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The RoboCup Humanoid Challenge

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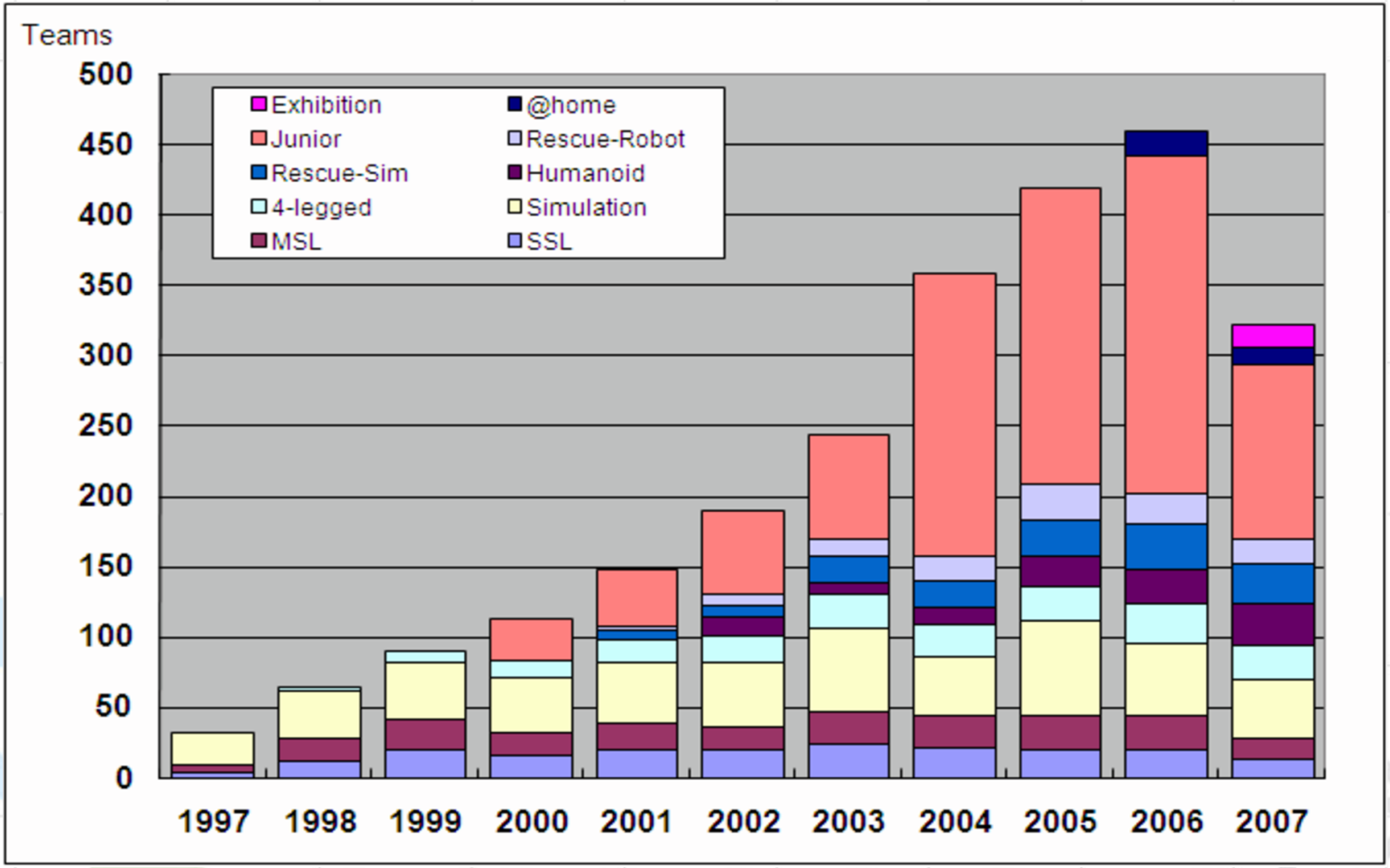
Atlanta 2007: 1st Human vs. Robot Match

In the year 2050 a team of [humanoid] robots is going to win against the human world champion

