Webots™ 5

Fast Prototyping & Simulation of Mobile Robots

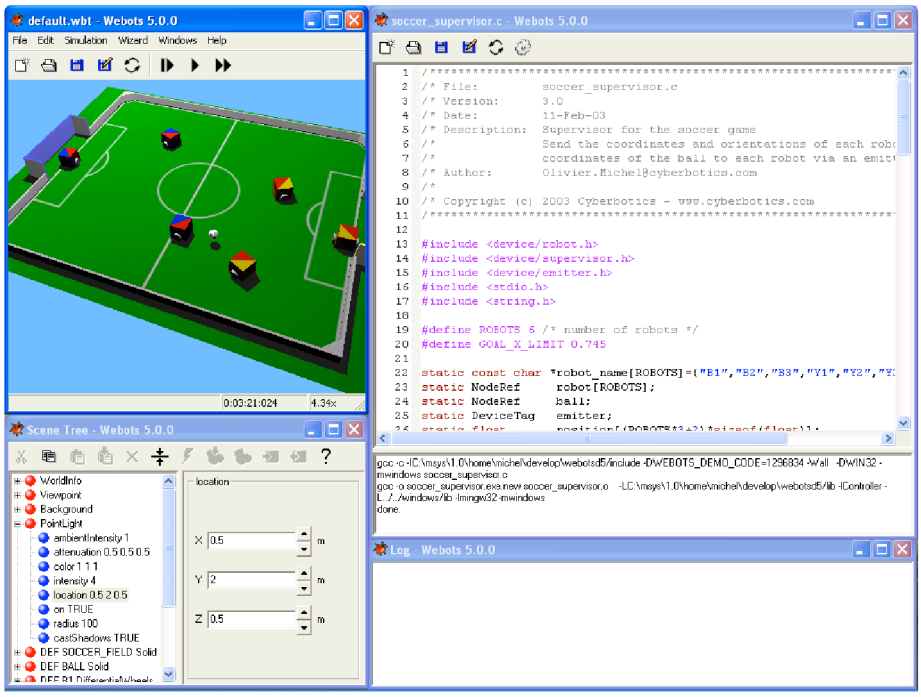
The Webots™ software is used by over 250 universities and research centers worldwide to model, program and simulate mobile robots. The included robot libraries enable you to transfer your control programs to several commercially available real mobile robots.

With Webots™, you take advantage of proven technology that has been co-developed by the Swiss Federal Institute of Technology in Lausanne, thoroughly tested, well documented and continuously maintained for over 8 years. The development time you save is enormous!

Webots™ lets you define a complete mobile robotics setup, even several different robots sharing the same environment. For each object, you can define properties, such as shape, color, texture, mass, friction, etc. You can equip each robot with a large number of available sensors and actuators. You can program these robots using the build-in IDE or your favorit development environment, simulate them and optionally transfer the resulting programs on your real robots.

KEY FEATURES

- Models and simulates any mobile robot, including wheeled, legged and flying robots
- Includes a complete library of sensors and actuators
- Uses accelerated OpenGL and built-in 3D editor for robots and world with 3D model import facilities
- Lets you program the robots in C, C++ and Java, or from third party software through TCP/IP
- Uses the ODE (Open Dynamics Engine) library for accurate physics simulation
- Transfers controllers to real mobile robots, including Aibo™, LEGO™ Mindstorms™, Khepera™ and Hemisson™
- Creates AVI or MPEG simulation movies for web and public presentations
- Includes many examples with controller source code and models of commercially available robots
- Lets you simulate multi-agent systems, with communication facilities



Webots™ screen capture.

CYBERBOTICS
professional mobile robot simulation

www.cyberbotics.com

Complete Sensor Library

A number of sensors can be plugged into your robot model and tuned individually (range, noise, response, field of view, etc.).

