Simple Soccer Agent
RoboCup 3D

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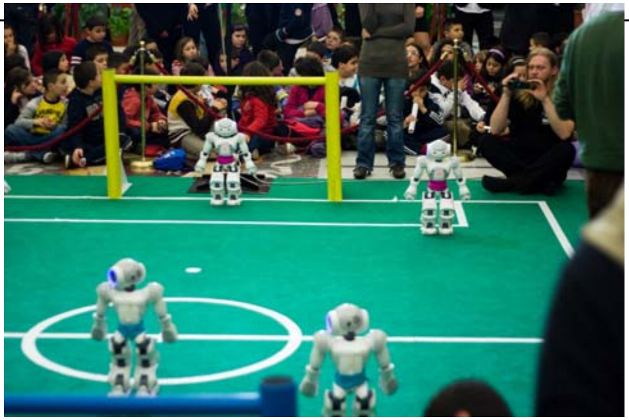
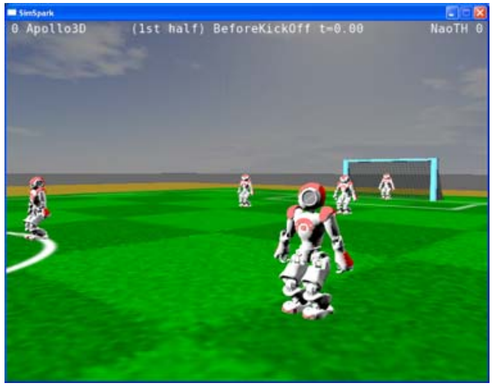
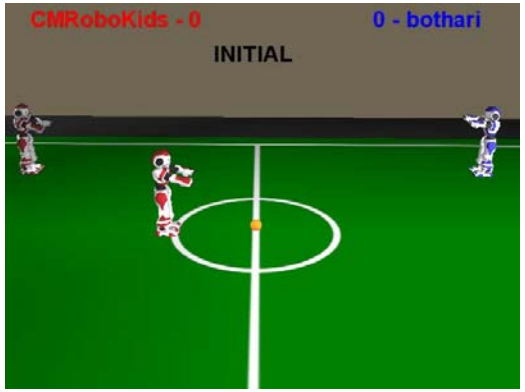
Real and simulated Nao robots

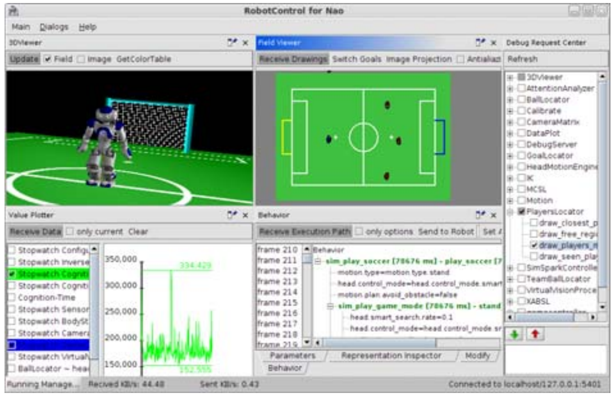
- Standard Platform League
  with NAO from Aldebaran



- 3D Simulation League with simulated NAO robots
- Webots Simualtion from Cyberbotics
- Simulation in our development tool Robot Control



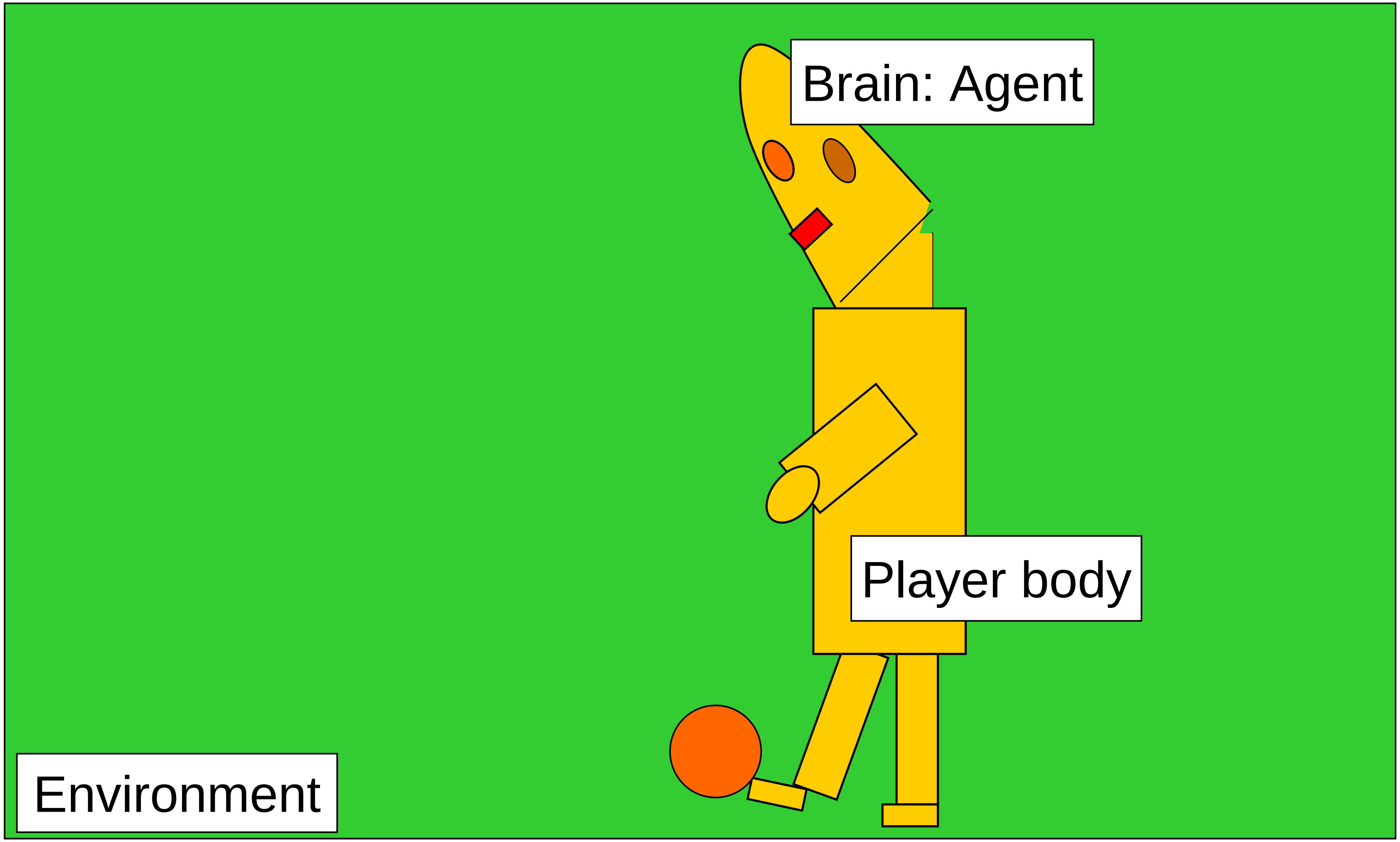




```
Behavior
⊟ sim_play_soccer [78676 ms] - play_soccer [7
    motion.type=motion.type.stand
    head.control_mode=head.control_mode.smart
    motion.plan.avoid_obstacle=false
  ⊟ sim_play_game_mode [78676 ms] - stand
      head.smart_search.rate=0.1
      head.control_mode=head.control_mode.sr
```

```
Running Manage...   Recived KB/s: 44.48   Sent KB/s: 0.43   Connected to localhost/127.0.0.1:5401
```

Robot/Agent in Real/simulated Environment



Components of Simulation

Environment:

Simulation of real soccer world

- field and ball
- referee
- body of players

Common for all teams

Individual teams

Agents:

Simulation of player control (“brain”)

Simple Soccer Agent

Download from

Thanks to helpful testers!

http://www.naoteamhumboldt.de/projects/simple-soccer-agent/

The code is derived from the code of Nao Team Humboldt which became vice champion at the RoboCup Worldchampionship Singapore 2010.