Overview over the participating teams in RoboCup since 1997



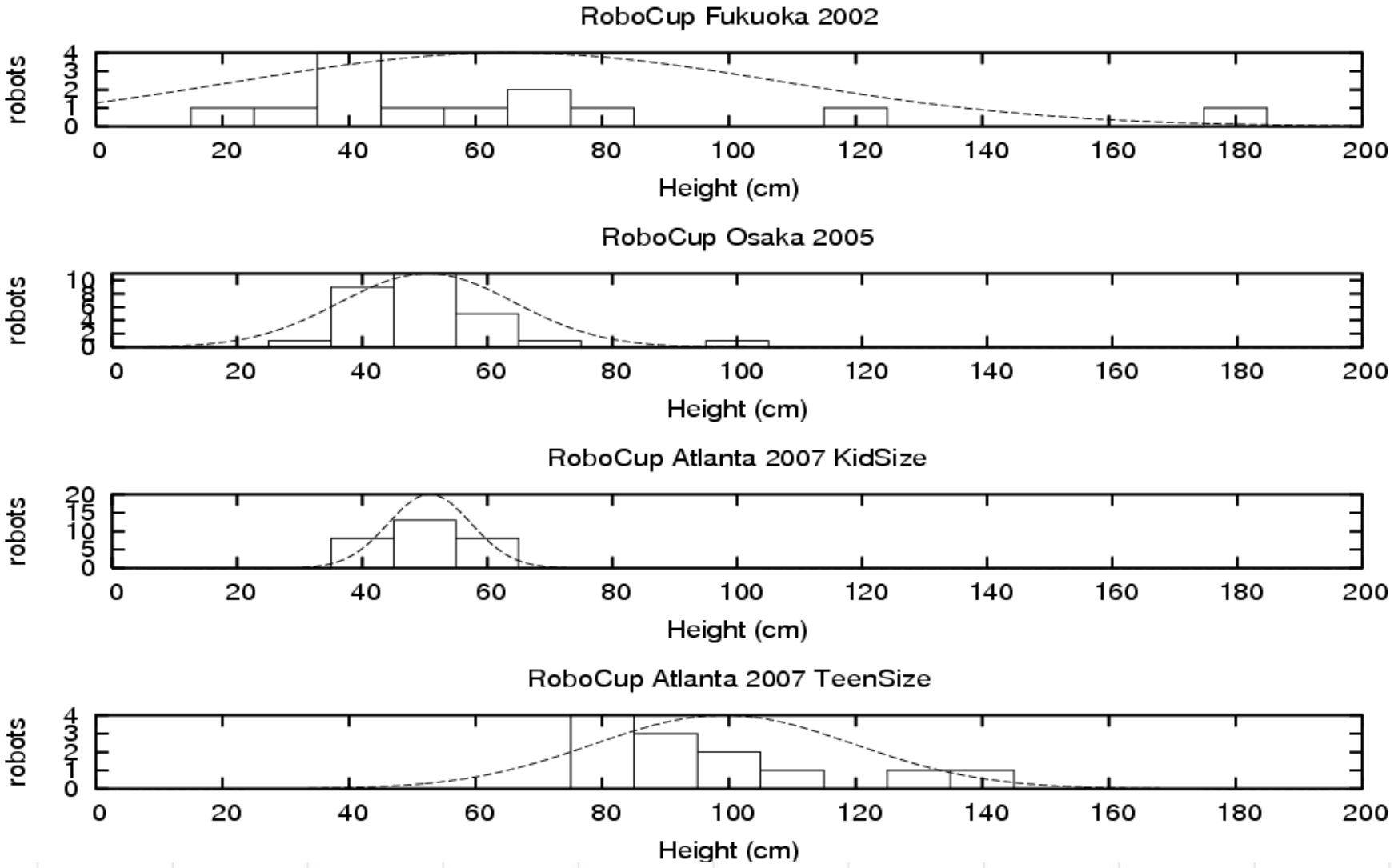
RoboCup Humanoid League since 2002

(2002)

2 size classes:
- KidSize (<60cm)
-TeenSize(>1m)

