Robots for Fun and Research

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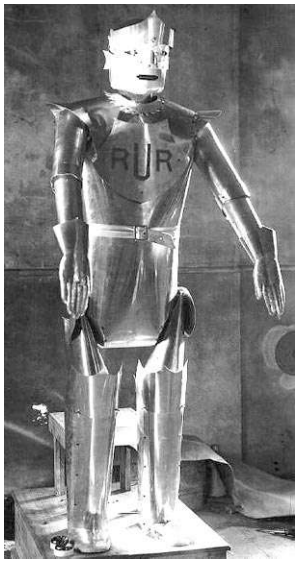
AI and Robots

Outline:

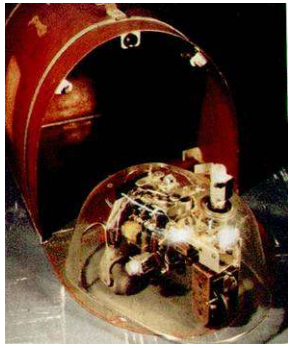
- History of Robotics
- Hot Research Issues
- Social Issues
- Robot Hardware Hacking
- Security Issues
- The Future?

A History of Robots in AI



- 18th C.: early animated machines (automated duck)
- 1921: Karel Capek coins the term “robot”
- 1942: Asimov's three laws of robotics (“I, Robot”)

A History of Robots in AI



Elsie

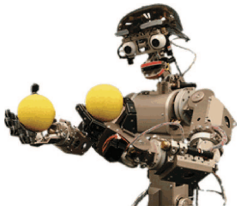
- 1940s/50s: Grey Walter's tortoises
- 1969: Shakey (Stanford, California)

Shakey

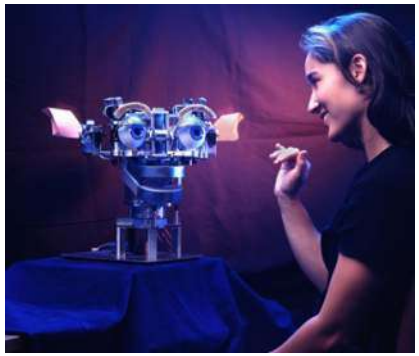
A History of Robots in AI

- 1980s: Behaviour based Robotics

- 1990: entertainment robots



Infanoid



Kismet

The Importance of Embodiment

Deep Blue (IBM)

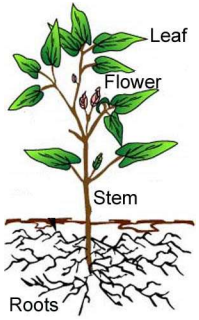
Chess vs. Football

Aibos (SONY) at the Robocup

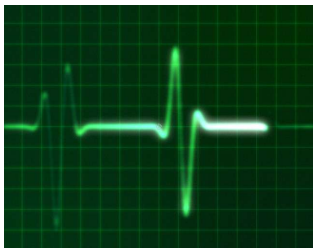
Embodiment

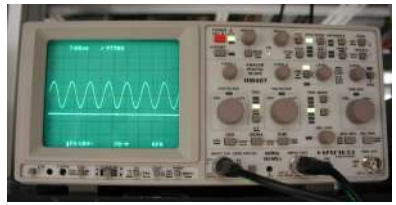
- Evolutionary pressure for the evolution of brains. "Why don't plants have brains? [...] The answer is quite simple - they do not have to move and that is what brains are for." [Lewis Wolpert]

- Understanding Navigation can teach us a lot! Prerequisite for many other behaviours



Robots as Research Tools





Robots:
- reproducible behaviour
- internal states can be accessed easily
- survive most of the experiments

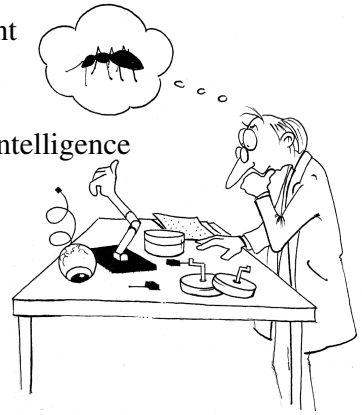
Biorobotics: understanding by building

- Methods:

  - Building a model of a natural agent (simulation or robot)

  - Abstracting general principles of intelligence

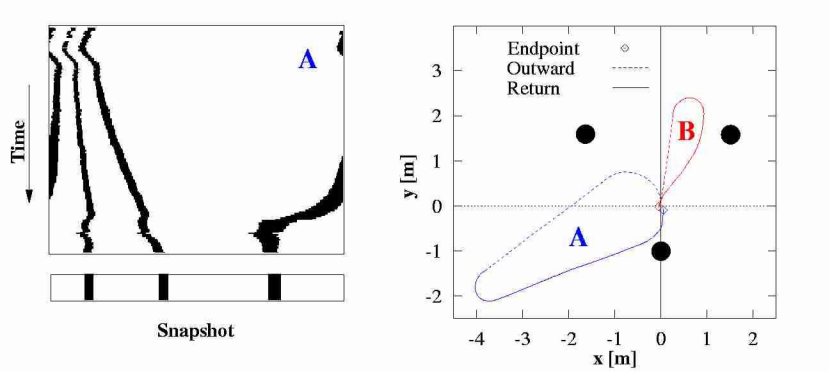
  - Applying the general principles to the design of intelligent devices

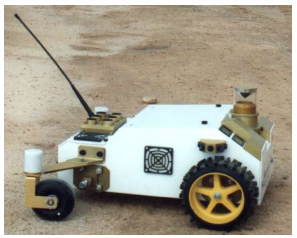


Inspiration from Biology

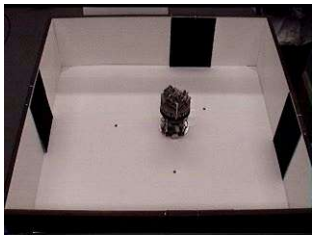
Desert Ant `Cataglyphis'