It still contains the whole structure and methods. But only a few of them are used in the Simple Soccer Agent. That allows even beginners to have an easy start and make their own experience. Later extensions are possible using more parts of the code in the provided structure.

Simple Soccer Agent

Environment (SoccerServer): *rcssserver3d.exe*

Agent: *simple-soccer-agent.exe*

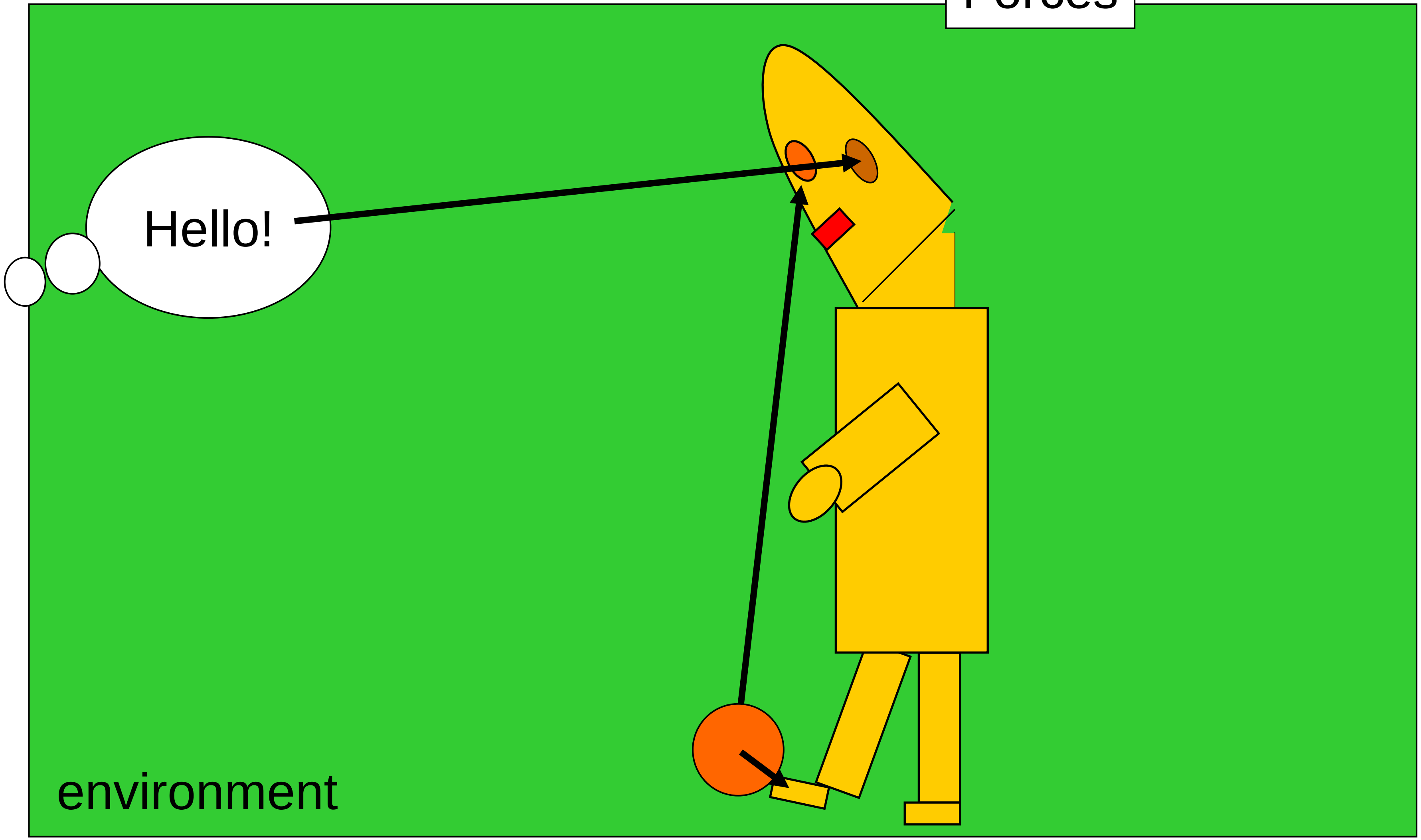
Simply start first Soccer Server and then the Agent.
It may take some time, ignore messages,
you can navigate on monitor e.g. using keys a,d,w,s,1-7