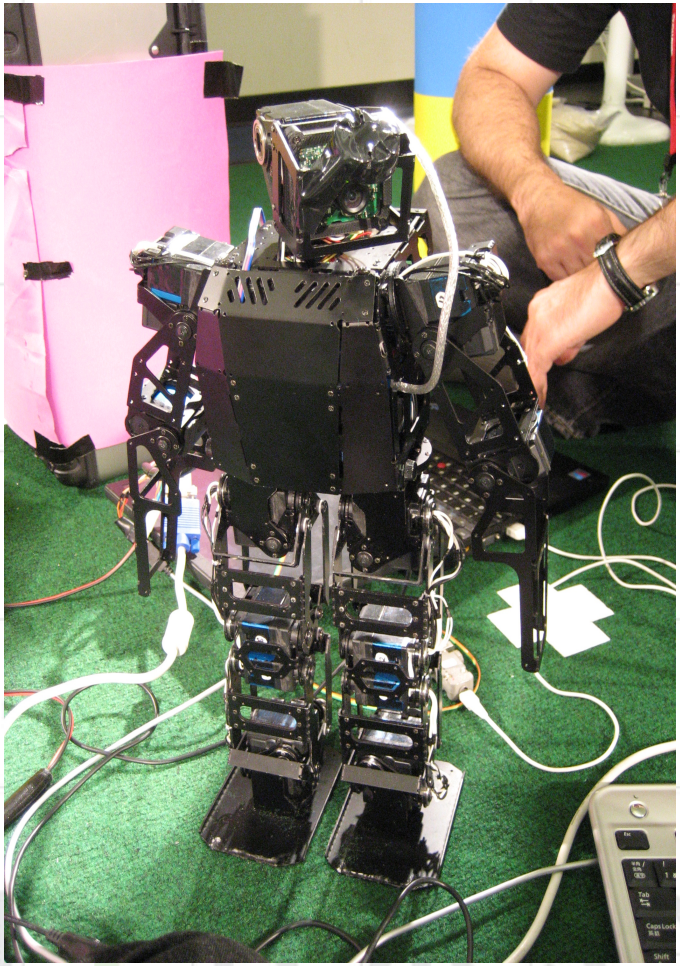
(2007)

Evolution of the HL: Distributions of heights



Standard KidSize robot hardware (example 4G)

- mini PC and micro-controller
- RC-servos
  - digital communication in serial bus
- around 20 degrees of freedom
- camera(s) in the head
- acceleration/gyro sensors



Issues

- Robots are still not robust and versatile enough
  - batteries
  - actuators
- Active balancing
  - Good walking performance on even, hard surfaces, but poor performance on uneven surfaces
- Complex motion planning
  - Only a limited set of motions (walk, turn, kick, stand up)
  - Only limited switching between motions
- Human robot interaction
  - gestures, voice, ...,safety
- Vision
  - all leagues have problems with vision

