

Object Identification and Orientation



Jacky Baltes
Center for Imaging, Technology and Robotics
University of Auckland
Email: j.baltes@auckland.ac.nz
WWW: <http://www.citr.auckland.ac.nz/~jacky>

Lecturer: Jacky Baltes

Date: 6/13/01

Overhead sheet 1



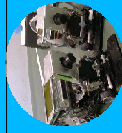
Introduction

- RoboCup Vision Problem
- Robot Position
- Robot Orientation
- Robot Identification
- Conclusion

Lecturer: Jacky Baltes

Date: 6/13/01

Overhead sheet 2



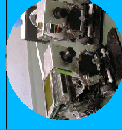
RoboCup Vision



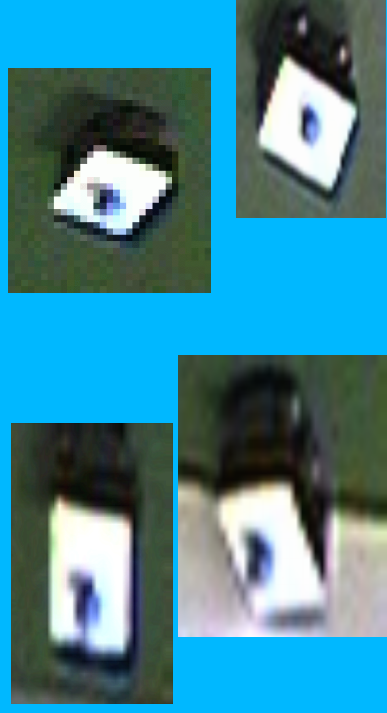
Lecturer: Jacky Baltes

Date: 6/13/01

Overhead sheet 3



Sample Views



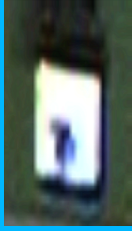
Lecturer: Jacky Baltes

Date: 6/13/01

Overhead sheet 4

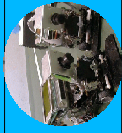
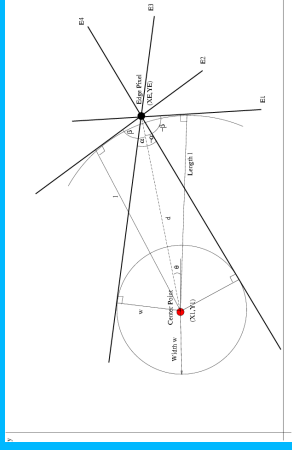


Output of Edge Detection



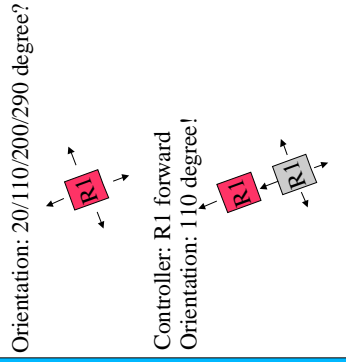
Hough Transform

- Four possible orientations for each edge pixel
- Increment accumulator for each supported orientation
- 0..90 Degrees.
- 5 Deg. Steps



Orientation

- Robots are roughly square, so impossible to determine the orientation without additional information
- Hough transform only determines four possible orientations
- Quadrant is determined by correlating behavior of the robot with the command stream



Identity

- Identity of the robot is important, since the client needs to know to which robot to send commands
- Other teams use unique features to identify their robots (bar codes, colors) or manually tag their robots
- Robots look exactly alike



Identity

- Similar to the problem of determining the orientation, we correlate the command stream with the observed behavior of the robots
- Robot is in one of four states
 - Stationary
 - Turning clockwise
 - Moving in a straight line
 - Turning anti-clockwise
- Other factor: physical distance to last observed position

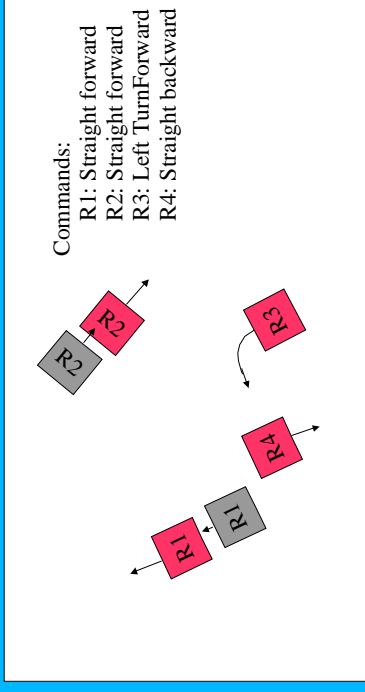
Lecturer: Jacky Baltes

Date: 6/13/01

Overhead sheet 9



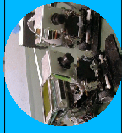
Command Correlation



Lecturer: Jacky Baltes

Date: 6/13/01

Overhead sheet 10



Example

- In the example, R3 and R4 can be identified by their unique motion commands
- R1 and R2 are disambiguated through tracking objects. Given the last known position of an object, objects are disambiguated by using the assignment of Ids that minimizes the distance error

Lecturer: Jacky Baltes

Date: 6/13/01

Overhead sheet 11



Practical Implementation

- Simple principle, but difficult to implement in practice
- Noise (robots not found, wrong position, wrong orientation)
- Obstacles (Path of the robot is blocked by other robots or the wall)
- Time delay between command send and command acted upon

Lecturer: Jacky Baltes

Date: 6/13/01

Overhead sheet 12



Conclusion

- Efficient method for determining orientation without additional colors or feature points
- Efficient method for indentifying robots without unique features or manual tagging
- Only RoboCup team in the world which does not require additional colors, features, or manual tagging
- Improve robustness by adjusting probabilities of different events