Webots

fast prototyping and simulation
software for mobile robots

Tutorial

Loïc Matthey

Materials courtesy of:

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Cyberbotics©
Simon Ruffieux

CYBERBOTICS
professional mobile robot simulation

April 11th 2008

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Contents

1. Origin of the product

Company

- Cyberbotics Ltd.: founded 1998, 6 employees, self-funded
- Spin-off from EPFL, located on EPFL campus (Switzerland)
- Main product: Webots – mobile robotics simulation software
- Worldwide market: universities, corporate R&D centers
- More on: www.cyberbotics.com

1. Origin of the product

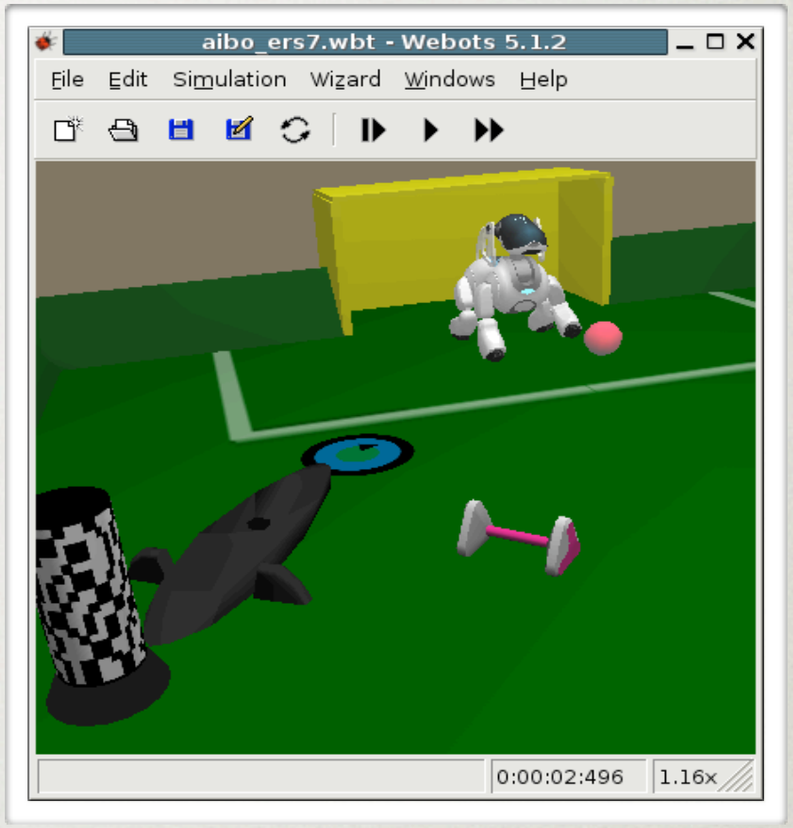
History

- 1998-1999:
  Khepera simulation (EPFL)

- 1998-2005:
  Aibo Simulation (Sony, Japan)

- 2003-2005:
  Dynamics simulation (EPFL)

- 2005-2006: Custom R&D
  (Stanford Research Institute)