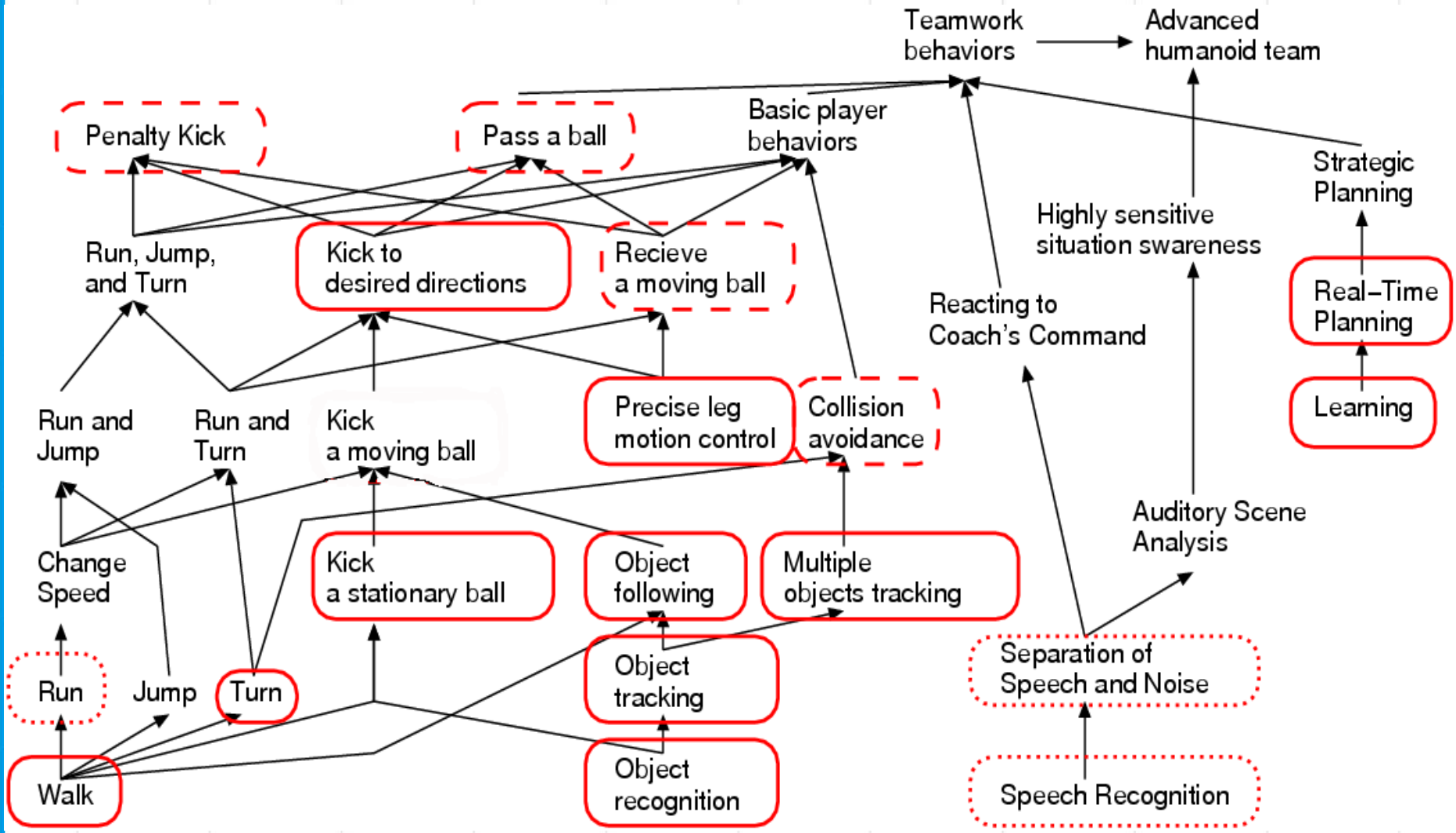
Planned changes 2008

- 3-3 games in Kid, same field size for Teen and Kid
- Minimum height in TeenSize now 1m
- 360 degree vision is going to be banned
- maximum foot size further reduced
- Teen PK more challenging