Components of Agents

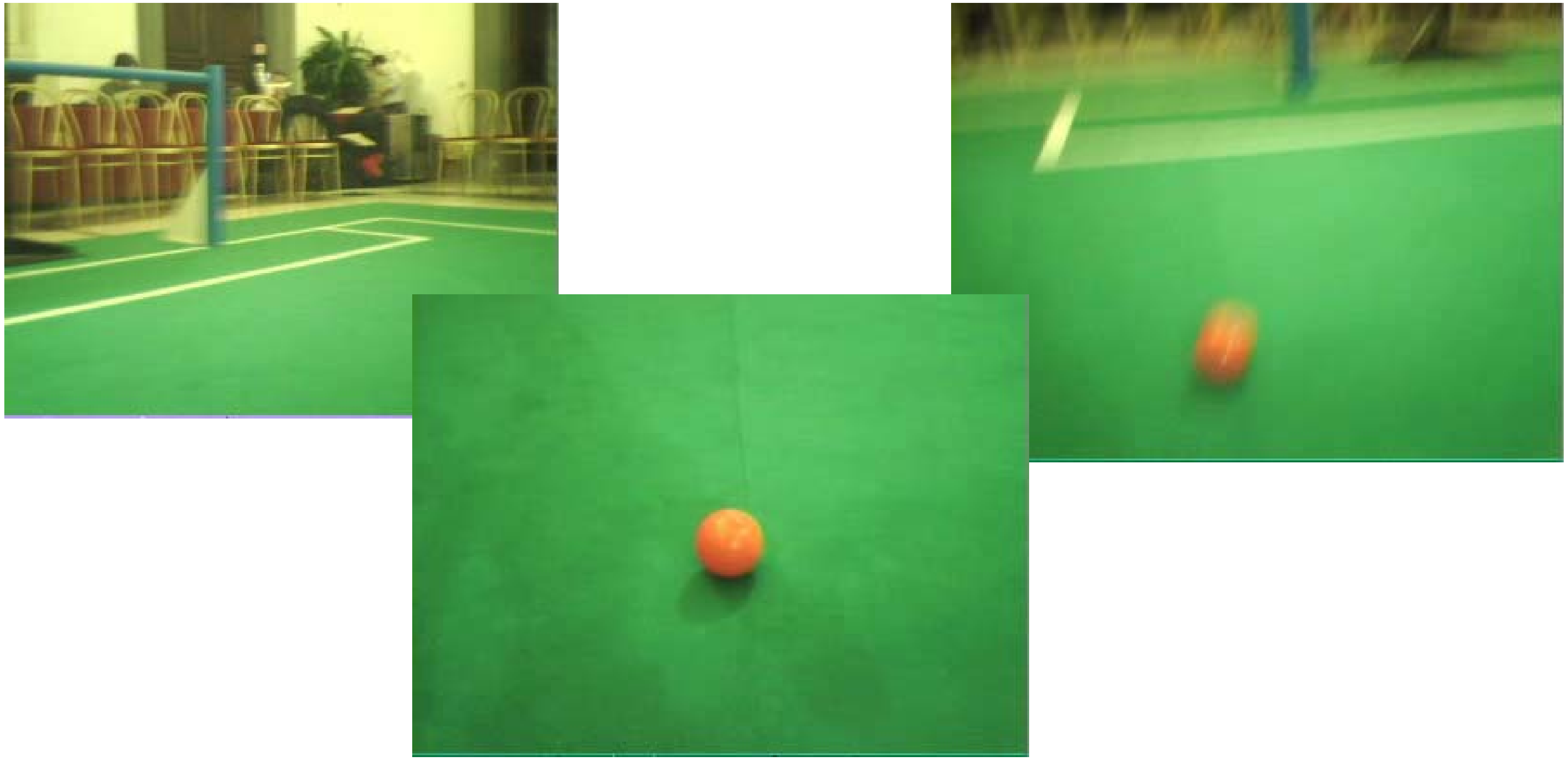
- Sensing + Perception
- Motion
- Cognition
  - Interpretation of Situation
  - Decision+Planning
- System Control, Scheduling

Sensing the outside world

Vision
Audio
Forces

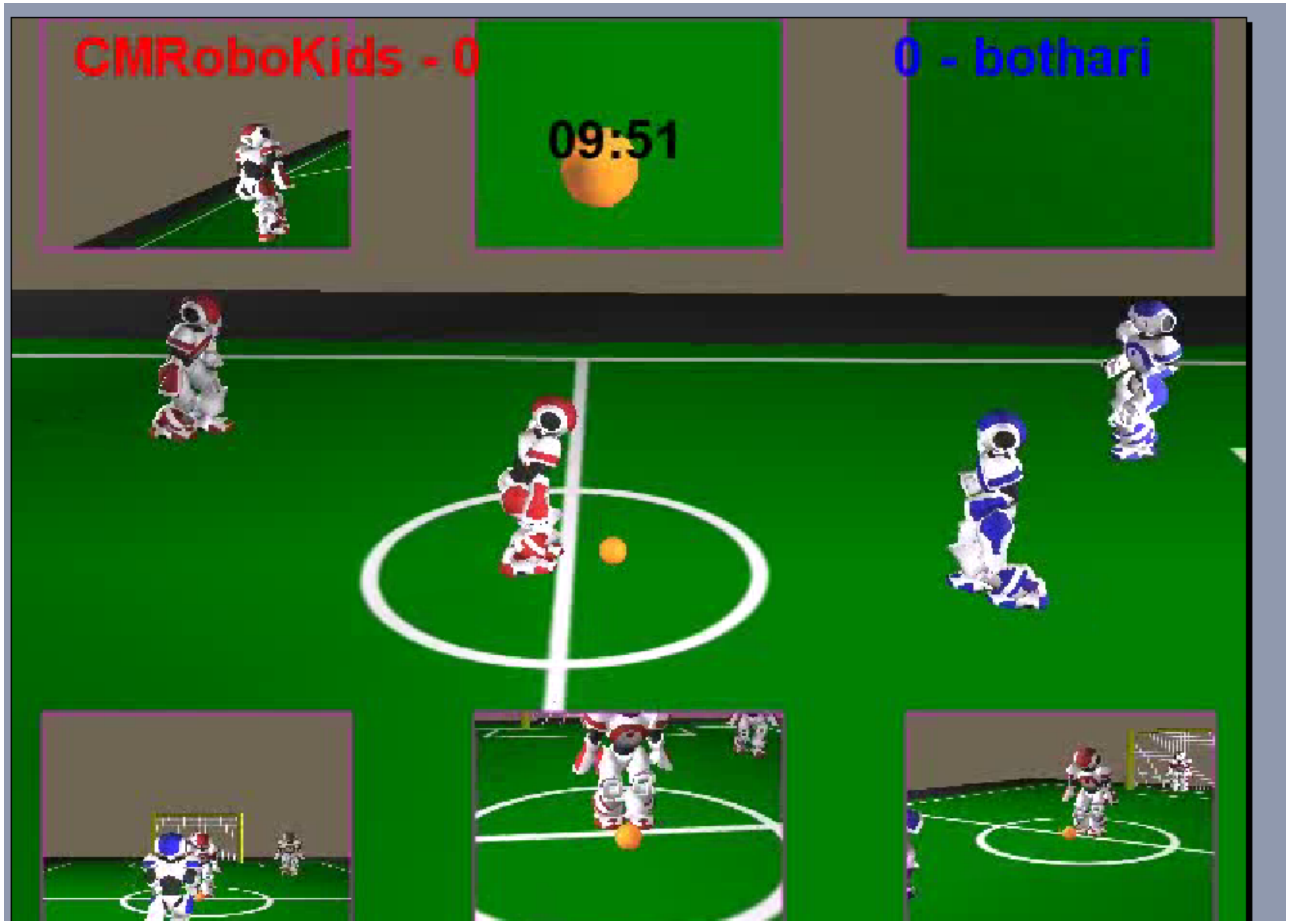


Visual Information real Nao: Images



Interpretation by image processing:
Calculate percepts

Visual Information Webots: Images



Interpretation by image processing:
Calculate percepts

Visual Information 3D-League: Percepts

No image processing, simulator provides percepts

Format:

```
(See
(<name> (pol <distance> <angle1> <angle2>))
(P (team <teamname>) (id <playerID>) (pol <distance> <angle1> <angle2>)))
```

Example:

```
(See
(G1L (pol 9.88 139.29 -21.07))
(G2L (pol 8.40 -156.91 -25.00))
(B (pol 18.34 4.66 -9.90))
(P (team RoboLog) (id 1) (pol 37.50 16.15 -0.00)))
```