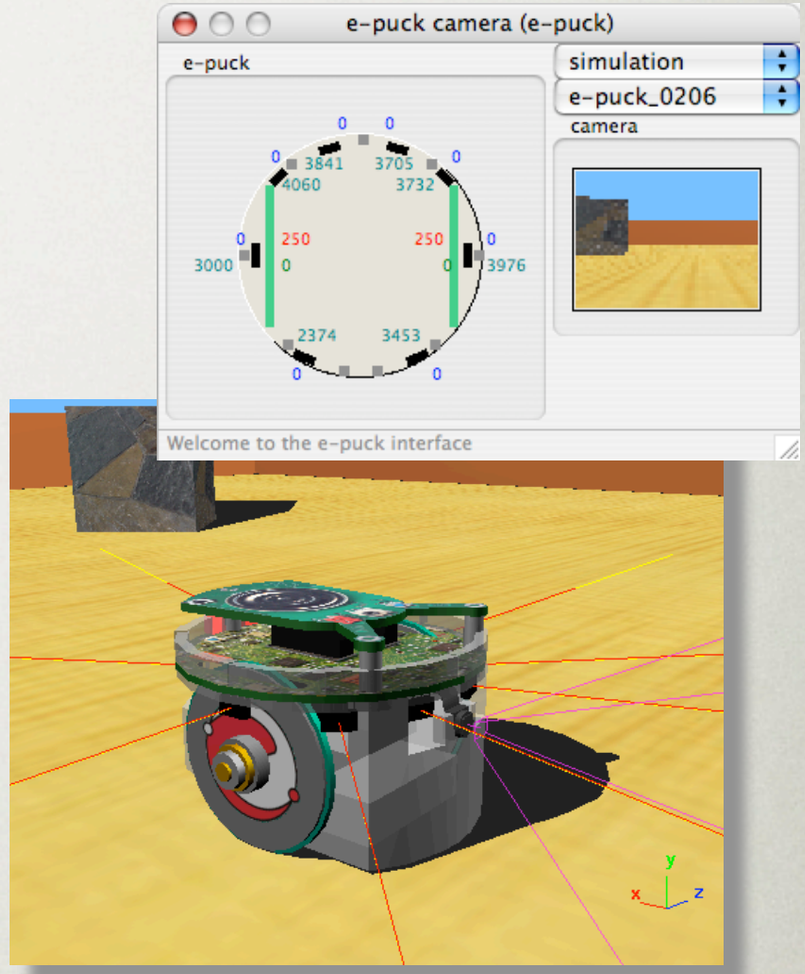


Sony Aibo ERS-7 Simulation

1. Origin of the product

Current collaborations

- 2003: Collaboration & support (EPFL, SWIS & BIRG groups)
- 2006: Gostai / URBI, robot programming environment
- 2006: ICEA, rat robot model (European project, IP-FP6)
- 2006: e-puck robot support (EPFL, GCTronic)



E-puck robot

2. Customers

Some of the 500+ customers

RIKEN

TOKYO UNIVERSITY OF SCIENCE since 1881

STANFORD UNIVERSITY

CALIFORNIA INSTITUTE OF TECHNOLOGY 1891

JAIST JAPAN ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY, HOKURIKU 1990

CNRS CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

UNIVERSITAS TURICENSIS MDCCC XXXIII

Tokyo Institute of Technology

KING'S College LONDON University of London

Imperial College London

UCSD

BOSTON UNIVERSITY

Duke UNIVERSITY

THE UNIVERSITY OF TOKYO

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

2. Customers

Some of the 500+ customers

SAMSUNG

NASA

SRI International

BAE SYSTEMS

Panasonic
ideas for life

HONDA

TOYOTA

SONY

NTT

Pioneer

Tanner RESEARCH

VORWERK

3. Overview

Principle

- Generic robot prototyping and simulation software
- Predefined robot models and sensor & actuators library
- Physics simulation and complex dynamics environments (ODE)

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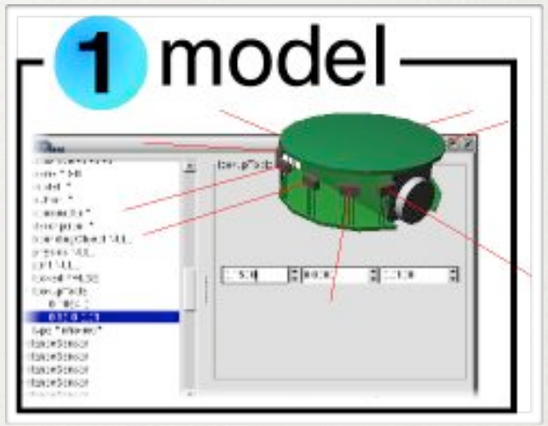

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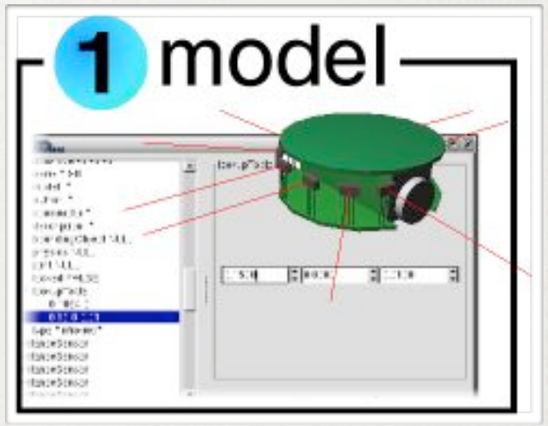

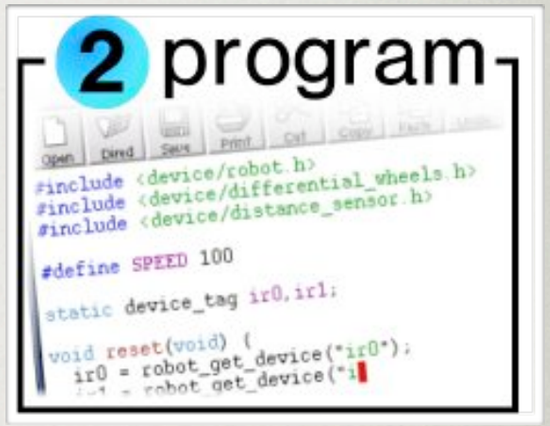

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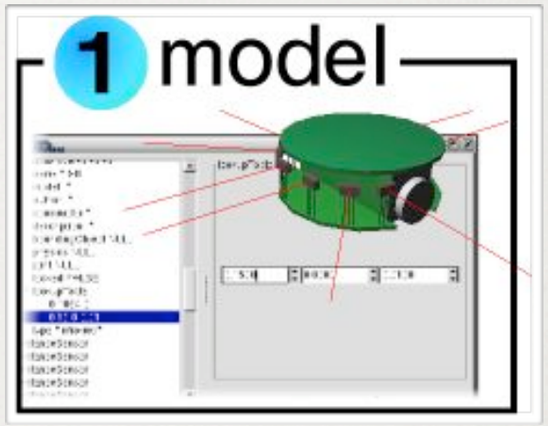

