BIOLOGICALLY INSPIRED
ROBOTICS GROUP (BIRG)

Logic Systems Laboratory (LSL)
School of Computer and Communication Sciences
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Summer Semester Project 2004

Aibo Simulation in Webots and Controller Transfer to Aibo Robot

Lukas Hohl, semester 8
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- Simulation
- Remote Control
- Cross-Compilation
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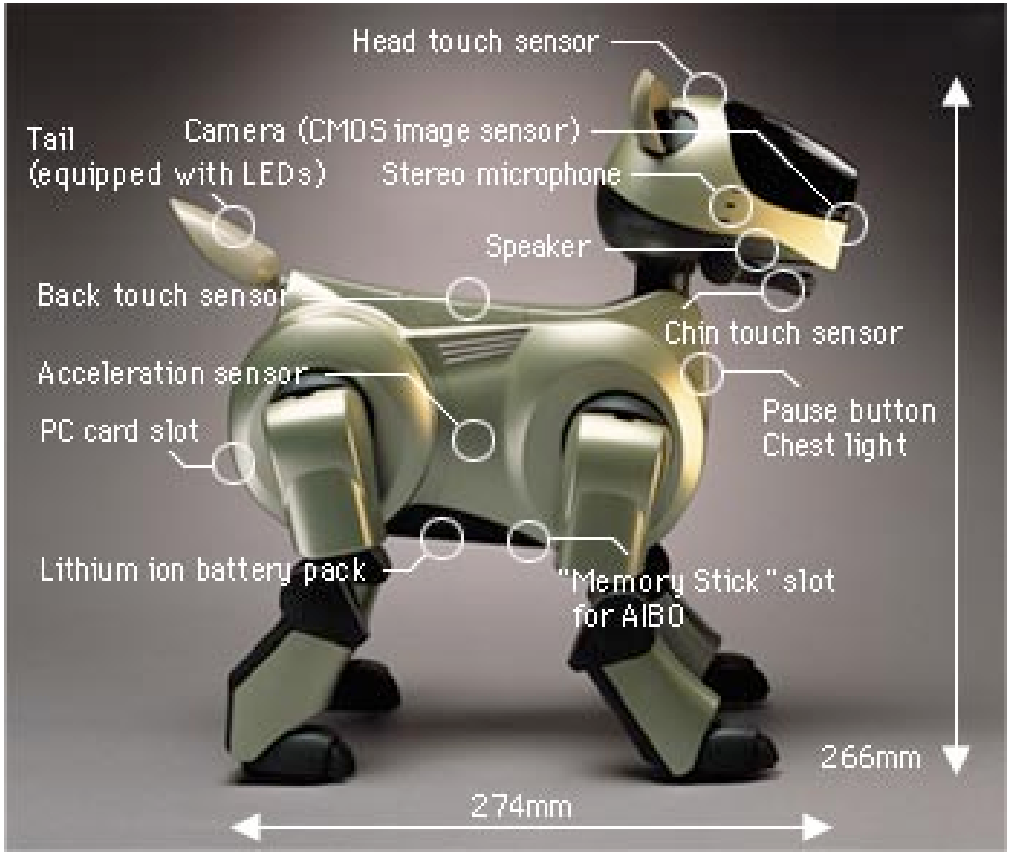
Introduction

Sony Aibo ERS-210(A)
Remote Control System
Webots 4

Sony Aibo ERS-210(A)