Force Resistance Perceptor in 3D-League

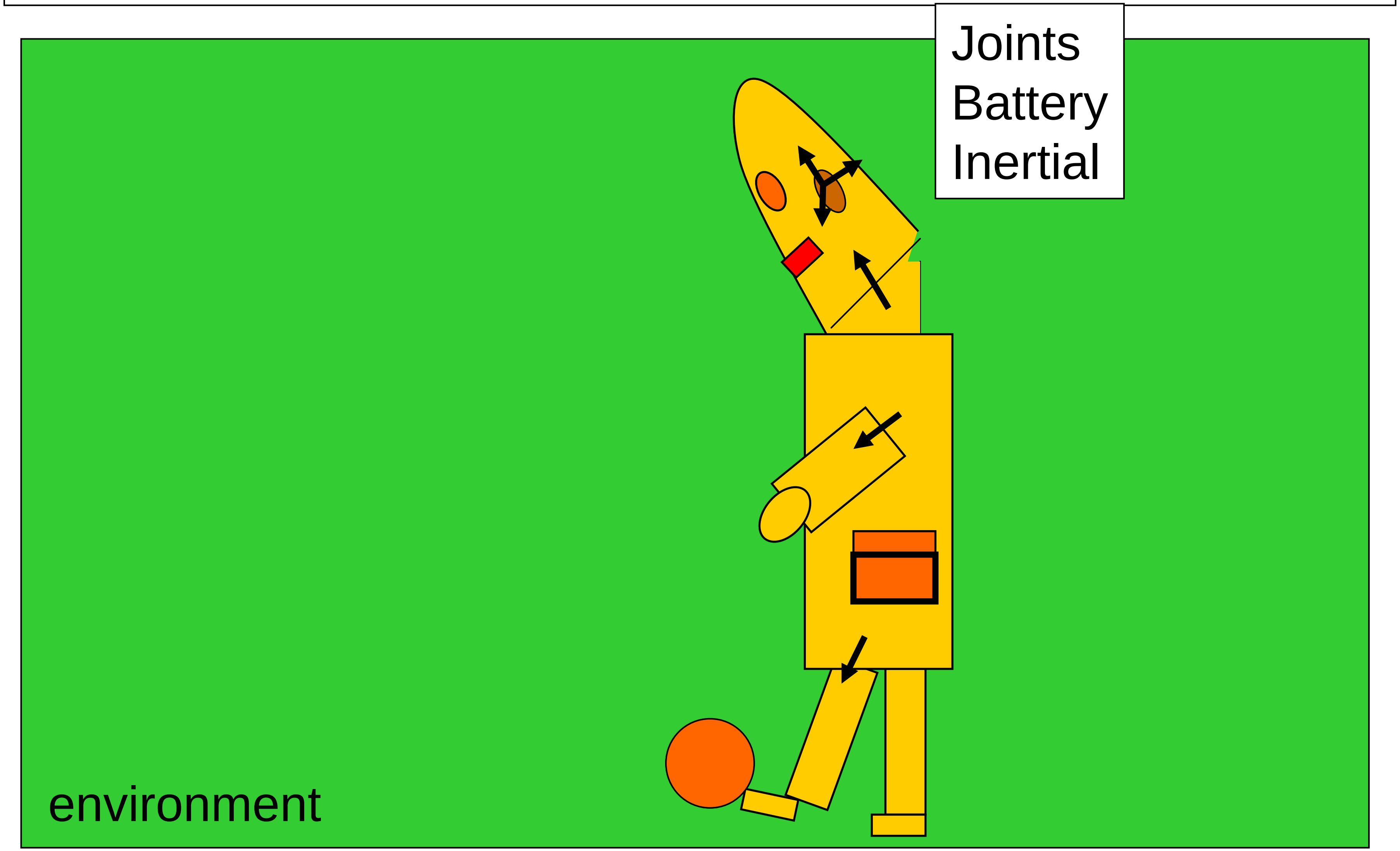
Format:

```
(FRP
(n <name>)              body part
(c <px> <py> <pz>)   point on the body
(f <fx> <fy> <fz>))     force vector
```

Example:

```
(FRP
(n lf)
(c -0.14 0.08 -0.05)
(f 1.12 -0.26 13.07))
```

Sensing the Own Body (Proprioception)



Joints
Battery
Inertial

Proprioception 3D-League: Percepts

Battery

Format :

(AgentState (temp <degree>) (battery <percentile>))

Example:

(AgentState (temp 48) (battery 75))

Accelerometer (acceleration relative to free fall).

Format:

(ACC (n <name>) (a <x> <y> <z>))

Example:

(ACC (n torso) (a 0.00 0.00 9.81))

Experiences for Sensing

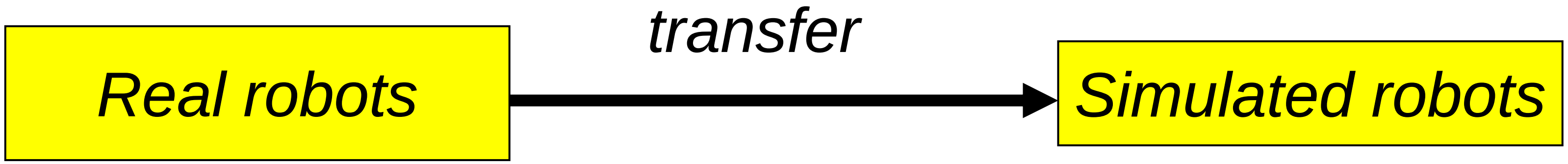
Real world is very noisy (no chance!).

Difficult (impossible?) to simulate realistic noise.

Methods developed for simulation tend to fail in reality.