changes within 10 years

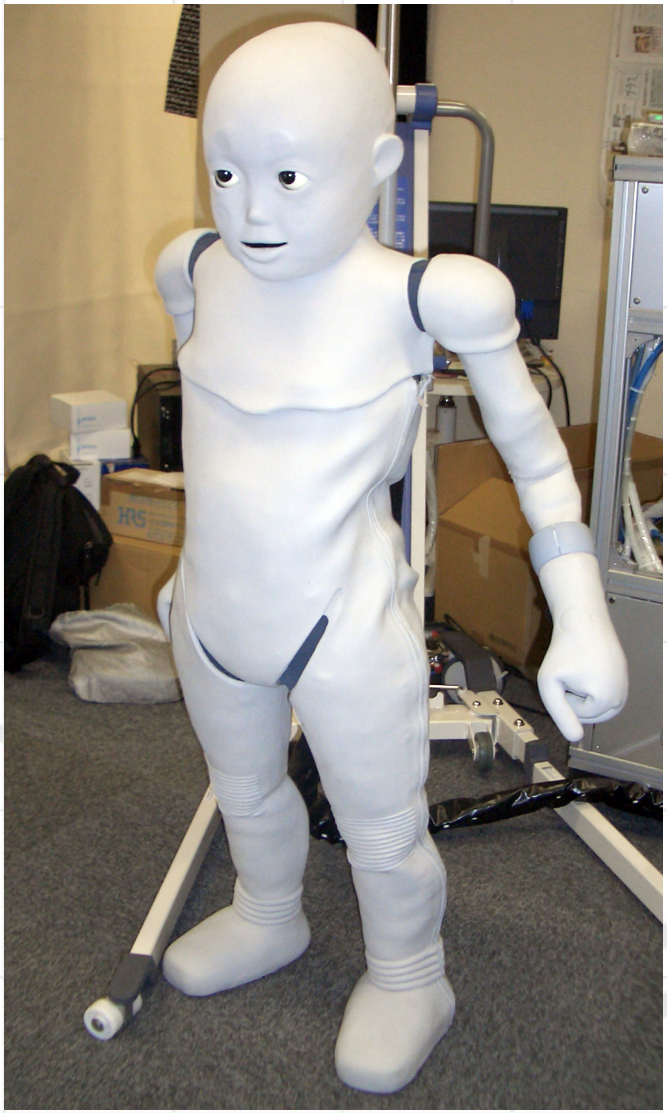
- Challenges based on current issues
  - Smaller feet, rough terrain challenges (see active balancing)
  - react to “natural” referee commands (see human robot interation)
    - initially in the teen size
  - use of arms (e.g., pick up a ball)
    - Complex motion planning
- increasing the number of players towards 11-11