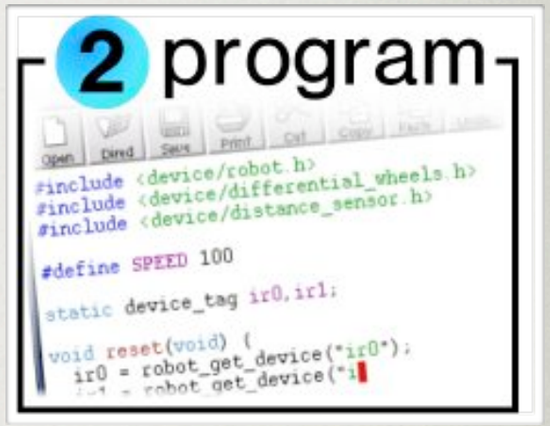

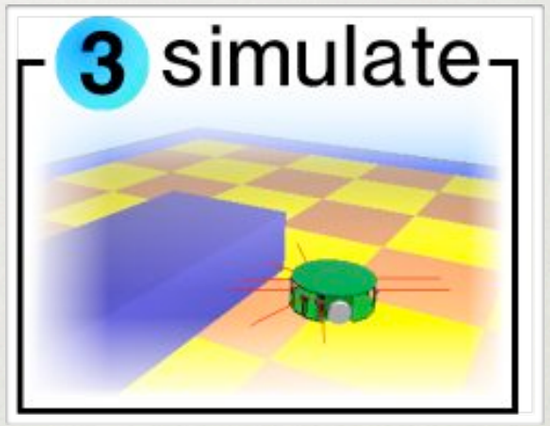

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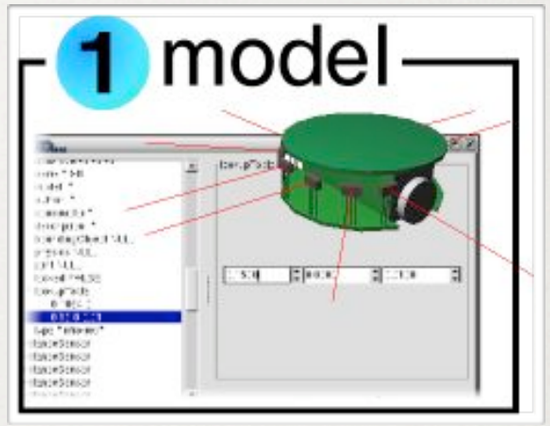