Methods developed for reality work in simulation

- -are some kind of overkill
- -simulation can test for principle functioning

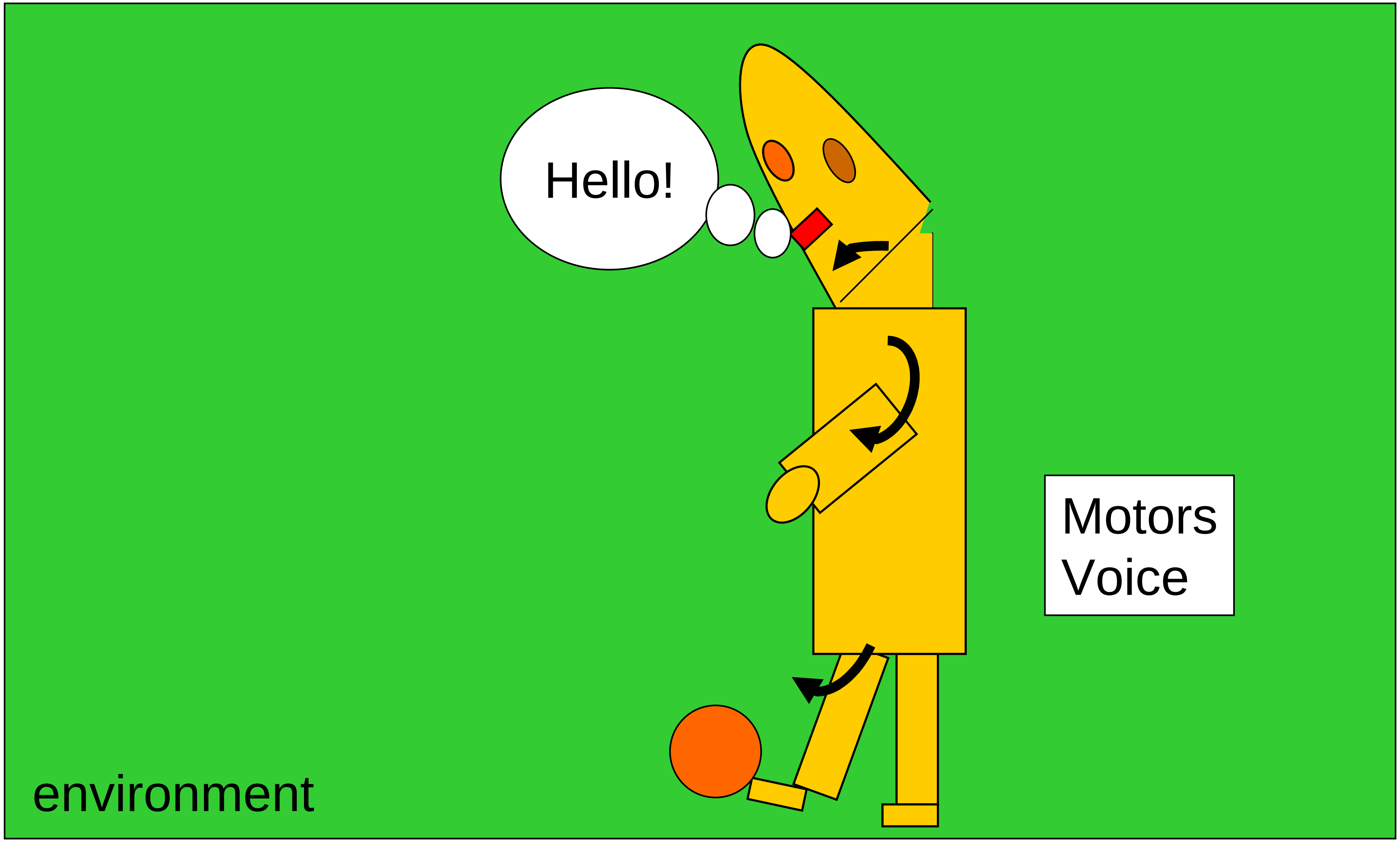


Real robots

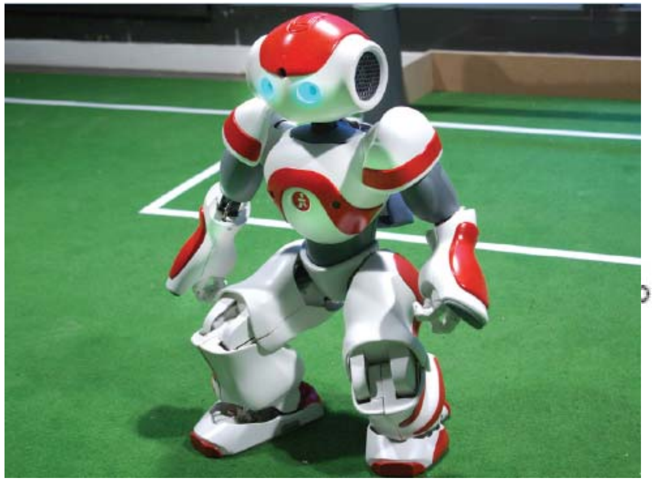
transfer

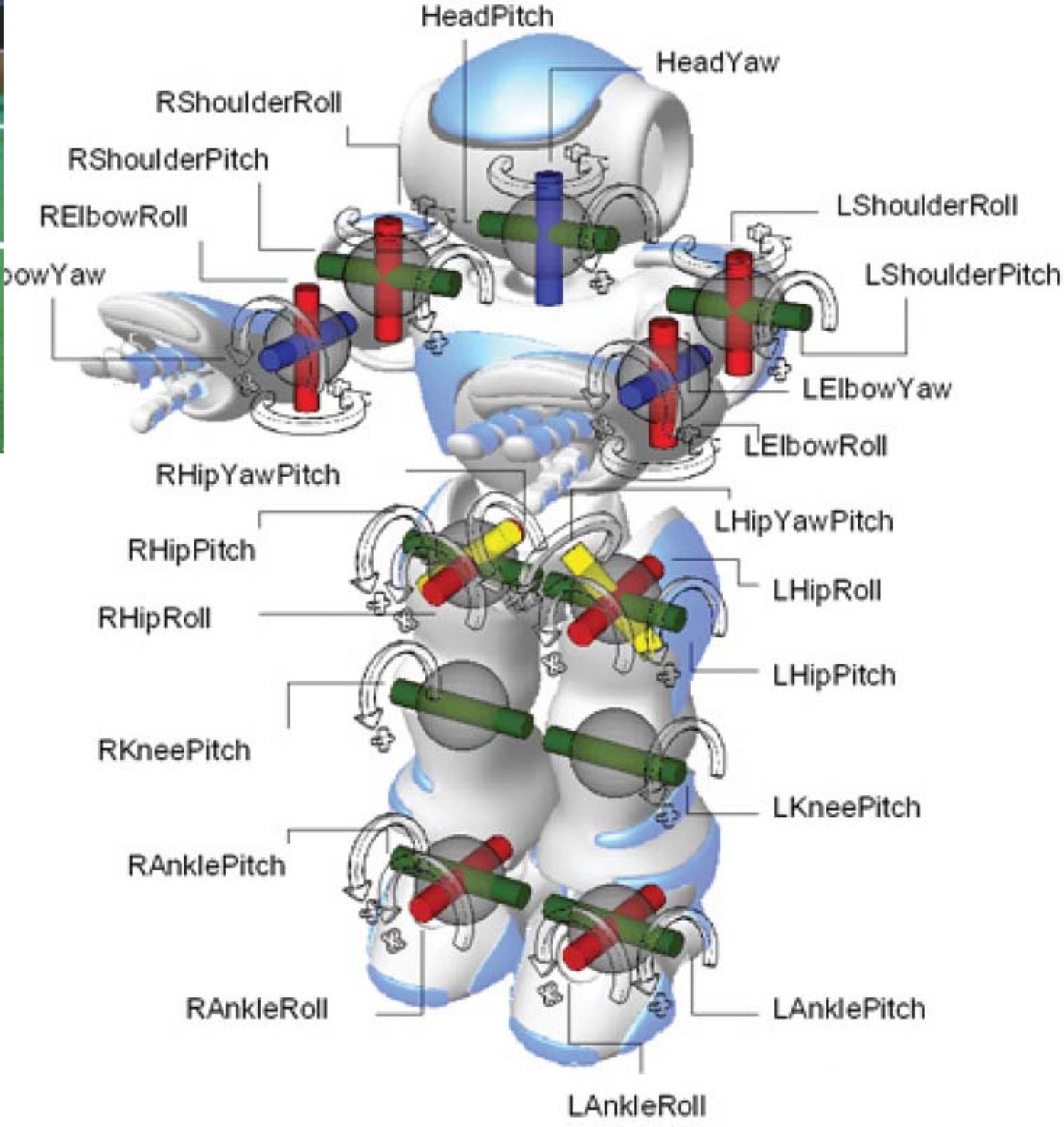
Simulated robots

Actuation



Actuation of Nao from Aldebaran





21 Servo-Motors:

- 2 per head
- 4 per arm
- 5 per leg
- 1 hip

Actuation: Keyframe

Complete set of joint angles to be set in given time

Time 1000

HeadPitch HeadYaw 0

RShoulderPitch LShoulderPitch 120

RShoulder RollLShoulderRoll 0

RElbowRoll 90

LElbowRoll -90

RElbowYaw 90

LElbowYaw -90

RHipYawPitch LHipYawPitch 0

RHipPitch LHipPitch -31

RHipRoll LHipRoll 0

RKneePitch LKneePitch 63

RAnklePitch LAnklePitch -31

RAnkleRoll LAnkleRoll 0

Motion skill: Set of keyframes

```
500 0 0 84 84 -15 15 58 -58 0 0 0 0 0 0 0 0 0 0 0 0 0 0
500 21 0 110 62 -60 32 58 -58 69 -69 0 0 -12 10 -8 -8 0 0 9 -12 11 14
500 31 -5 110 62 -46 46 59 -59 69 -69 0 0 -18 10 0 0 0 0 9 -17 4 5
500 21 0 110 62 -32 60 59 -59 69 -69 0 0 -12 10 8 8 0 0 3 -13 -14 -11
