables
- behavioral dynamics
- attractors
- repellers
- instabilities

human walking paths

- using the model to account for human walking paths

### 3 Attractor dynamics approach to vehicle motion planning: sub-symbolic approaches

attractor dynamics approach: sub-symbolic

- how sensors erect attractors/repellers
- why it works
- implementations

second order attractor dynamics

- method
- performance

#### 4 Approaches to vehicle path planning

- classes of path planning approaches
- global planning
- potential field approach
- virtual force field approach

#### 5 Robotic manipulators and the degree of freedom problem

- the basic notions of robotic/human arm kinematics
- attractor dynamics of motion planning in robot arms
- human analogy: redundancy and synergies

#### 6 Movement primitive, constraint satisfaction

- the notion of movement primitive
- discrete vs. rhythmic movement
- integrating constraints
- obstacle avoidance in humans

#### 7 Movement timing and coordination

- timing and coordination in human movement
- theoretical accounts for coordination
- robotic demonstrations of timing and coordination

#### 8 Motor control in robots and human movement

- the dynamics of robot/human arms
- control of arm dynamics
- basic notions of control
- basic notion of optimal control
- operational space

#### 9 Motor control in human movement

- muscles as visco-elastic systems
- reflex control of muscles
- implications for control
- implications of motor planning

#### 10 Summary and outlook

- preparing for exam

## Literature

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