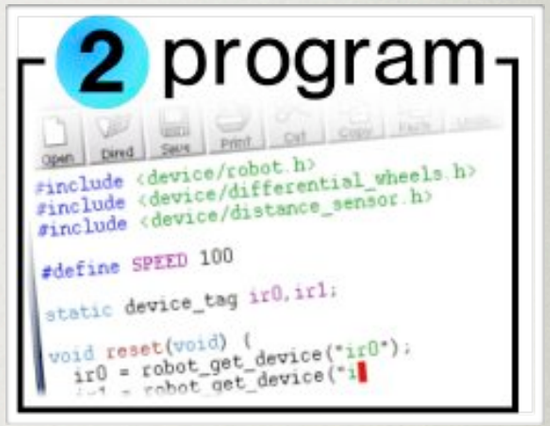

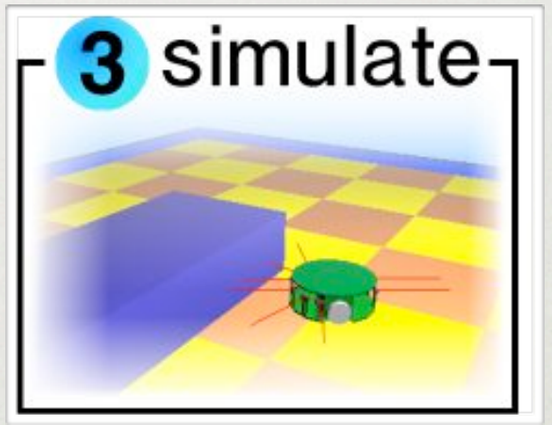

3. Overview

Examples