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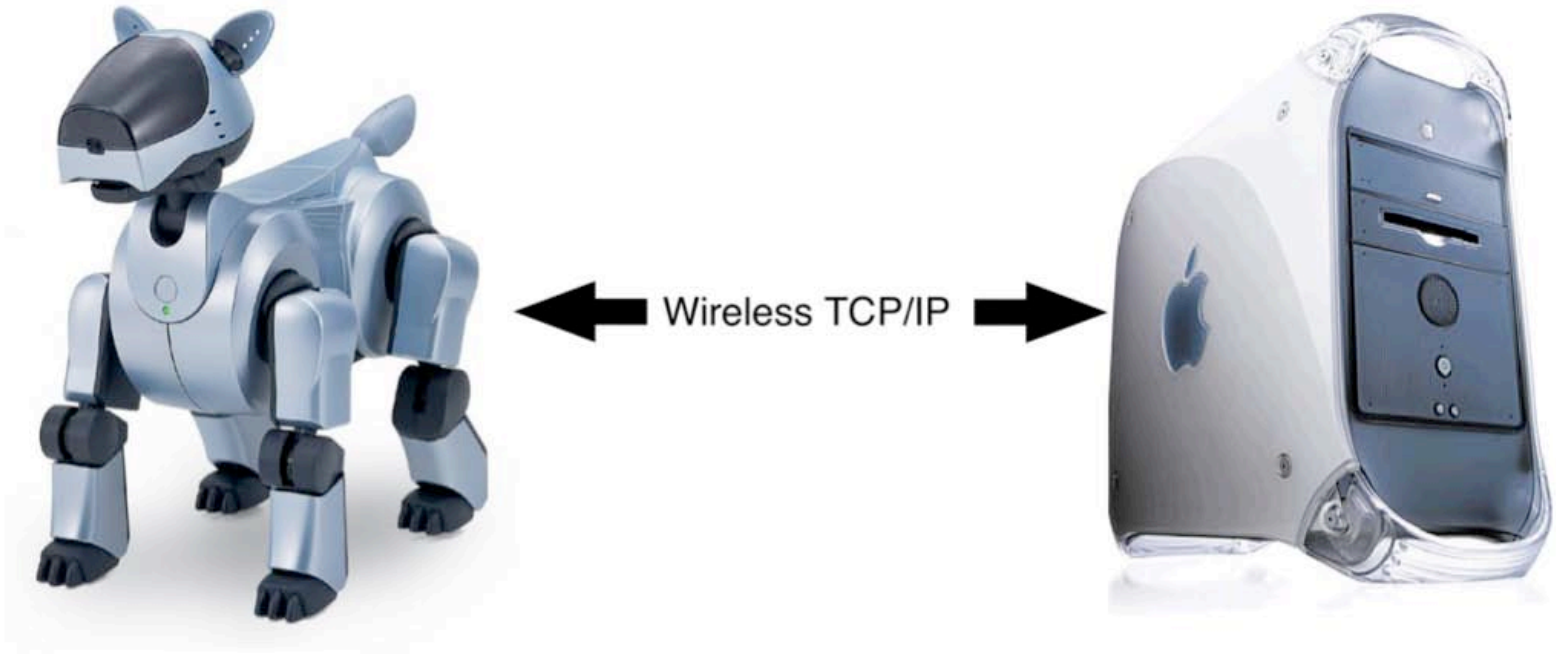
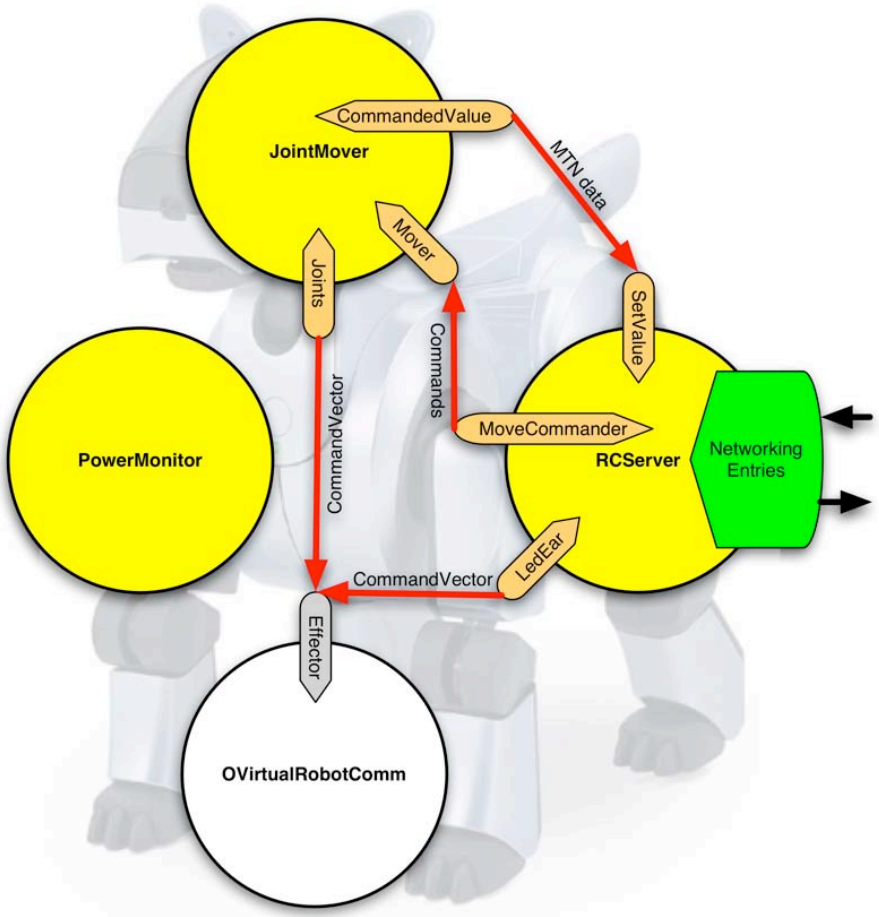
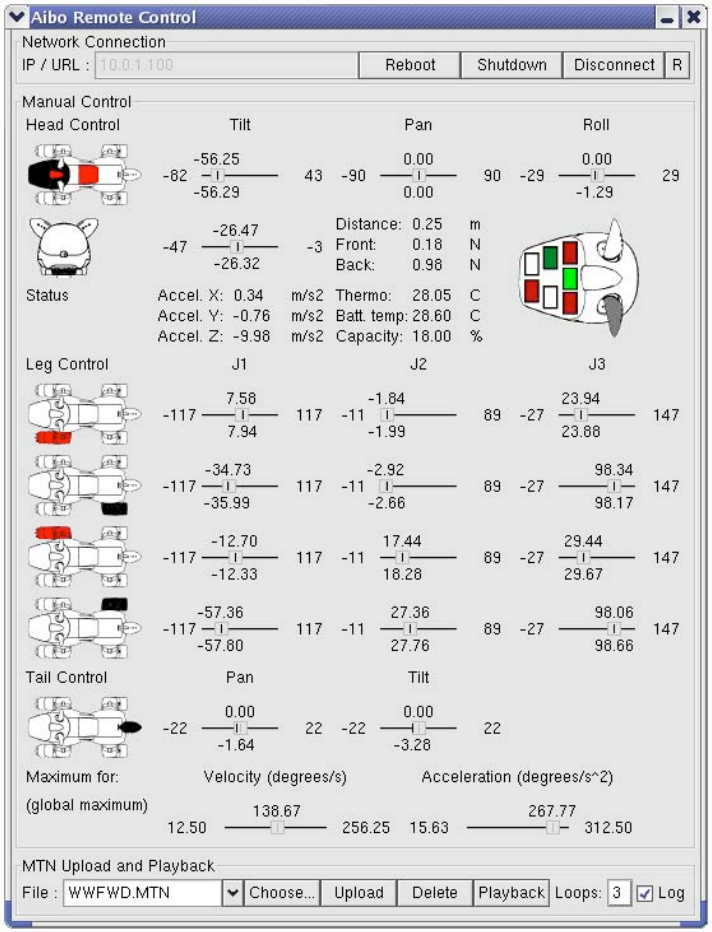
Remote Control System