Graph of to solve research issues

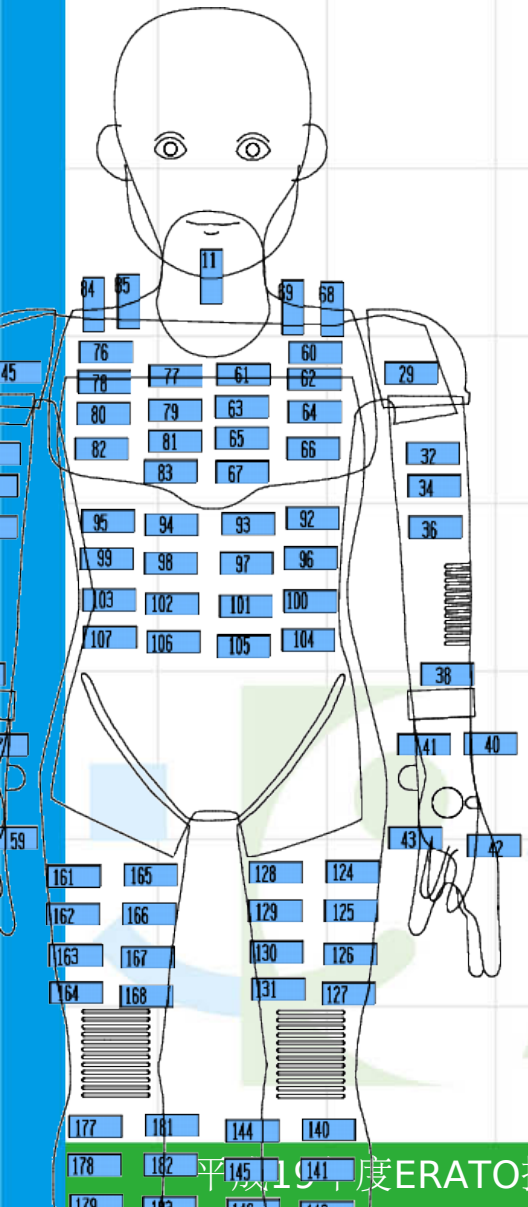


other future research issues and possible solutions: CB^2

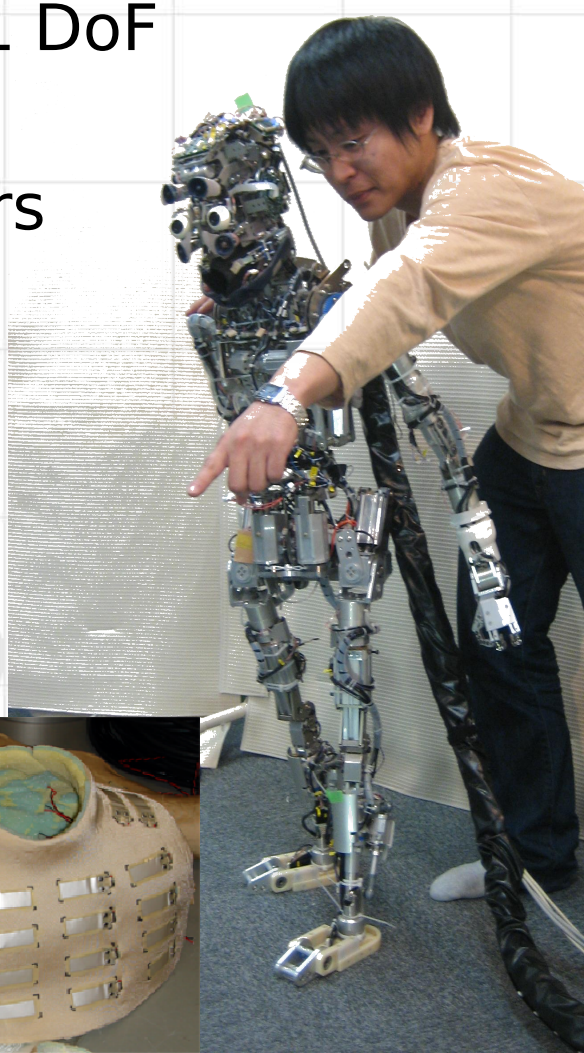
- Safety in Human Robot interaction
  - soft, adaptive force actuators: Mc Kibben muscles etc.
  - soft skin
- Touch
  - touch sensors in soft artificial skin



Naturally interactive soft-bodied humanoid robot (CB2): Actuators, sensors, body



- 1.3 m, 33kg
- pneumatic actuators 51 DoF
- 5 DC motors
- 197 tactile PVDF sensors
- soft silicon skin



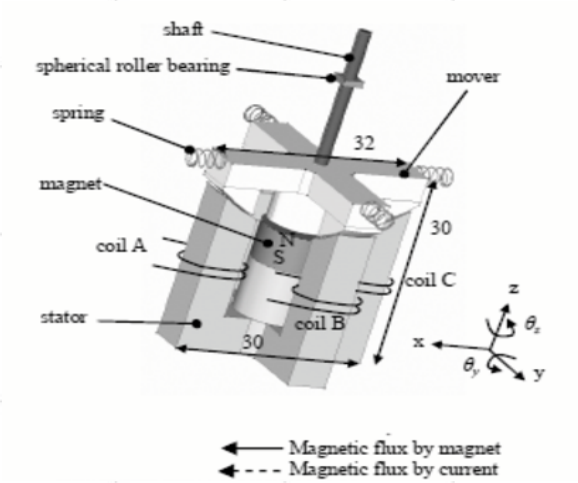
Example for human-robot interaction

[Film of robot help to stand up]