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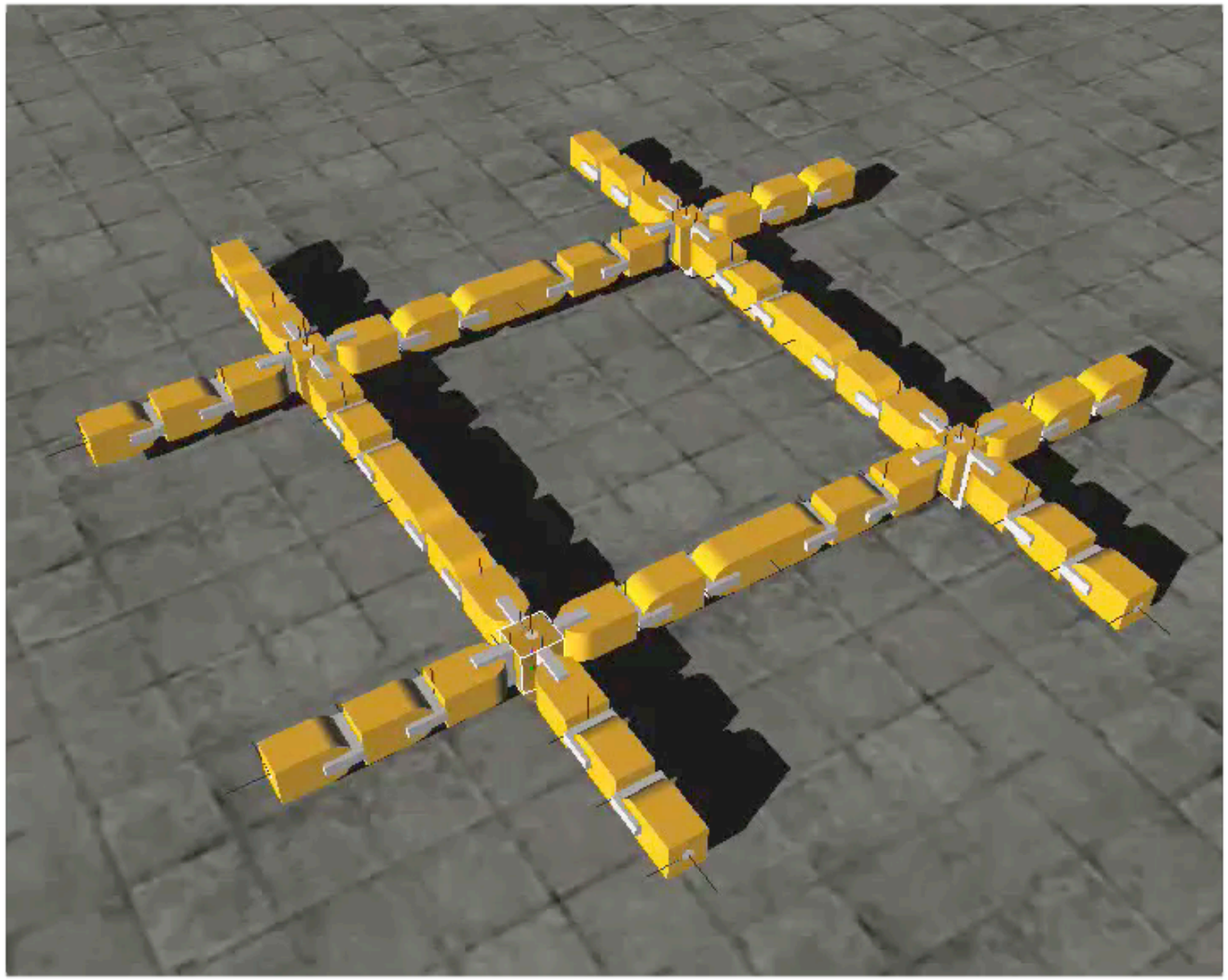
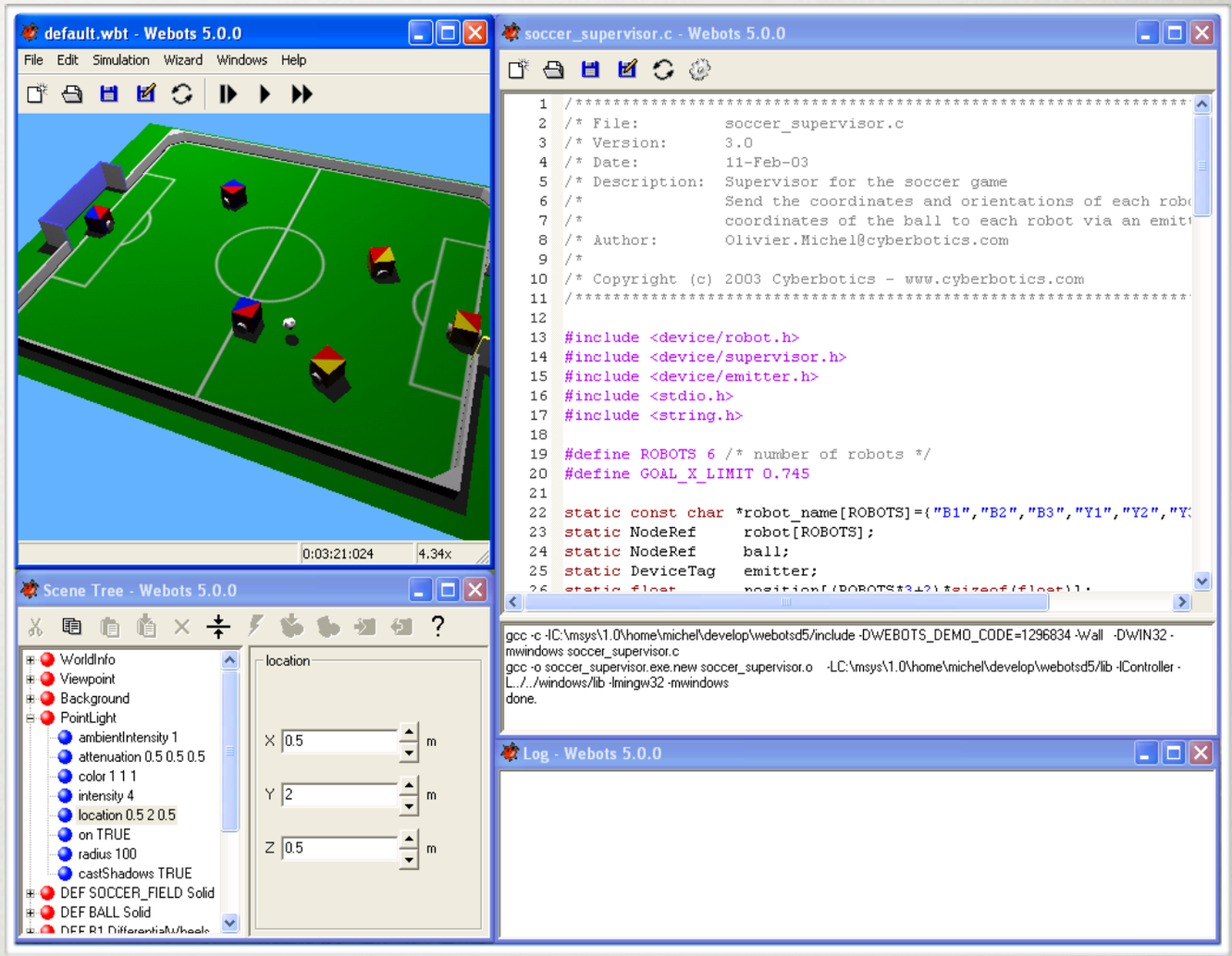