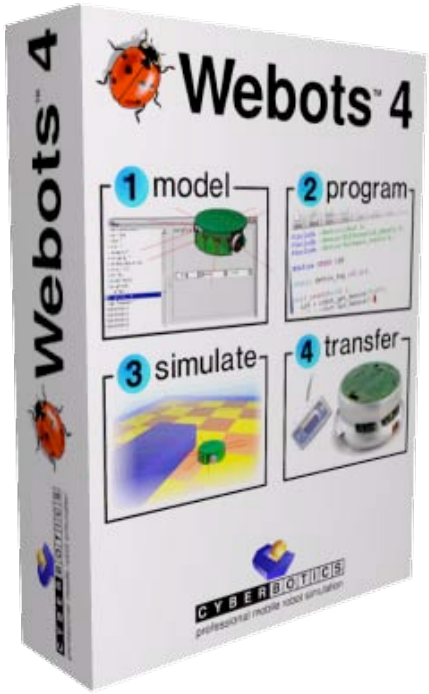
Aibo | Communication Protocol | Aibo Remote Control

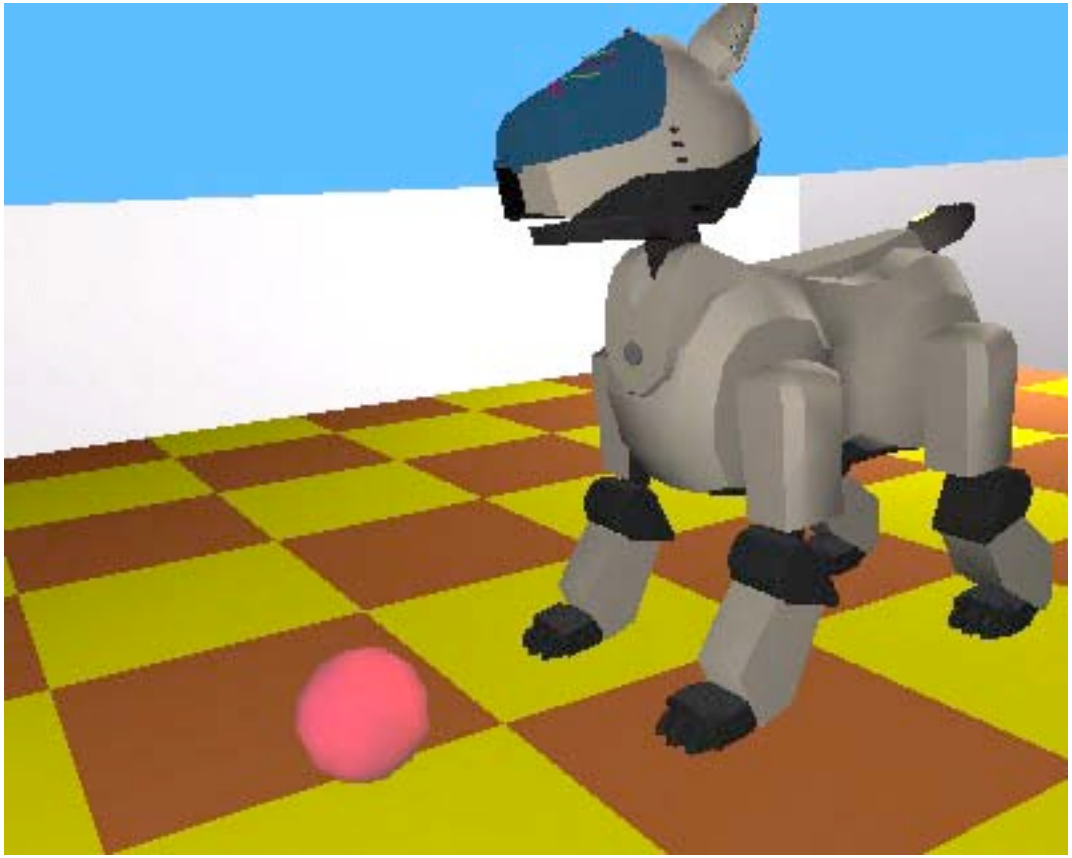
Aibo Simulation in Webots and Controller Transfer to Aibo Robot