Walking robots with McKibben muscles

Film of Hosoda Sensei's robot

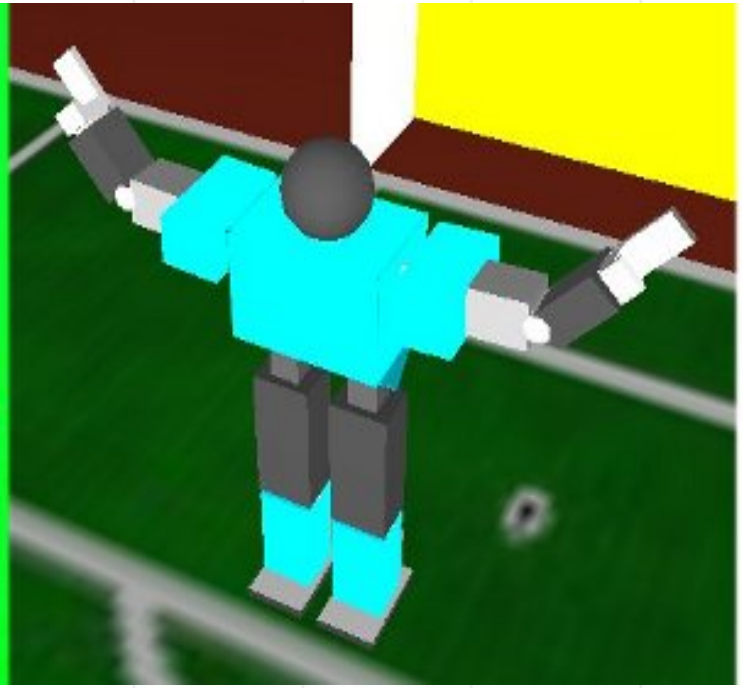
Electric spherical resonance actuator



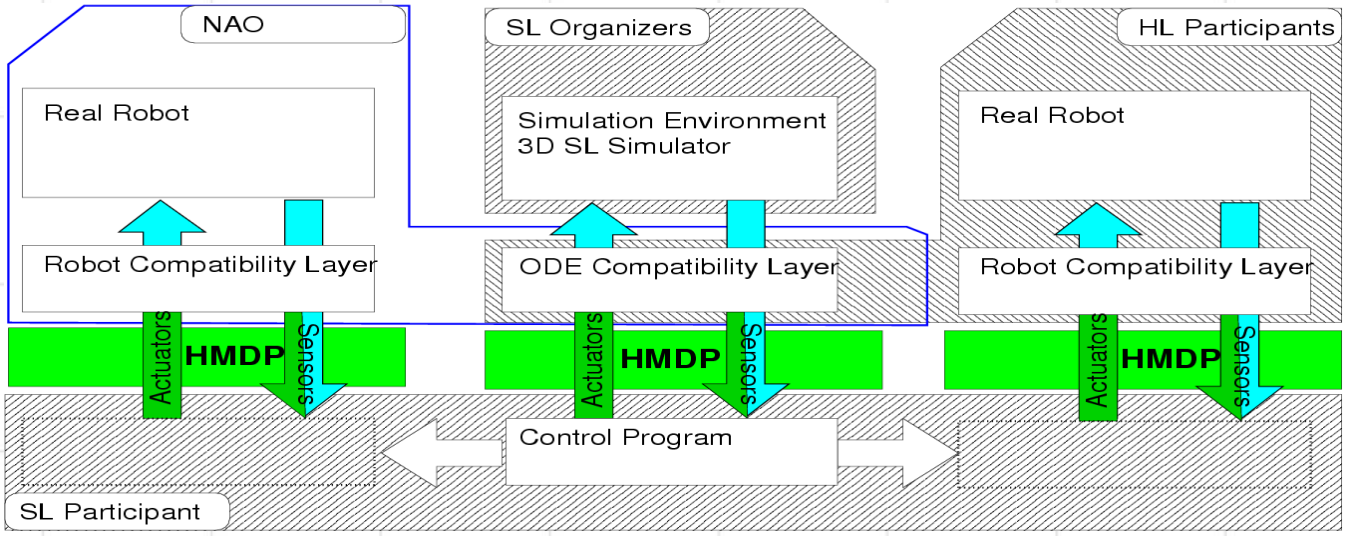
- 2 DoF
- adaptive strength
- could be used for shoulder, ankle, wrist joints

Towards several Humanoid Leagues

- From next year 3 humanoid leagues



Common platform idea



- conduct the finals of the 3D simulation league with real robots
- road map until 2010
- common interface between custom program on one side and 3D simulator and real robot on the other side

Outlook

- we could distinguish 2 groups:
  - small robots: KidSize, Standard Platform, 3D Simulation can be seen as one group with similar research interests as team interaction, dynamice movements, passing, ... Important could be to increase further the compatibility between the leagues: e.g. field layout, body related rules, demo games between standard platform and KidSize, 3D2Real etc.
  - big robots: TeenSize class could face distinct research items for example human-robot interaction, fully autonomous advanced information processing, soft skin, adaptive force actuators