- Distance sensors (IR & US)
- Range finders
- Light sensors
- Touch sensors
- Global Positioning Sensor (GPS)
- Cameras (1D, 2D, color, B&W)
- Receivers
- Position and force sensors for servos
- Incremental encoders for wheels

Complete Actuator Library

Similarly, a number of actuators can be plugged into your robot model, and even be combined hierarchically:

- Differential wheel motor unit
- Independent wheel motors
- Servos (for legs, arms, etc.)
- LEDs
- Emitters
- Grippers

World and Robot editor

With Webots, you can create complex environments for your mobile robot simulations, using advanced hardware accelerated OpenGL technologies, including lighting, smooth shading, texture mapping, fog, etc. Moreover, Webots™ allows you to import 3D models from most 3D modelling software through the VRML97 standard.

You can create worlds as large as you need and Webots™ will optimize them to enable fast simulations.

Complex robots can be built by assembling chains of servo nodes. This allows you to easily create legged robots with several joints per leg, robot arms, pan / tilt camera systems, etc.

You can place several cameras on the same robot to perform binocular stereo vision, or 360 degree vision systems.

Accurate Simulation System

The simulation system used in Webots™ uses virtual time, making it possible to run simulations much faster than it would take on a real robot. Depending on the complexity of the setup and the power of your computer, simulations can run up to 300 times faster than the real robot when using the fast simulation mode.

The basic simulation time step can be adjusted to suit your needs (precision versus speed). A step-by-step mode is available to study in detail how your robots behave.

Open Physics Simulation

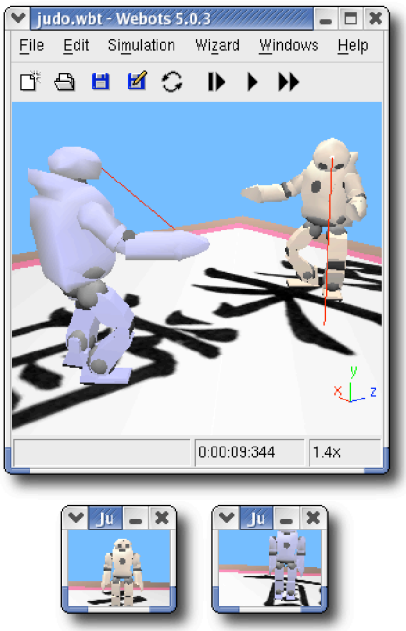
Simulating complex robotic devices including articulated mechanical parts requires precise physics simulation. Webots™ relies on ODE (Open Dynamics Engine) to perform accurate physics simulation wherever it is necessary.

For each component of a robot or solid body, you can specify a bounding object for collision detection, a mass distribution matrix (or use primitives for simple geometries), static and kinematic friction coefficients, bounciness, etc. You can also expand the physics simulation programmatically.

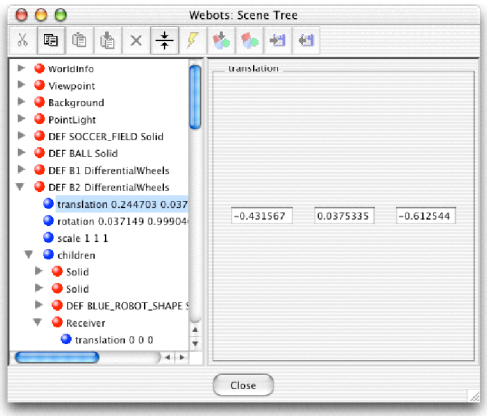
Servo devices can be controlled by your program in torque, position or velocity. The control parameters for the servo can be individually adjusted from your controller program.

Interactivity

The graphical user interface of Webots™ allows you to easily interact with the simulation while it is running. By dragging the mouse, you can change the viewpoint position, orientation and zoom using the mouse wheel. Pressing the shift key while dragging the mouse allows you to move or rotate objects. This feature facilitates interactive testing.



Models of humanoid robots engaging a wrestling game, each including 22 servos, a camera, a distance sensor, two inclinometers, four LEDs, etc.



The scene tree window allows you to add new objects and to edit all properties of objects in the simulated world.