Webots 4

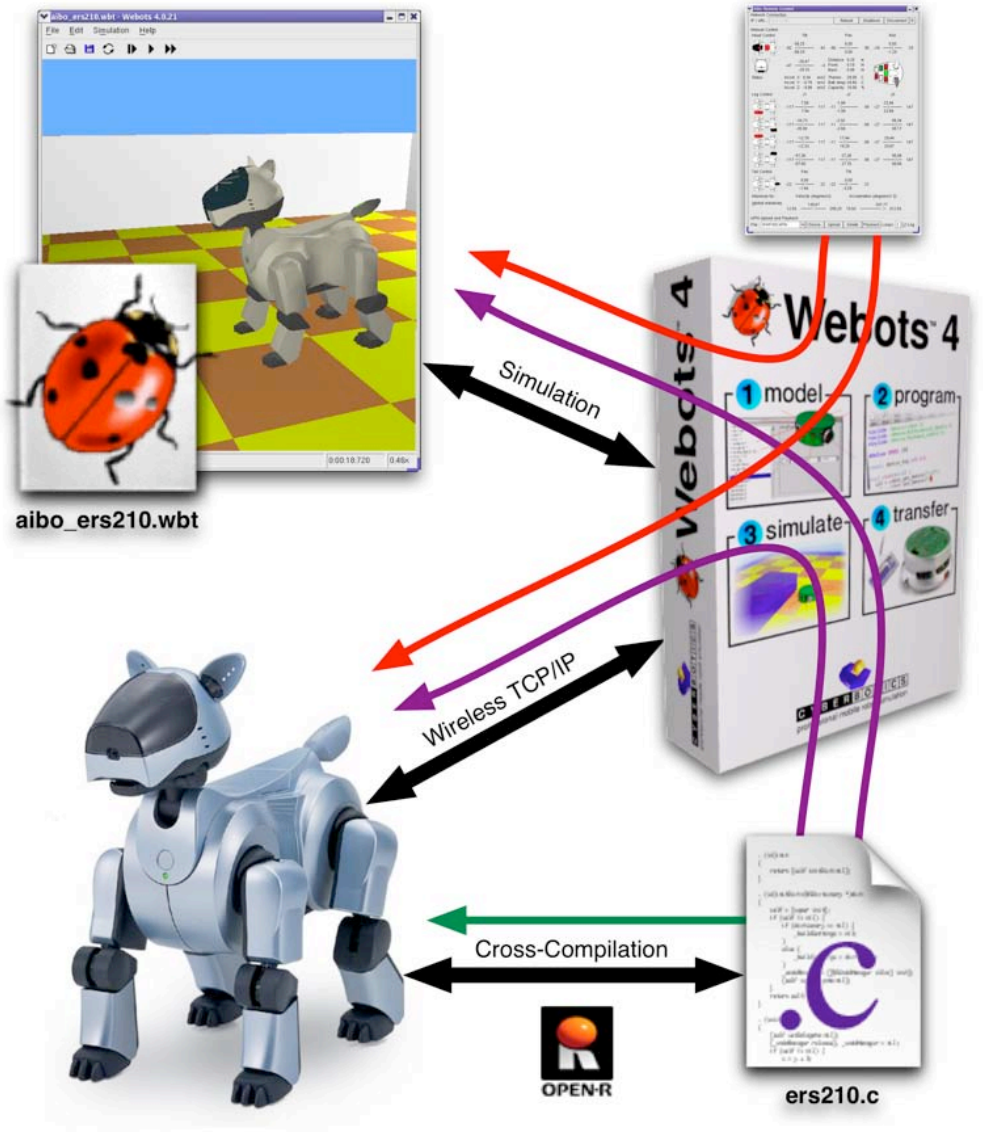

Webots 4
1 model
2 program
3 simulate
4 transfer
CYBERBOTICS



System Overview

Integration of Remote Control System into Webots
Simulation controlled by GUI and Controller
Real Aibo controlled by GUI and Controller
Controller Cross-Compilation

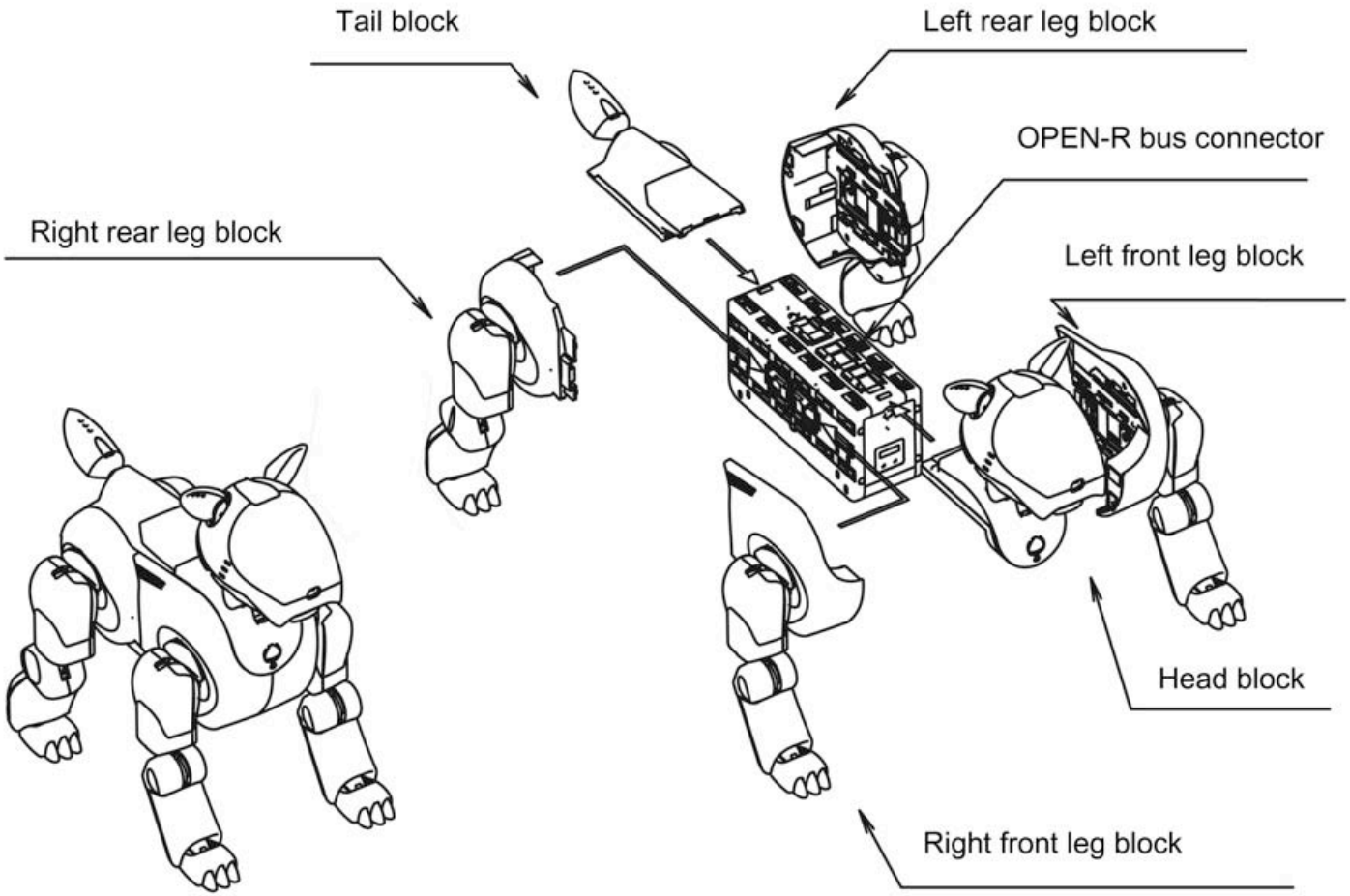
Aibo Simulation in Webots and Controller Transfer to Aibo Robot