3. Overview

Commercial product ?

- Not free, but:
  - Software quality
  - Documentation
  - User support
  - Maintenance
  - Portability



Webots integrated development environment

3. Overview

Portability

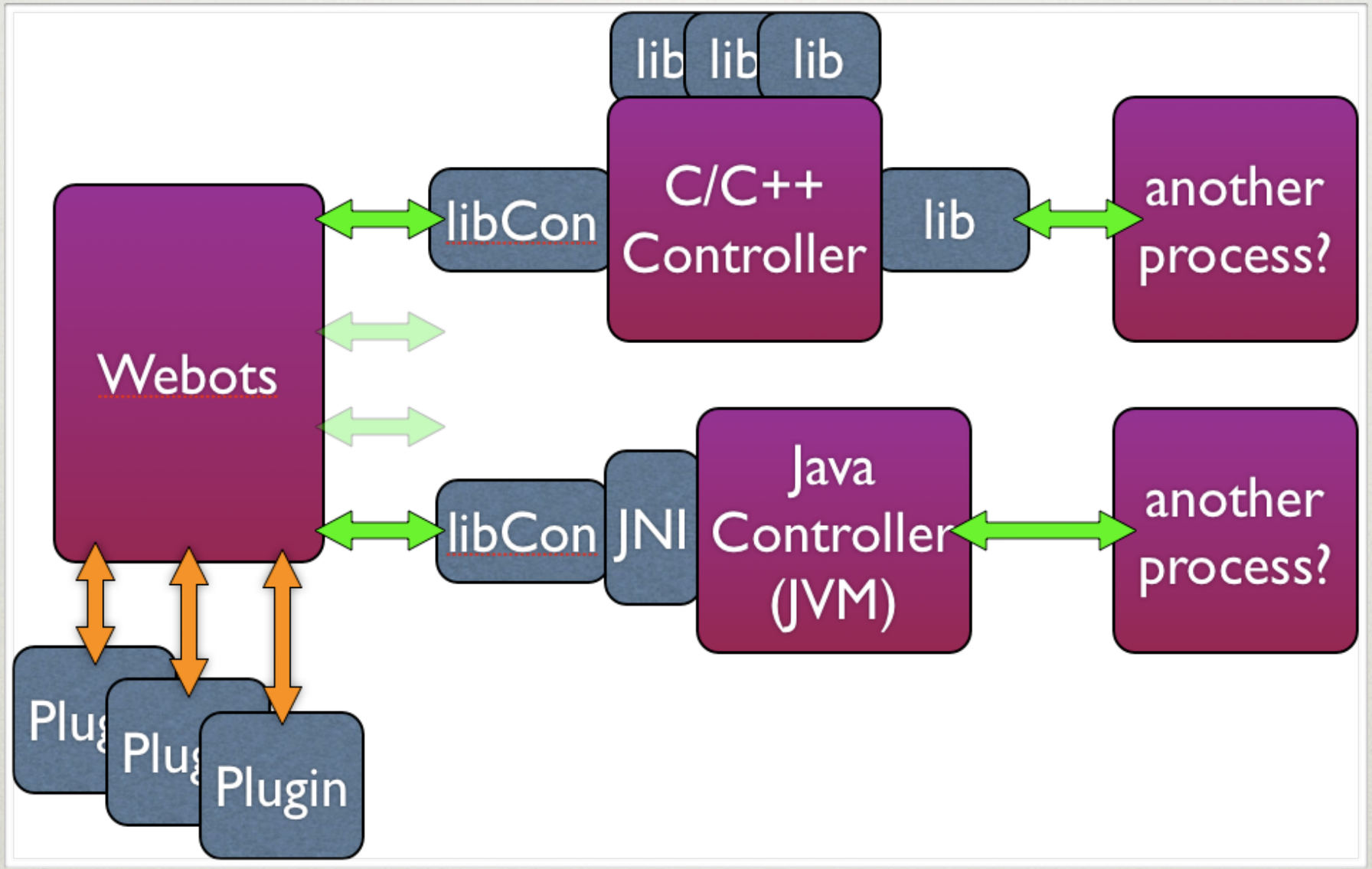
Windows Vista, XP, 2000

Mac OS X 10.4 “Tiger”
Mac OS X 10.5 “Leopard”
(Universal binary)

Main Linux distributions:
Ubuntu, Fedora, SUSE, Debian, etc.
(32 & 64 bit architectures)

4. Technical Description

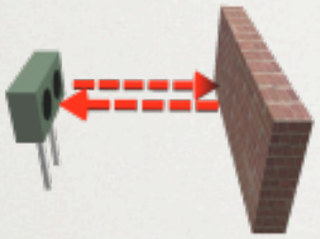
Architecture



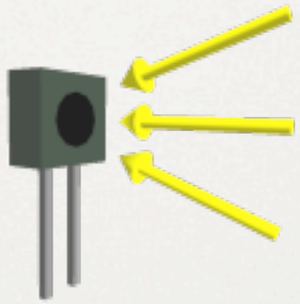
... and Matlab interface

4. Technical Description

Sensors

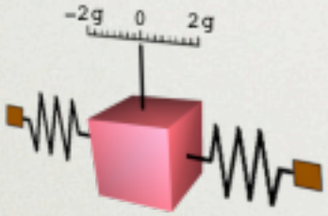


Distance sensor

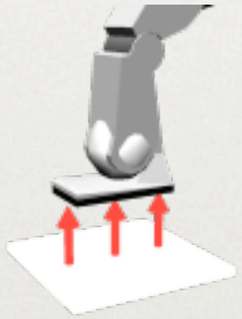


Light sensor

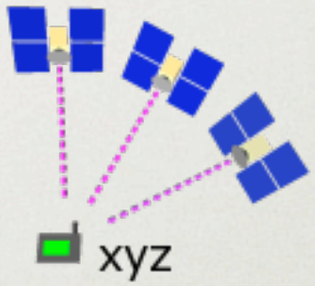
Camera



Accelerometer



Touch / pressure sensor

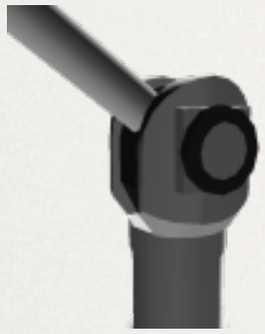


GPS

... and battery sensor, torque sensor, etc.

4. Technical Description

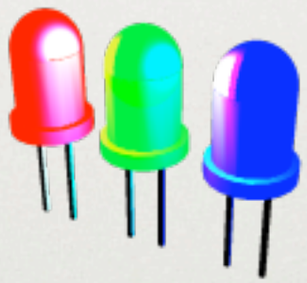
Actuators



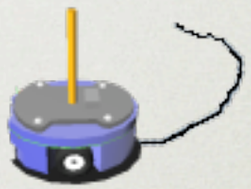
Servo
(rotational / linear)

Gripper

Connector
(docking systems)