500 21 0 97 75 -32 60 59 -59 69 -69 0 0 -12 -6 8 8 15 36 -7 -27 -14 -11
500 21 0 86 86 -32 60 59 -59 69 -69 0 0 -13 -42 8 8 30 69 -23 -11 -14 -11
500 21 0 62 110 -32 60 59 -59 69 -69 0 0 10 -12 8 8 0 0 -13 9 -14 -11
500 31 -5 62 110 -46 46 59 -59 69 -69 0 0 10 -18 0 0 0 0 -17 9 -5 -4
500 21 0 62 110 -60 32 58 -58 69 -69 0 0 10 -12 -8 -8 0 0 -12 3 11 14
500 21 0 75 97 -60 32 59 -59 69 -69 0 0 -6 -12 -8 -8 36 15 -27 -7 11 14
500 21 0 86 86 -60 32 59 -59 69 -69 0 0 -42 -12 -8 -8 69 30 -11 -23 11 14
```

FILE walk_forward.txt
in SimpleSoccerAgent\keyframes

Motion skills

Implementation by

- Predefined keyframes
- Inverse cinematics
- Neural control

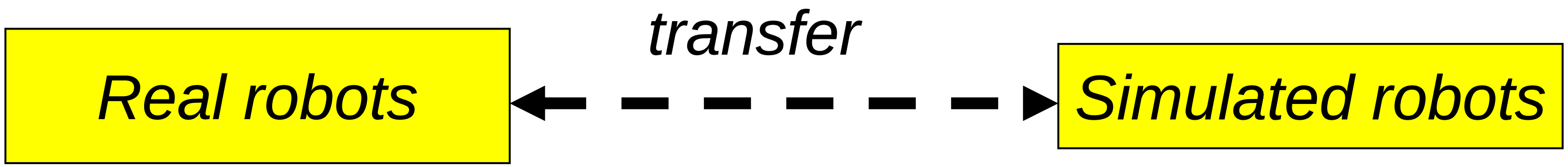
Development by

- Machine learning
- Teaching
- Modeling

Experiences for Actuation

General principles can be transferred in both directions.

Each platform needs fine tuning for different physical effects.



transfer

Real robots

Simulated robots

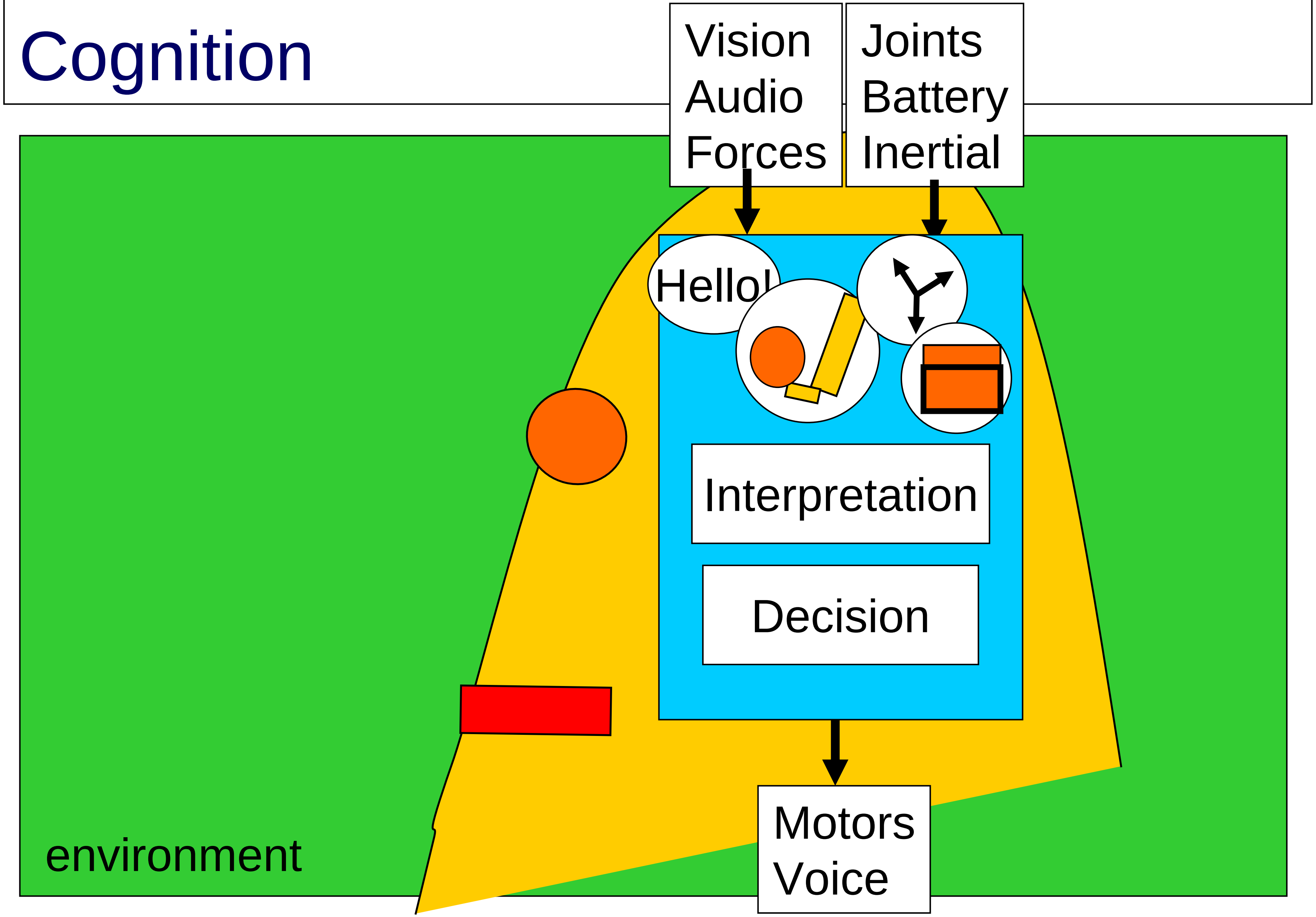
Keyframe development easier with real robots (teaching).

Machine Learning easier with simulation.

Compromise:

Learning on real robots with primary evaluation in simulation.