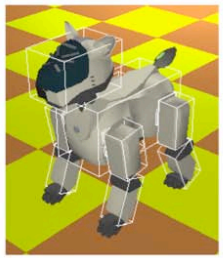
Simulation

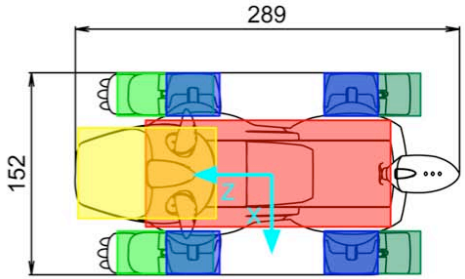
Webots Model
Graphical User Interface
Controller Program

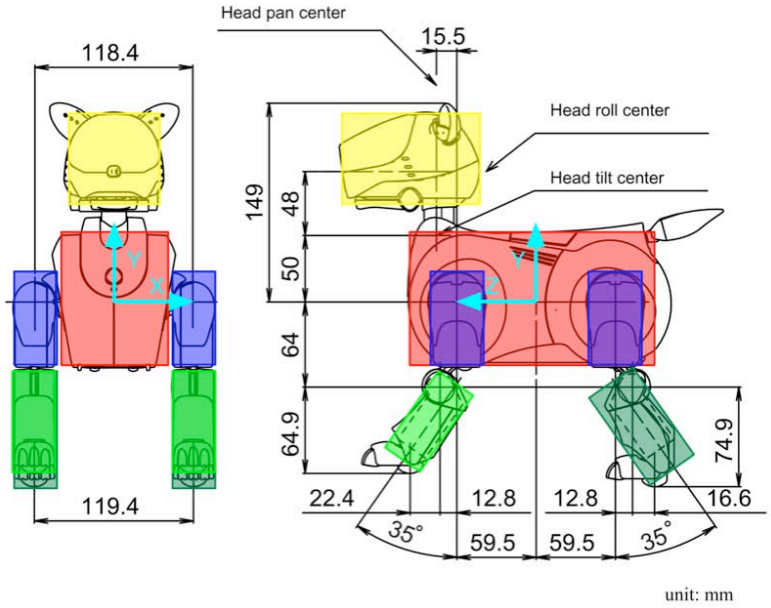
Webots Model



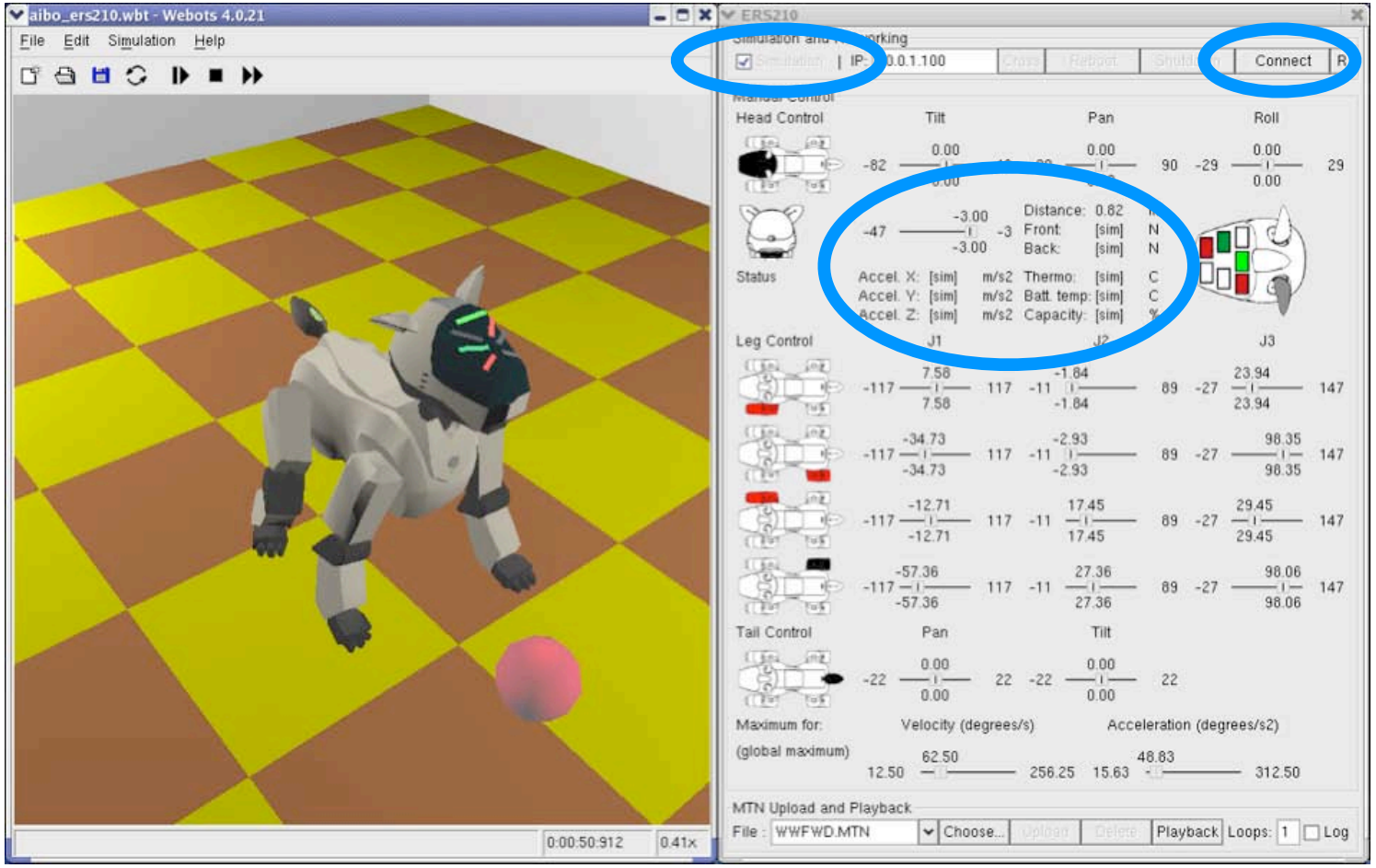
Aibo Simulation in Webots and Controller Transfer to Aibo Robot



