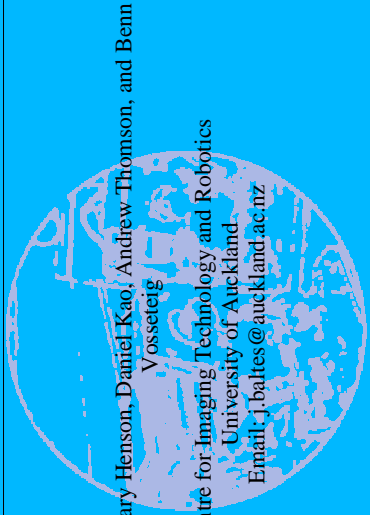




## Research into Robots Playing Soccer



Jacky Baltes, Gary Henson, Daniel Kao, Andrew Thomson, and Benn Vosserteig

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Lecturer: Jacky Baltes

Date: 14 Feb 2001

Overhead sheet 1



## What is RoboCup

- RoboCup is a competition of robots playing soccer
- 1991: Alan MacWorth posed this as a challenge problem for AI
- 1997: Dr. Hiroaki Kitano organized the first competition in Japan
- Yearly event. 2000 World Cup in Melbourne

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Overhead sheet 2



## What are the Problems

- Hardware – Mechanics, Actuators, Sensors
- Cheap, robust, reliable platform
- Computer Vision
- Localization, Identity
- Control
- Accurate, robust, flexible
- Path Planning
- Dynamic obstacles
- Task Planning
- Real-time domain

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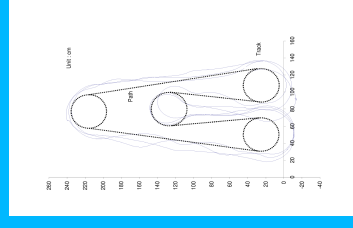
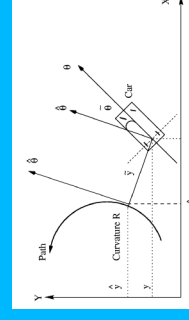
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Overhead sheet 3



## Control

- Non-holonomic control problem
- Non-linear
- Reinforcement learning



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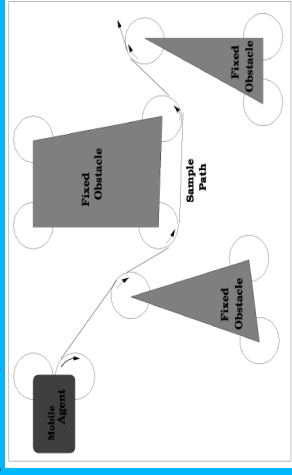
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Overhead sheet 4



## Path Planning

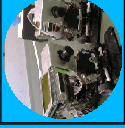
- Find a way through a set of obstacles (static or dynamic)



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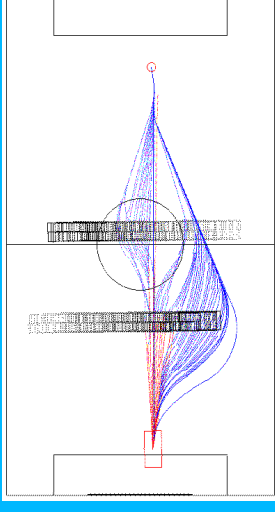
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Overhead sheet 5



## Dynamic Path Planning

- Multiple moving obstacles
- Real-time constraint



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Overhead sheet 6



## Task Planning (AI)

- When to shoot? When to pass?
- Play defensively/offensively
- Symbolic AI
  - (ball my-team) and (goal-shot blocked) and ...
- Reactive systems
  - If the ball is in front of me and ... then shoot
  - If the ball is behind me then turn ...
- Balance between reactive and strategic planning

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Overhead sheet 7



## RoboCup 2000 Events

- Workshop: Scientific developments are presented in a conference style forum
  - > 100 Submissions
  - Distinguished Science Award (4 Papers)
- Humanoid Robot Exhibition
  - New league in 2001/2
- Humanoid Soccer Match

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Overhead sheet 8



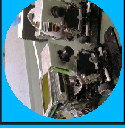
## ***RoboCup and the University of Auckland***

- University of Auckland competed at the last three games
- In 2000, we competed with two teams in the small sized league
- All Botz: Global vision system. Competed previously. Toy cars.
- 4 Stooges: Local vision team. Fully autonomous. Based on Braeunl's Eyebot Controller and CMOS Camera. Old All Botz toy cars as base

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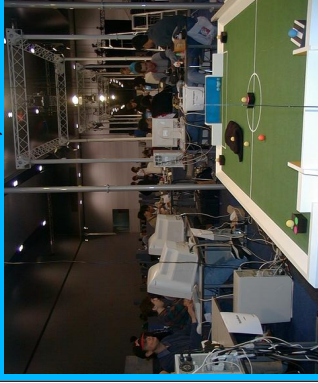
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Overhead sheet 9



## ***Setup***

- Nice fields, but no camera mounts



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Overhead sheet 10



## ***Setup of the All Botz***

- Completely new ID and orientation methods
- In Stockholm, spend 3 days calibrating colours
- Camera calibration went very quickly. Visual feedback was good. 3D Points improved it. Same method now used by Big Red
- Colour calibration took about 4 hrs.
- Carpet posed no problem
- Problems with the ID? But what to do?
- 4 Stooges calibrated colours most of the time

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Overhead sheet 11



## ***Problem with Identification***

- All robots look alike.
- Different sources
- Commands
- Locality
- Discrepancies between commands and reaction
- Additional problems
- Time delay, occlusion, car is stuck, car is tipped over
- Lots of parameters. Bayesian approach. Guess the probabilities of different events



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Overhead sheet 12



## All Botz vs. Yale



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Overhead sheet 13



## All Botz vs. Yale



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Overhead sheet 14



## All Botz vs. RoboRoos



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Overhead sheet 15



## All Botz vs. Singapore Field Rangers



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Overhead sheet 16



## All Botz vs. Singapore Field Rangers

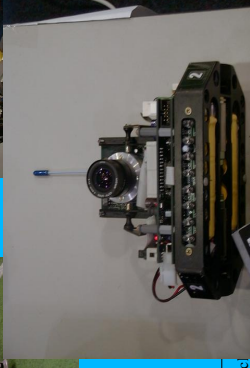
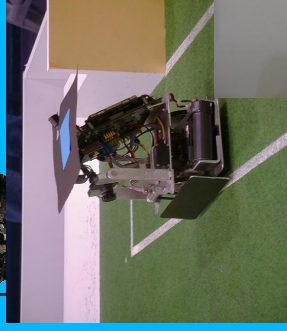


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Overhead sheet 17

## Local Vision Teams



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Overhead sheet 18



## Looking towards the Future

- Feb 2001: 4<sup>th</sup> Auckland Robotics Games in Auckland as part of Robotic Vision 2001
- Aug 2001: RoboCup in Seattle. Baltes is on the program committee for the workshop
- Nov 2001: RoboFesta competition in Japan
- Nov 2001: SEARCC Micromouse competition in Auckland. Organized by Baltes

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## Until Next Year



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