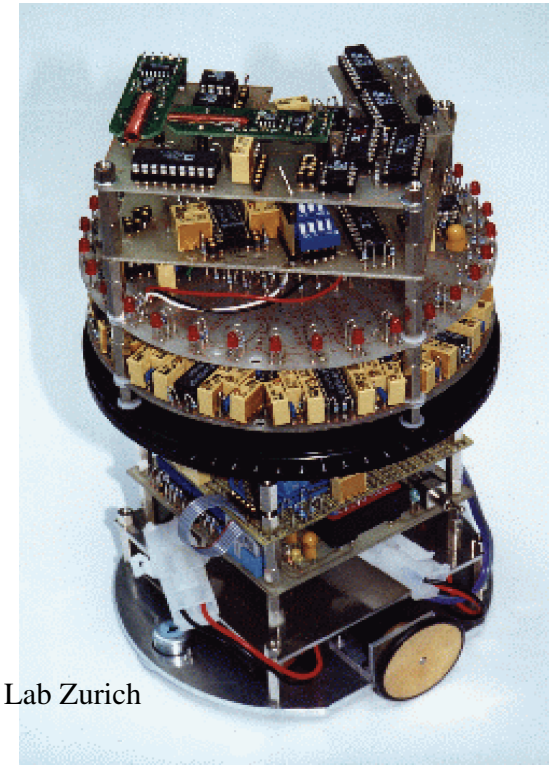
Sahabot II with Snapshot Model





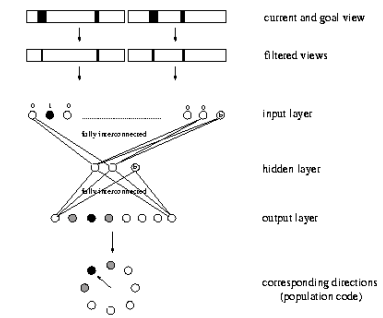
Analogue Robot with ALV Model

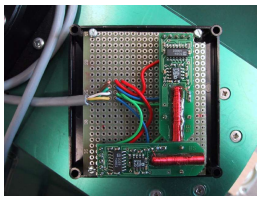


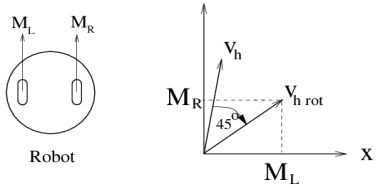


Analogue Robot by Ralf Möller, AI Lab Zurich

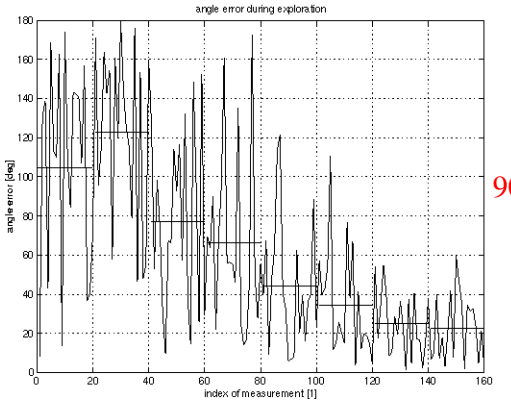
Learning Scenario







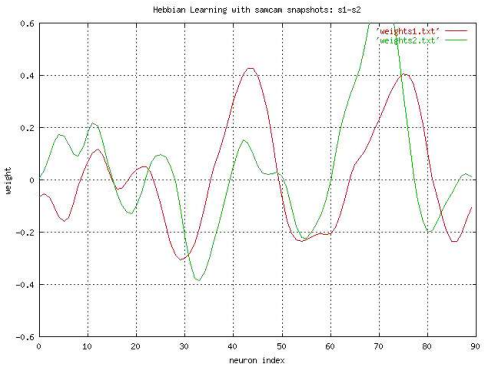
Result I: Learning of Visual Homing is Possible!



90

Angle error of the homing vector

Result II: The Learned Strategy is Similar to the ALV Model!

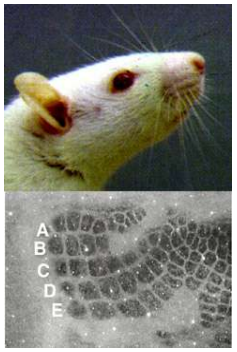


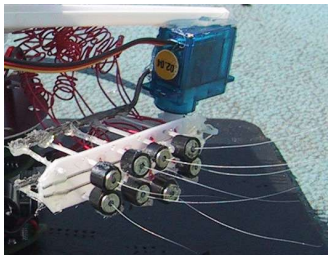
$$
\begin{aligned}
v_h &= (x, y) \\
&= (\sum_{i=0}^{l-1} w_{ix} n_i, \sum_{i=0}^{l-1} w_{iy} n_i) \\
&= C(\sum_{i=0}^{l-1} \cos(g_i) n_i, \sum_{i=0}^{l-1} \sin(g_i) n_i) \\
&= CALV_n \\
&= C(ALV_{s_1} - ALV_{s_2})
\end{aligned}
$$

Weights between visual and motor layer

Artificial Mouse Project

• Combination of different sensory modalities





http://www.amouse.de/

Developmental Robotics

Examples:

- Challenges of Joint Attention

- Open-ended Development based on a Curiosity Drive

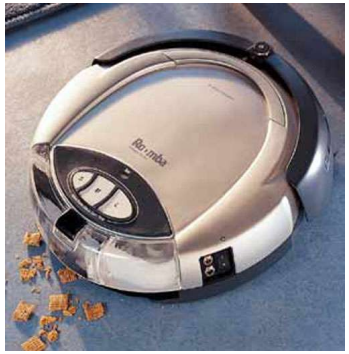
The Playground Experiment

- Predictions about consequences of own actions
- Action selection based on largest learning progress

http://playground.csl.sony.fr/

Robots as Tools

- more practical approach today
- no “universal household robot”
- hardware prices are falling



Roomba (iRobot)

Entertainment Robots

Furby

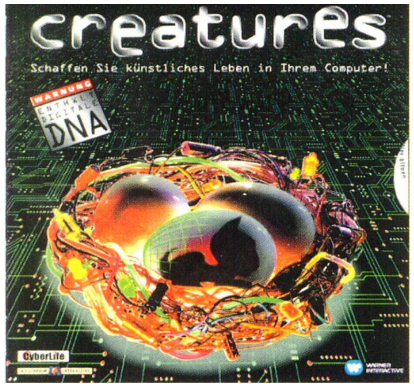
Tamagotchi

13 million Tamagotchis sold in one year!