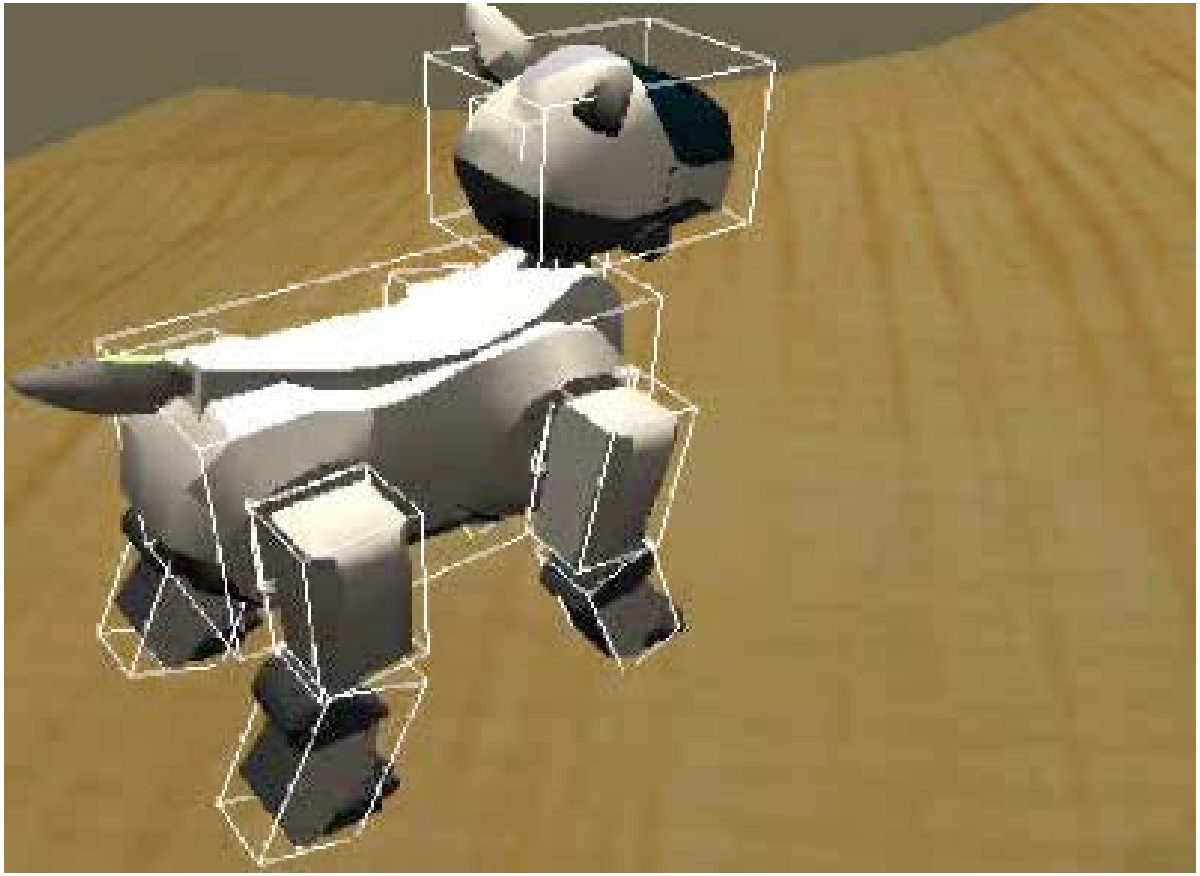




Graphical User Interface



Controller Program

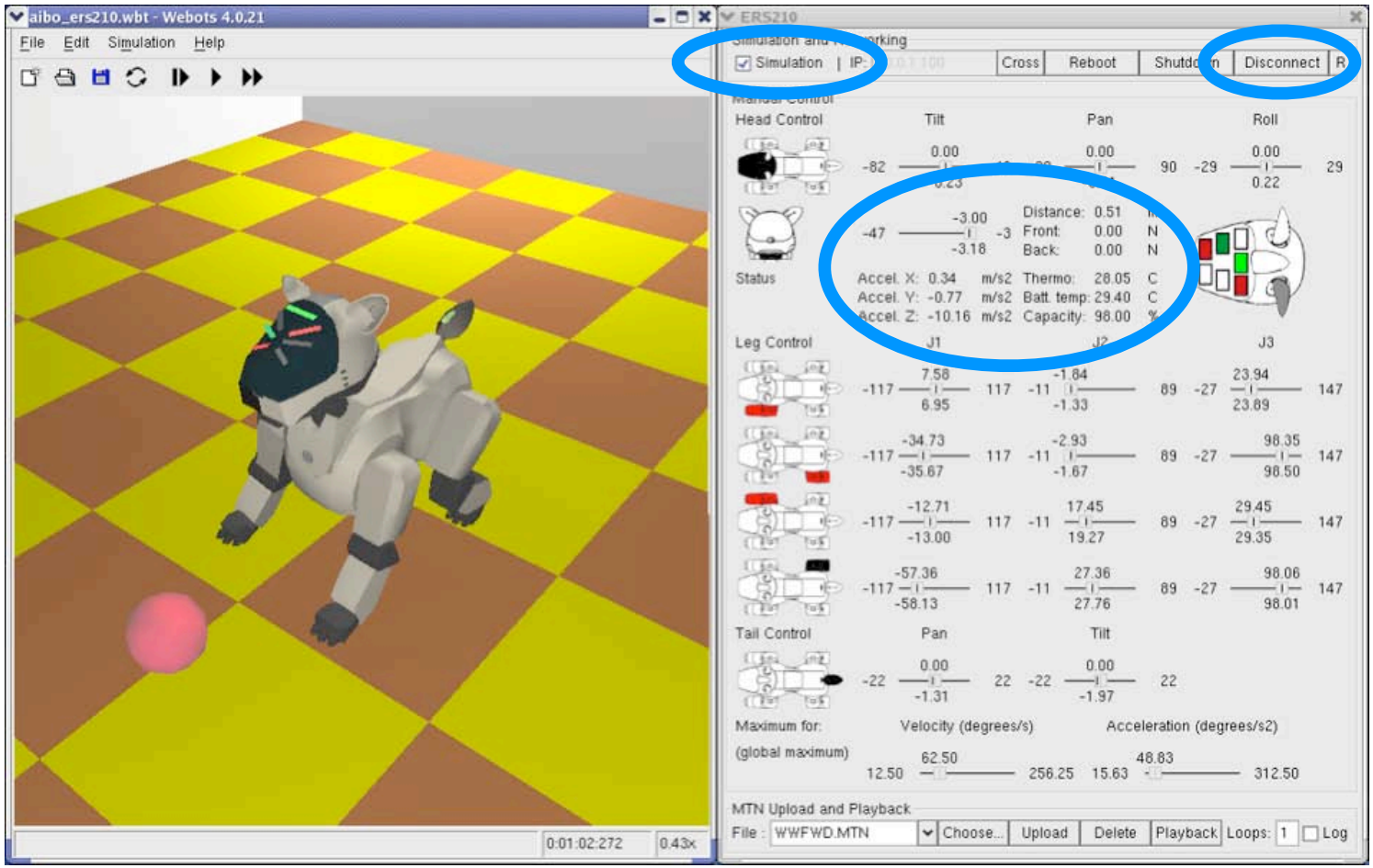


Controller Program

Remote Control

Graphical User Interface
Controller Program

Graphical User Interface



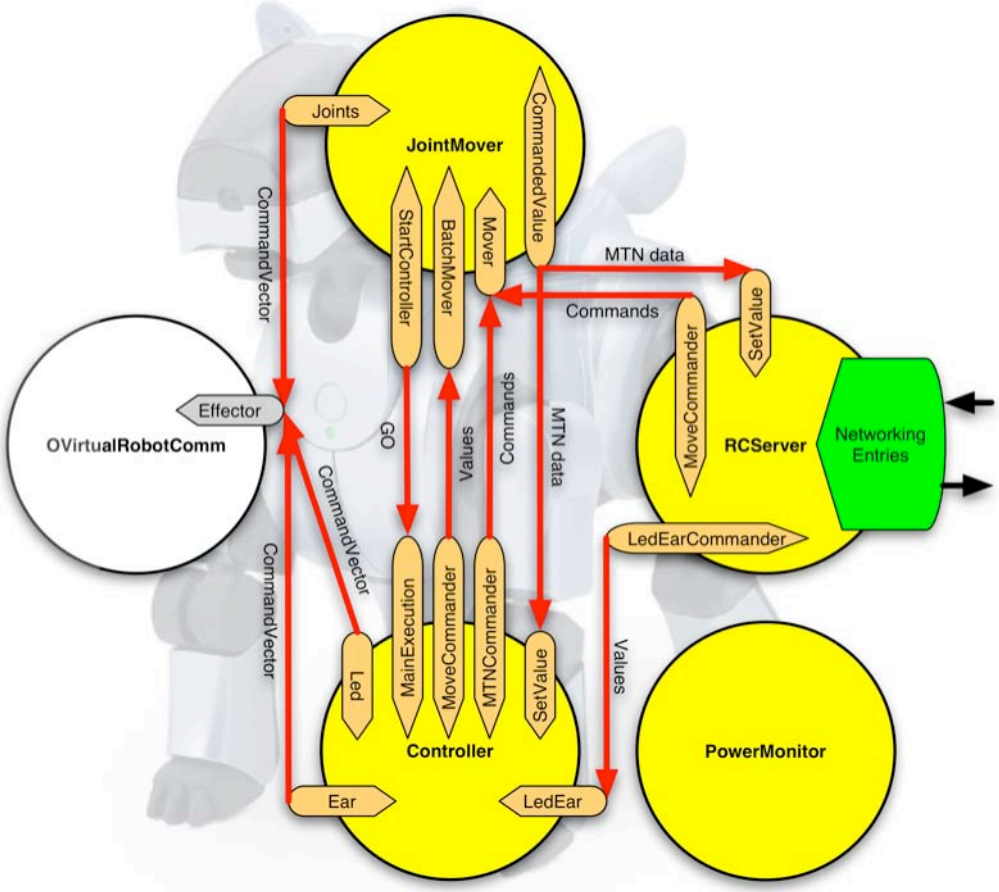
Controller Program

- Callback mechanism for simulated devices
- Under construction
- Sensor reading:
  Simulated value set to last measurement received
- Commands:
  Message sent to Aibo if difference in target value
- Limited by Communication Protocol