LED



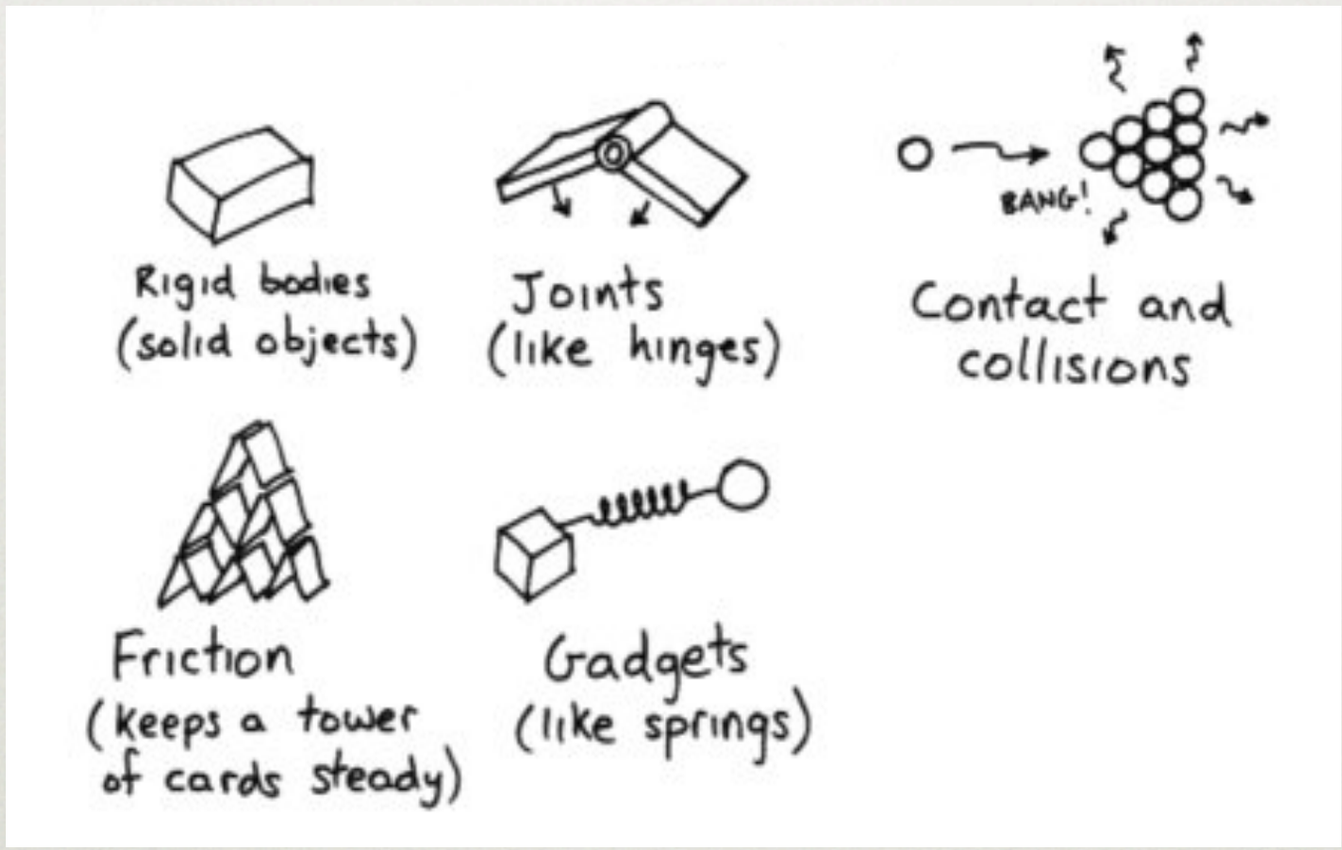
Pen

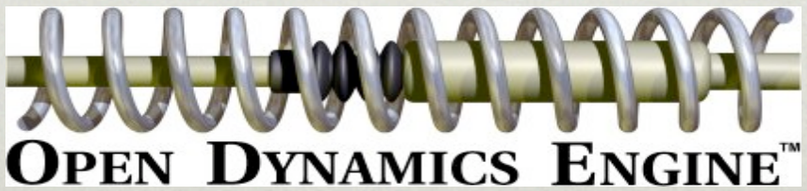
... and emitter & receiver etc.

4. Technical Description

Physics simulation

- Based on ODE (Open Dynamics Engine): collision detection and rigid body simulation library