Cognition


Vision
Audio
Forces
Joints
Battery
Inertial
Hello!
Interpretation
Decision
Motors
Voice
environment

Cognition

- Interpretation: What is the world about
- Decision: What should I do (planning, usage of skills)

```
IF NOT ball_seen THEN TURN
                               ELSE walk_forward
```

Cognition: World Model

Interpretation of percepts

Keep track of outside situation by

- Remember where objects were seen in past
- Anticipate changes

Where am I?

Cognition: Decision and Planning

- Choice of goals
- Choice of related skills

according to belief about outside world

What to do now?

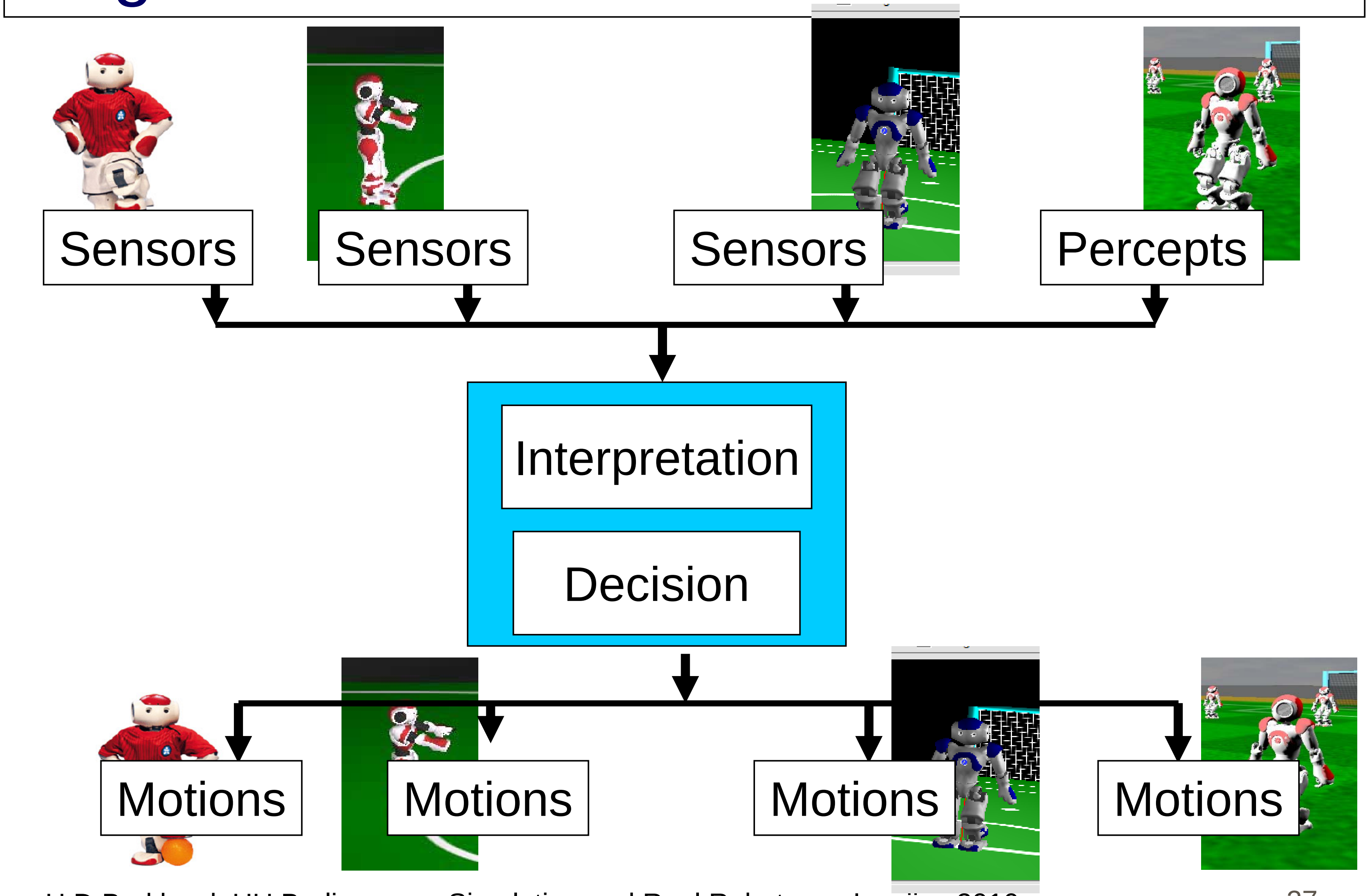
Example: Very Simple Cognition

```
void Cognition::percetion()
{ if (ballData != theVirtualVision.data.end())
  { theBall.wasSeen = true;
    theBall.distance = ballData->second[0];  }
  else  { theBall.wasSeen = false;} }

void Cognition::decide()
{if ( theBall.wasSeen )
  { Motion::request(Motion::walk_forward) }
  else {Motion::request(Motion::turn_left); }}
```

Fragment from
FILE Cognition.cpp

Cognition: Common Part for all Platforms



Sensors

Sensors

Sensors

Percepts

Interpretation

Decision

Motions

Motions

Motions

Motions

Experiences for cognition

Identical parts in reality and simulation

Real robots
Simulated robots

Unification helps to understand problems.

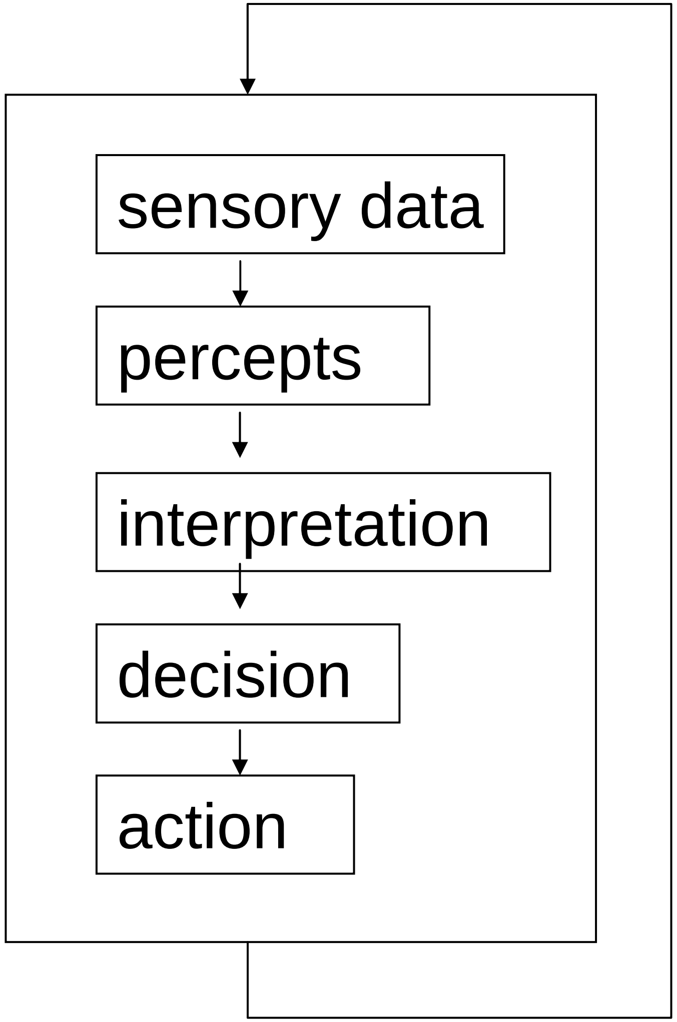
Development and evaluation as convenient.