Cross-Compilation

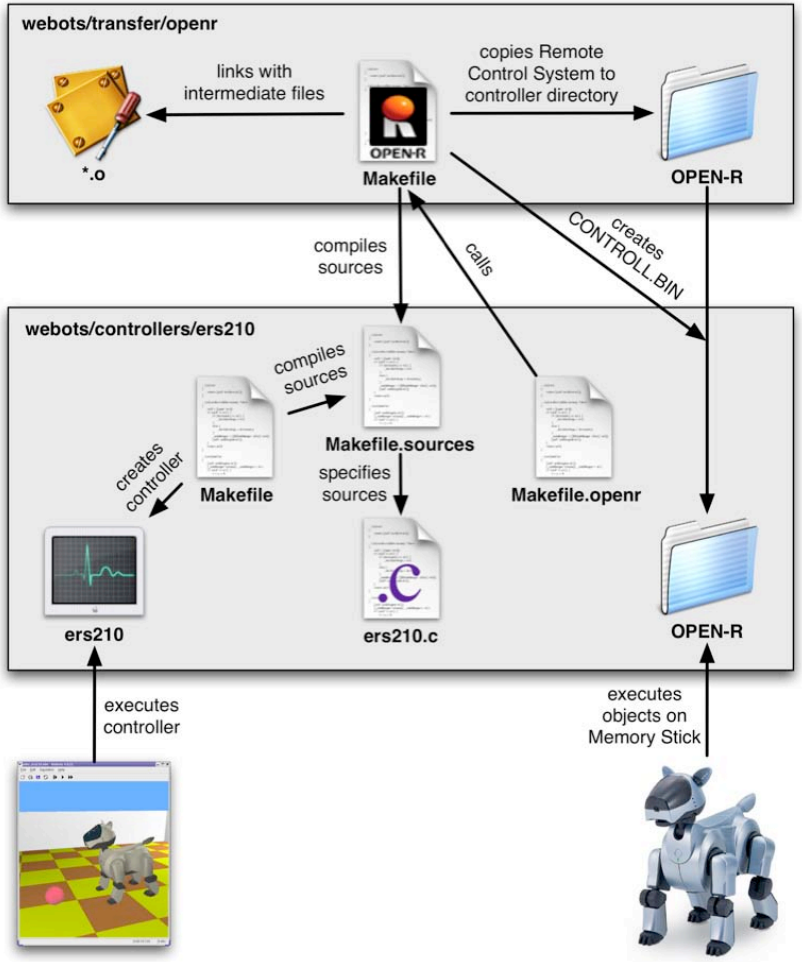
OPEN-R Objects
Cross-Compilation
Webots Controller Program vs. Aibo Programming Scheme

OPEN-R Objects



- main(): Controller
- API Translation: Controller
- LEDs & Plungers: Controller
- Joints & MTN: JointMover
- Remote Control: RCServer

Cross-Compilation



- Sony's OPEN-R Cross-Compiler
- Links intermediate files and compiled sources
- Creates binary to be put on Memory Stick
- Upload in Webots via GUI possible

```
DeviceTag led_1 = robot_get_device("PRM:/r1/c1/c2/c3/l1-LED2:l1");
// ...

led_set(led_1, touch_sensor_get_value(touch_sensor));
led_set(led_2, (distance_sensor_get_value(distance_sensor)<200));
// ...

MTN* mtn = mtn_new("WWFWD.MTN");
mtn_play(mtn);
// ...

if (mtn_is_over(mtn)) servo_motor_off(leg_left);
// ...

servo_set_position(leg_right, servo_get_position(leg_left));
// ...
```

Webots vs. Aibo

```
int main() {
  robot_live(reset);
  robot_die(die);
  for(;;) {
    // instructions
    robot_step(64);
  }
  return 0;
}
```

Infinite loop contrary to Aibo Programming Scheme

```
int run(int k) {
  // instructions
  return 64;
}

int main() {
  robot_live(reset);
  robot_die(die);
  robot_run(run);
  return 0;
}
```

Run function allows selective execution

- Webots executes `run` in infinite loop
- Aibo uses LED period for timing
- Aibo executes `run` in method handling ready notification after LED command execution
- Aibo sends new LED command vector message to robot immediately after `run`
- Implicit infinite loop on Aibo by continuous reception and sending of messages

Outlook

Other Aibo Models

Other Aibo Models

Aibo ERS-220

Aibo ERS-7

- ERS-220 almost identical to ERS-210
- Remote Control System ported to ERS-7

Modifications…

- Webots Model
- Webots Model Nodes
- Webots Controller Programming Interface
- Graphical User Interface
- Communication Protocol
- OPEN-R Objects on Aibo

How to learn more?

- Project Page @ BIRG (http://birg.epfl.ch/)
  - Report
  - ScreenShots
  - Presentation
- http://www.cyberbotics.com/
  - Webots
  - Movies

Thank you for your attention!