

# Roadmap Discussion

---

**Participants:** 14 members from the RoboCup Humanoid League (including 7 members of the TC / Exec committee). Five of the present teams have a current full-size field in their home lab.

Input from the league: What do you see as the most important challenge your team faces?

**Jacky Baltes (Team: ZSTT and AUTMan/Snrobots, Country: Taiwan, Executive Committee)**

- Push recovery and active balancing (via reinforcement learning)
- 3D stereo vision
- Ball and line detection
- Complex motion planning

**Hafez Farazi (Team: NimbRo, Country: Germany, Technical Committee)**

- Capture steps and learning framework on top of capture steps after pushes (that project stopped when Marcell Missura left)
- Perception using GPU based deep learning (obstacle, line, ball and goal-post detection)
- Identifying a team of heterogeneous robots

**Michael Sattler (Team: Sweaty, Country: Germany, Technical Committee)**

- Analysis and development of a proper human gait

**Reinhard Gerndt (Team: WF Wolves, Country: Germany, Executive Committee)**

- Robustness compliance, autonomy
- Deep learning for vision
- High level decision making

**Ludovic Hofer (Team: Rhoban, Country: France, Technical Committee)**

- Odometry, locomotion, kinematic learning, generating kicks
- Extracting stochastic models from the footsteps of the robot
- Decision making of robots alone or in team play

**Hamburg Bit-Bots (Country: Germany)**

- FCNN - mostly for vision and ball detection
- Collaboration between several teams
- ROS framework
- Walking approaches

### **NUbots (Country: Australia)**

- Optimized software architecture on embedded platforms
- Deep learning, Manifold learning
- Stereo vision

### **Tsinghua Hephaestus (Country: China)**

- Building a platform for the AdultSize league
- Controlling all motors and servers in real time
- New structures for humanoid robots that are more stable and more suitable to walk fast and do push recovery
- Model-based learning for walking, running and stabilizing

### **ICHIRO (Country: India)**

- Deep learning for ball and goal detection

### What should the scientific goals of the new roadmap be?

- Vision and learning cluster
- Kinematics (dynamic kicks...)
- Locomotion, Robustness

### Brainstorming about ideas

#### **Natural light environment**

- Proposal 1: Move outdoor to solve space issues
  - Problem: Robots need to be able to operate in rain and wind (makes walking more stable)
- Proposal 2: Natural light challenge as an intermediate step
- Proposal 3: Only have one training field and never allow teams to practice on the game fields
- Proposal 4: Randomly assign fields right before the game
  - Problem: Advantage for big teams who can just parallelize the training
- Proposal 5: Have different sets of lights and a coin is tossed which light condition is used

#### **Robots**

- Proposal 1: Have less color constraints on the robot
  - Remove the constrain for black feet
- Proposal 2: Longer playing time as a mechanical challenge
- Proposal 3: Better actuators, artificial muscles
- It's still too dangerous to play against an actual human
  - Proposal 4: Technical challenge to have a softer surface and safer robots

## **Playing Field**

- Proposal: Variations in the field dimensions as a challenge for localization
  - Emphasize the approximate measures of the field in the rules
- Proposal 2: Have the turf perpendicular to the playing direction
- Proposal 3: Larger fields for running and high-kick
- Comment: Enlarging field size will make the need for team play more prominent

## **Kinematics, Push-recovery, walking, balancing**

- Proposal 1: More variance in the surface
  - Uneven surface as a technical challenge
- Racing competition

## **Gameplay**

- More focus on adapting game strategy to different opponents, adaptive team play
- Rely less on the game controller in the future, so there is a need to be able to recognize what the referee is doing and saying
  - Whistle detection to start the game
  - Human-robot interaction as new research area (interaction with coach and referee)
- There are still too many pick-ups during the games
  - Proposal 1: Decrease the chance of pick-up to enforce more robustness
  - Proposal 2: Robots can only come back during a stoppage of the game

## **What scientific challenges are the teams most interested in?**

- Increased speed of robots: 5
- Uneven surfaces: 3
  - Problem: Might slow down the game even more