Khepera II™

LEGO™ Mindstorms™

Aibo™ ERS-7

Controller Programming Interface

Programming your robot using the C language is as simple as this:

```
#include <robot.h>
#include <differential_wheels.h>
#include <distance_sensor.h>

static DeviceTag ir;

static void my_robot_reset() {
  ir = robot_get_device("ir");
}

static void my_robot_run(int ms) {
  if (distance_sensor_get_value(ir)>100)
   differential_wheels_set_speed(0,0);
  else
   differential_wheels_set_speed(10,10);
  return 64; /* 64 ms simulation step */
}

void main() {
  robot_live(my_robot_reset);
  robot_run(my_robot_run);
}
```

In this example, the robot is a differential wheeled robot equipped with an infra-red distance sensor named "ir" looking forward. The robot will stop moving if the distance sensor detects an obstacle and restart moving when the obstacle is no longer detected.

A similar Java programming interface is also included. Moreover, any Webots™ controller can be connected to a third party software program, such as MatLab™, LabView™, LeLisp™, etc. through a TCP/IP interface.

Supervising a robotics experiment

Research experiments often need to interact automatically with the simulation. The supervisor capability allows you to write a program responsible for supervising the experiment. Such a program can dynamically move objects, send messages to robots, record robot trajectories, add new objects or robots, etc.

The supervisor capability can be used in computationally expensive simulations where a large number of robot configurations and control parameters have to be evaluated, as in genetic evolution, neural networking, machine learning, etc.

Hemisson™

Transfer to real robots

Once tested in simulation your robot controllers can be transferred to real robots:

Khepera™: cross-compilation of C Webots™ controllers and remote control (any programming language).

Hemisson™: Finite state automata graphical programming with remote control and autonomous execution modes.

LEGO™ Mindstorms™: cross-compilation for RCX of Java Webots™ controllers based on LeJOS.

Aibo™: cross-compilation of C/C++ Webots™ controller programs based on the Open-R SDK.

Your own robot: The Webots™ user guide explains how to build your own Webots™ cross-compilation system for your very own robot.

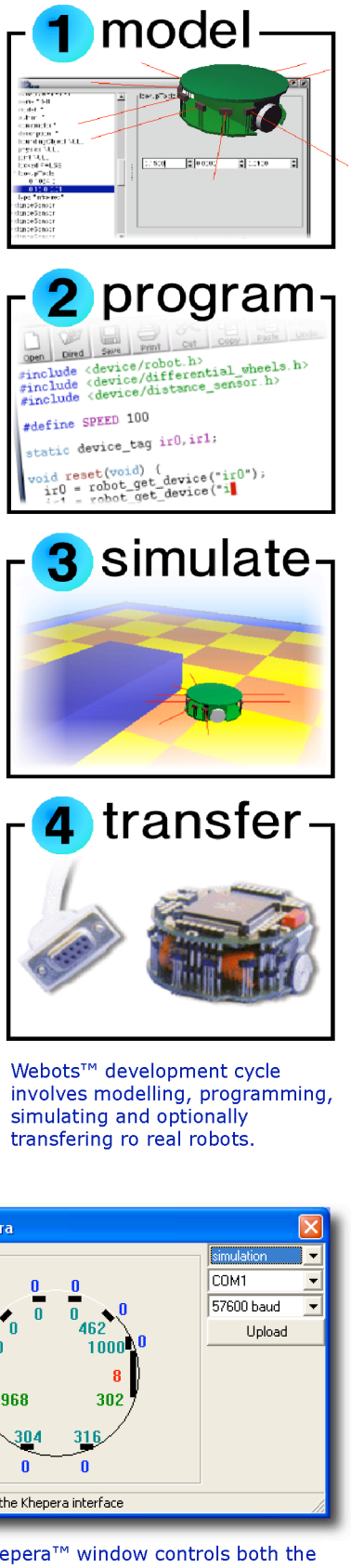
Mobile Robotics Applications

Webots™ has been used by our customers for years in many mobile robotics research applications:

- Mobile robot design and prototyping (wheeled, legged or flying robots)
- Evolution of reactive behaviors
- Multi-agent systems
- Computer vision
- Artificial Life
- Biological modelling
- Robot soccer