System Control and Scheduling

Scheduling of components.

Synchronization.

Communication.



Experiences for System Control

Real robots
Simulated robots

Common principle: Blackboard Architecture
(inheritance from German Team)

Useful for all platforms

Different specifications concerning

- Communication
- Time
- Hardware

General Experiences

Real world is very noisy w.r.t. sensing and effects of motions.

Difficult (impossible?) to model by simulation.

Simulation works on simplified models.

To deal with noise: use redundancies.

Sensors and Motions are platform dependent.

Principles can be transferred.

Development/evaluation by simulation is helpful.

General Experiences

Advantages of simulation:

- Useful for Machine learning.
- More experiments.
- Simplier tests.

Advantages of real robots:

- Smoothness by physics (e.g. inertia)
- Regularities of noise

Try by yourself!

The behavior is very simple – changes are easy.

To change motions you simply need to change the motion files in SimpleSoccerAgent\keyframes

e.g. the file walk_forward.txt for

- faster walk.
- Macedonian dancing.

It will work without new compilation.

Or you create new files e.g. for kick (which then must be called by cognition)

Try by yourself!

The behavior is very simple – changes are easy.

To change behavior (e.g. for better coordination) you simply need to change the files Cognition.cpp und Cognition.h accordingly.

Then of course you need re-compilation (it is prepared for using Visual Studio).

Try by yourself!

The behavior is very simple – changes are easy.

For better behavior you will need more percepts.
The cognition files (Cognition.cpp und Cognition.h)
of the Simple Soccer Agent provides examples
for usage

More Information

Can be found on the CD

Hope you will have fun!

RoboCup:
http://www.robocup.org/   (RoboCup Federation)
http://www.robocup2011.org/en/ (World Championship 2011 Istanbul)

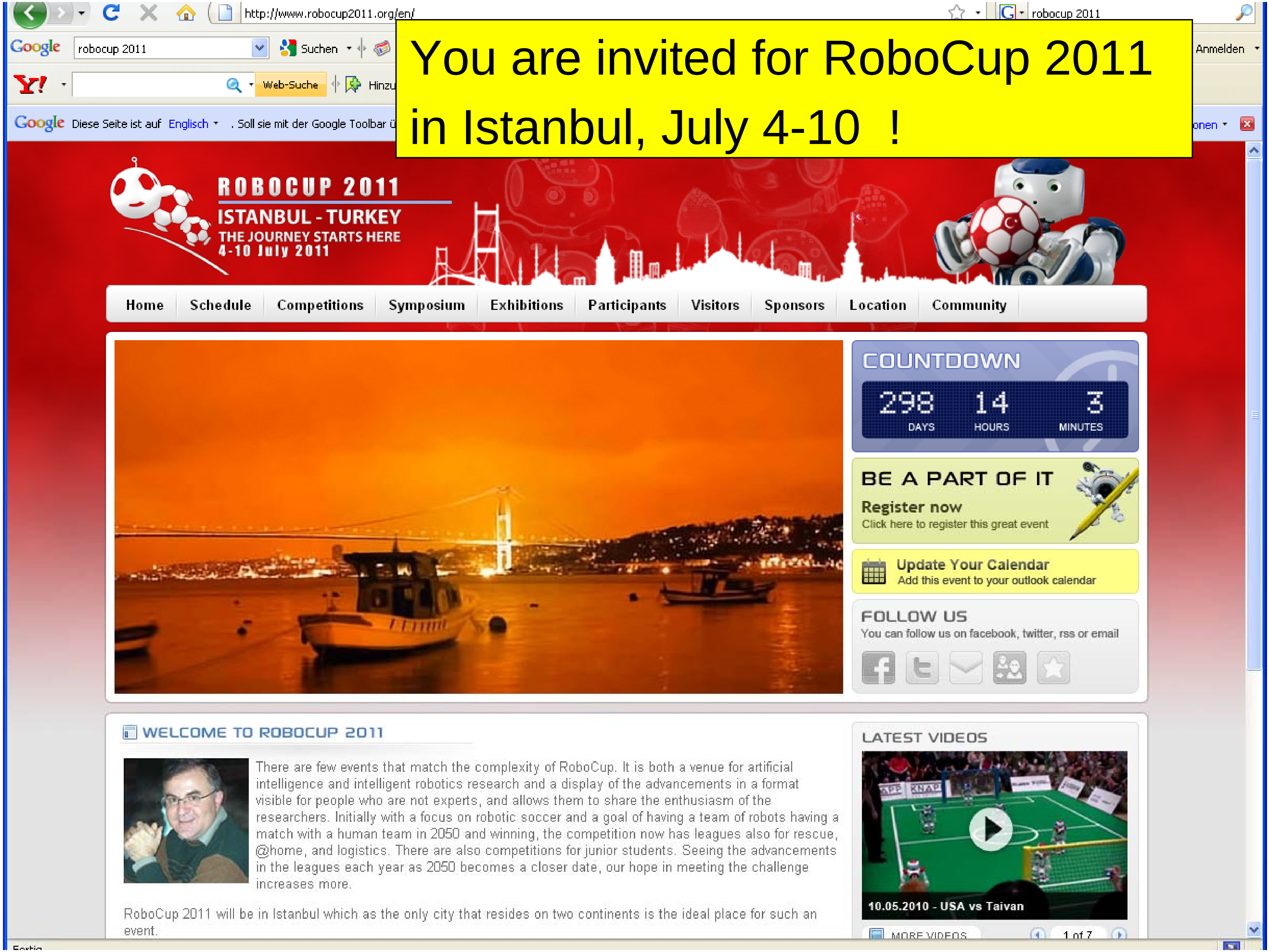
3D-Simulation-League :
http://simspark.sourceforge.net/
http://simspark.sourceforge.net/wiki/index.php/Soccer_Simulation

Standard-Platform-League (real Nao)
http://www.tzi.de/spl/bin/view/Website/WebHome

Mailing lists
https://lists.sourceforge.net/lists/listinfo/sserver-three-d
https://lists.cc.gatech.edu/mailman/listinfo/robocup-nao

Nao Team Humboldt:
http://www.naoteamhumboldt.de/

You are invited for RoboCup 2011 in Istanbul, July 4-10 !



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WELCOME TO ROBOCUP 2011

There are few events that match the complexity of RoboCup. It is both a venue for artificial intelligence and intelligent robotics research and a display of the advancements in a format visible for people who are not experts, and allows them to share the enthusiasm of the researchers. Initially with a focus on robotic soccer and a goal of having a team of robots having a match with a human team in 2050 and winning, the competition now has leagues also for rescue, @home, and logistics. There are also competitions for junior students. Seeing the advancements in the leagues each year as 2050 becomes a closer date, our hope in meeting the challenge increases more.

RoboCup 2011 will be in Istanbul which as the only city that resides on two continents is the ideal place for such an event.

LATEST VIDEOS

10.05.2010 - USA vs Taivan

MORE VIDEOS 1 of 7