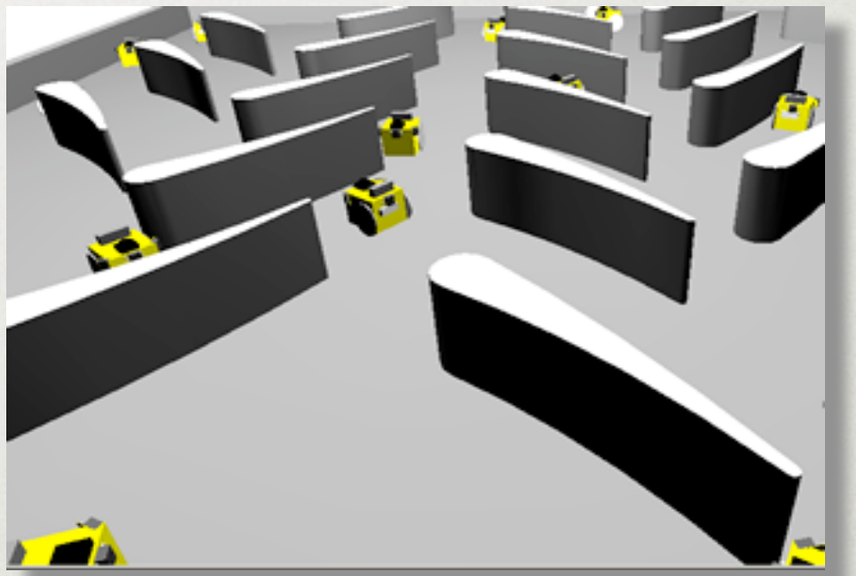




4. Technical Description

Inter-robot communications

- emitter (radio / infrared)
- receiver (radio / infrared)



Simulation & Pictures by Nikolaus Corell

4. Technical Description

Real robots integration

- Calibrated 3D models
- Programming interface
- Remote control interface
- Cross-compilation

- Validation with transfer to real robots (e-puck, Khepera, Aibo, LEGO, etc.)

4. Technical Description

Real robots integration

- Calibrated 3D models
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5. Webots Demo

- General interface
- Robot and controllers
  - compilation: Makefile
- World Tree
  - Tree view
  - VRML
- Examples

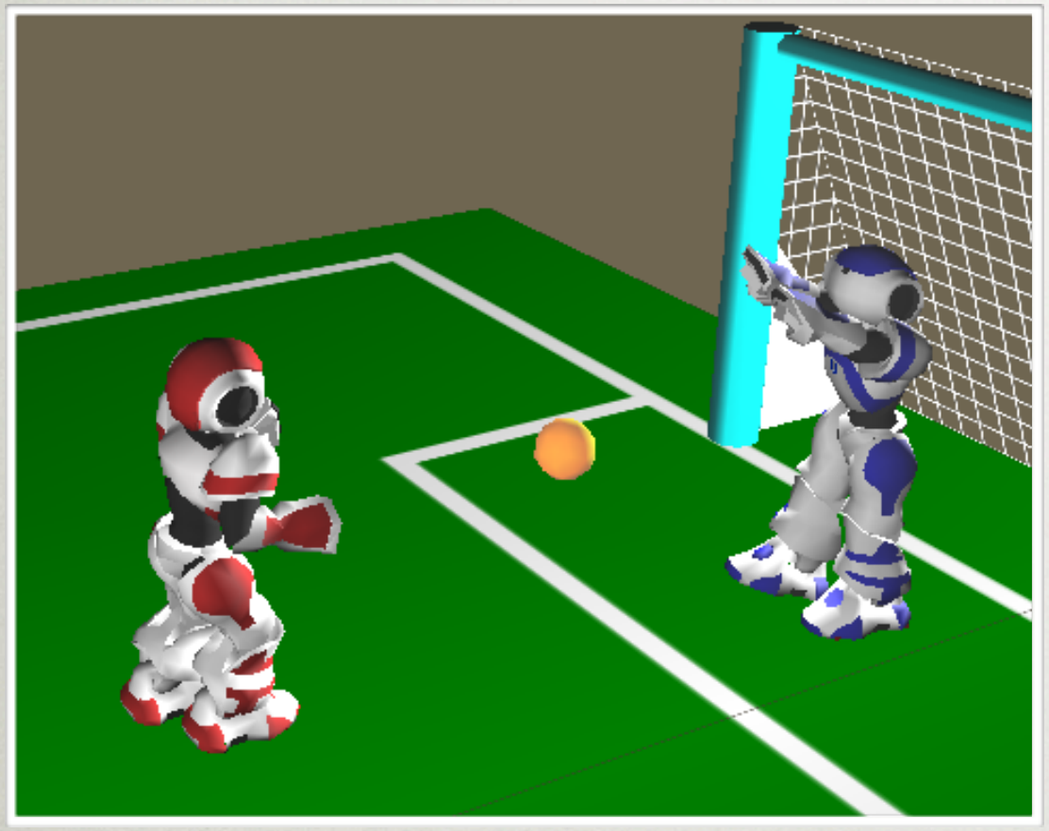
6. Advanced Features

- Batch mode, no GUI.
  - integration with scripts
- Physic plugins
  - code special behaviors (random wind, special collisions)
  - ODE level
  - Example: Spider by Simon Ruffieux
- Fast2D
  - For fastest simulation: no 3D.
  - Based on Enki Simulator.

7. Comparison with Gazebo

- Looks really similar
- Bigger library and capabilities out of the box
  - e.g. emitter/receiver, connectors
- Easy world and robot creation
- Clear separation between controller and simulation
- No middleware level like Player, but interface creation possible and considered.

8. Programming contests



Robotstadium (2008)
www.robotstadium.org

Rat's Life (2008)
www.ratslife.org

Thank you

Any Questions ?