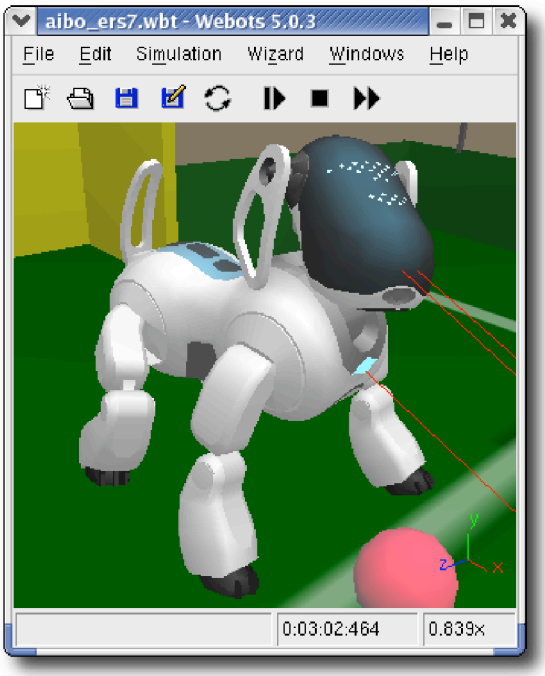
Moreover, Webots™ is used in university classrooms for teaching the following subjects:

- C/C++/Java programming
- Robotics
- Programming contests
- Robot soccer



Webots™ development cycle involves modelling, programming, simulating and optionally transfering ro real robots.

The Khepera™ window controls both the simulated and real Khepera™ robot.



Simulation of an Aibo™ ERS7, including 20 servo motors, 3 distance sensors, a color camera, 4 touch sensors, etc.

Documentation

Webots™ comes with complete documentation, including two printed manuals with full colors. This documentation is also included on the Webots CD-ROM in both PDF and HTML format.

The Webots™ user guide explains how to install and get started with Webots™. This manual includes a step-by-step tutorial for modelling and programming your own robot, and describes a number of example experiments included on the CD-ROM. It explains the basic principles of Webots™ and shows you the procedure for transfering your programs to real robots.

The Webots™ reference manual contains everything you need to develop your Webots™ application. It provides a complete description of all the objects you can simulate with Webots™, including robot bases, sensors, actuators, simple objects, etc. The programming interface is completely documented with examples. Functions are sorted by categories.

Finally a number of example worlds and controllers are provided on the CD-ROM which can serve as a starting point for developing your application.

User support: Premier service

Webots™ users take advantage of the Webots™ users community through a support mailing list. Most questions are answered within 24 hours by Cyberbotics support services. All Webots™ licenses include one year of Premier service for personalized user support, free upgrades via the Internet as well as free laptop licenses.

Webots™ PRO: the research tool

Webots™ PRO is designed for research and development projets. It includes extended capabilities to customize a robot, a fast simulation mode and the possibility to create a supervisor process for controlling robotics experiments.

Webots™ EDU: for classrooms

Webots™ EDU is tailored for classroom courses. Students learn how to model a robot, create their own environment and program the behavior of the robot. To validate their model, they can optionally transfer their control program to a real robot.

Webots™ STD: the hobbyist tool

Webots™ STD is an affordable version of Webots™ allowing the hobbyist to simulate mobile robots the easy way. This version is available only by electronic download.

Webots™	PRO	EDU	STD
Supervisor capability	✔		
Custom physics programming	✔		
Fast simulation mode	✔		
Multiple-platform (1)	✔		
Floating license option	✔	✔	
Transfer to real robots	✔	✔	
Packaged or electronic version	✔	✔	✔
1 year Premier service included	✔	✔	✔

(1) includes Windows, Linux and Mac OS X

Platform and System Requirements

Recommended minimal configuration:
- Redhat Linux 9.0/Fedora, or
- Mac OS X 10.3, or
- Windows 2000/XP/2003
- Intel Pentium IV 500 or PowerPC 400
- 256 MB RAM / 100 MB disk space
- 3D graphics card with 32MB RAM

For demos, questions and pricing information, contact us directly by e-mail, phone or fax:

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