No practical purpose, on the contrary: annoying

Entertainment Robots

First computer game with artificial life
(Cyberlife Technologies)



Norn

Entertainment Robots

Humanoids often used as “mascots” for their company

Aibo (SONY)

Qrio (SONY)

Asimo (Honda)

Another Robot Definition...

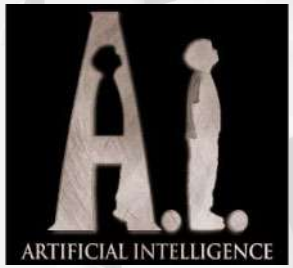
The Encyclopaedia Galactica defines a robot as a mechanical apparatus designed to do the work of a man. The marketing division of the Sirius Cybernetics Corporation defines a robot as "*Your Plastic Pal Who's Fun To Be With*."

[Douglas Adams, 1979]

Entertainment Robots

- Emotional attachment
- Functionality? interesting?
- Need to be interesting for a long time -> able to learn, adaptive, unpredictable
- Design issues

Robots in Films - SciFi



Western / Eastern Image of Robots

Different View on Robots

paradox?

AIBO/QRIO/Asimo

Izanagi+Izanami

spontaneous generation

Michelangelo

creation?
- in 2 steps

Frankenstein's Monster

Rabbi Loev's Golem

Robotic Hardware Hacks

aMouse

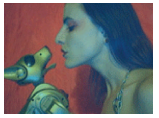
NimbRo

schizodog

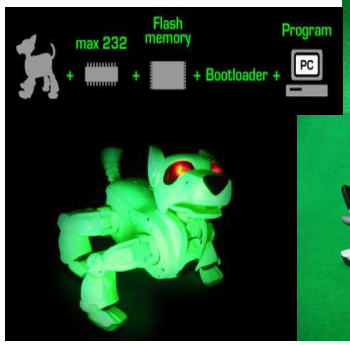
Lego Mindstorms

Robotic Hardware Hacks

“Cyberdoll”



I-Cybie



Robotic Hardware Hacks

RoboSapien

Mark Tilden: *"A single screwdriver takes the RS completely apart, and inside everything is labled, colorcoded, and socketed for convenience."*

robot swarms

Security Issues

military robots

AIBO: WLAN, Video camera, reads your email! plays mp3s

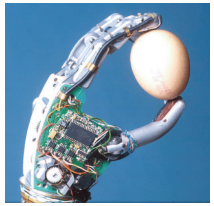
AIBO Entertainment Player version 2.0 PC based software:

In Navigator, you can either remotely control or monitor AIBO while viewing the world through AIBO's camera. House sitting mode allows you to record video from AIBO while you are away. In Player, AIBO can play your favorite music (audio CD, MP3, WMA, WAV, and internet radio) as a dancing speaker.

In Scheduler, AIBO will be synchronized with your Microsoft Outlook schedule, enabling AIBO to inform you of your appointments. In Diary, AIBO, will keep a diary with pictures everyday, and AIBO can both read the pages and upload them to a blog.

Robotic Hardware Hacks

Modified RoboSapien (WowWee) for RoboCup (Sven Behnke, Freiburg) add-ons: PDA, camera



The Future of Robotics

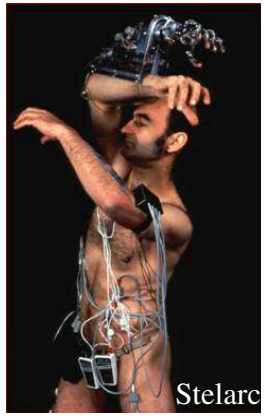
Predictions about the Future of Robotics:

- Robots beat human world champions in soccer:
  2050 - RoboCup mission statement, 1999
- AI reaches the human level:
  2019 - Ray Kurzweil, 1999
  2020 - Arthur C. Clarke, 2001
  2050 - Hans Moravec, 1999

Previous predictions failed...

Are we Cyborgs already?

Warwick



Stelarc

THE END