Using Rust for Playing Soccer With Robots at RoboCup

Hendrik Sieck

zühlke empowering ideas

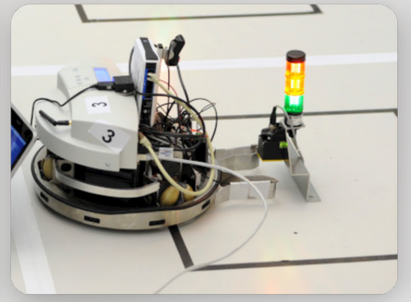
HULKs

RoboCup

Rescue

At Home

At Work



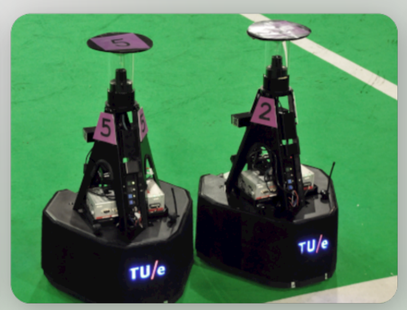
Logistics

Soccer

Simulation

Small Size

Mid Size



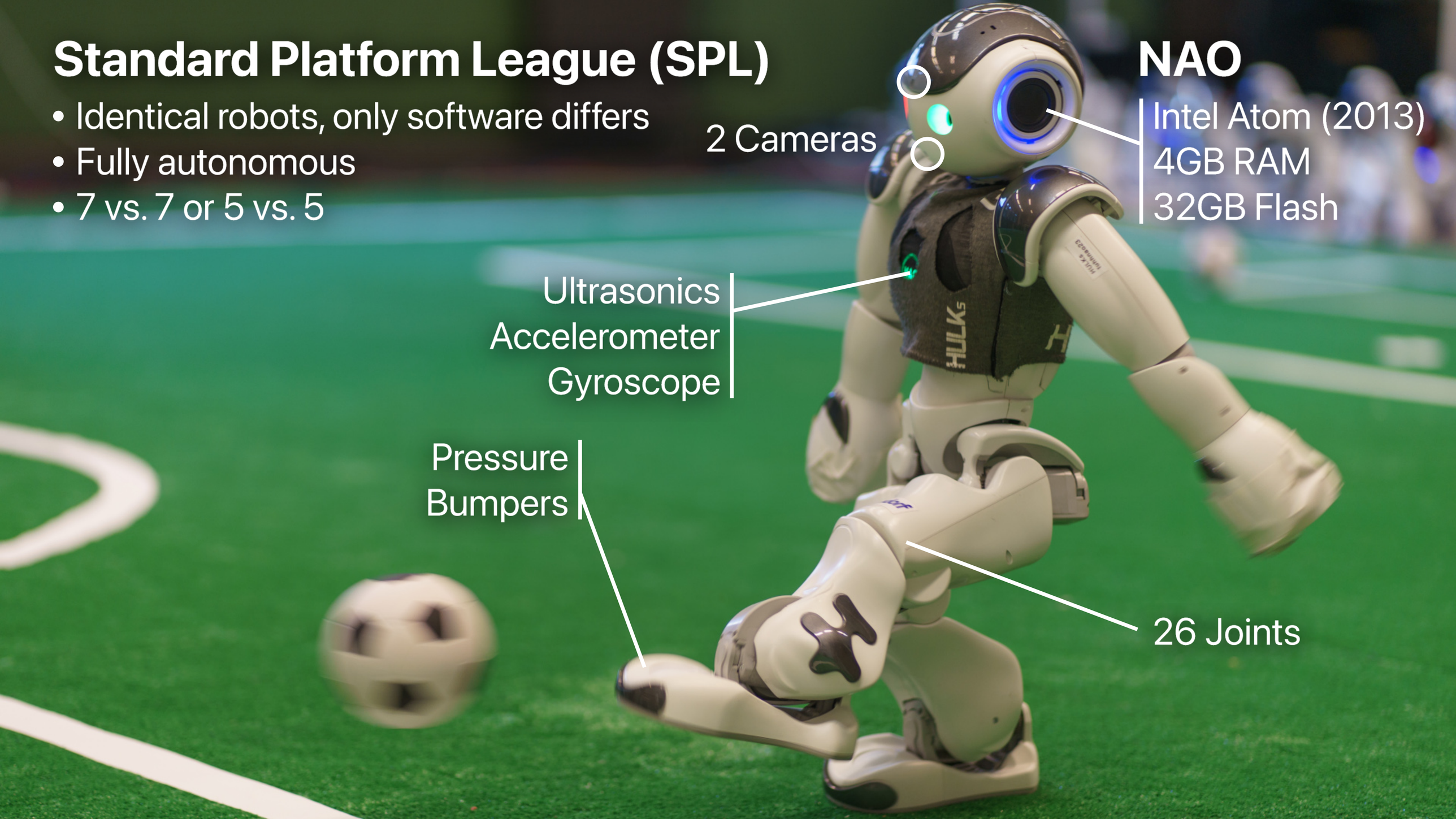
Humanoid

Standard Platform

Goal: Robots vs. Humans in 2050

Standard Platform League (SPL)

- Identical robots, only software differs
- Fully autonomous
- 7 vs. 7 or 5 vs. 5



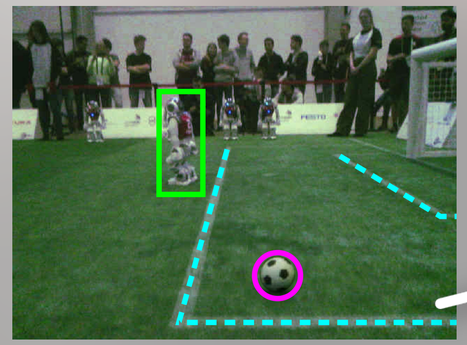
Team HULKs

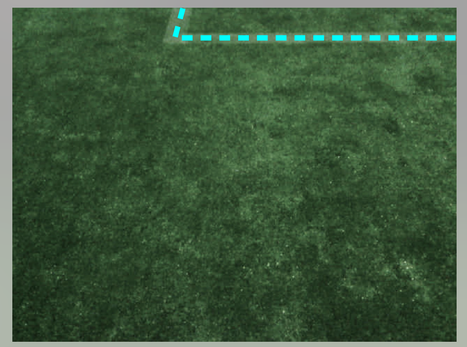

AIRBUS
slashwhy
BASLER
Haspa
TUHH
HULKs
RoboCup SPL Team - TU Hamburg, Germany


TUHH

Robot Control Software

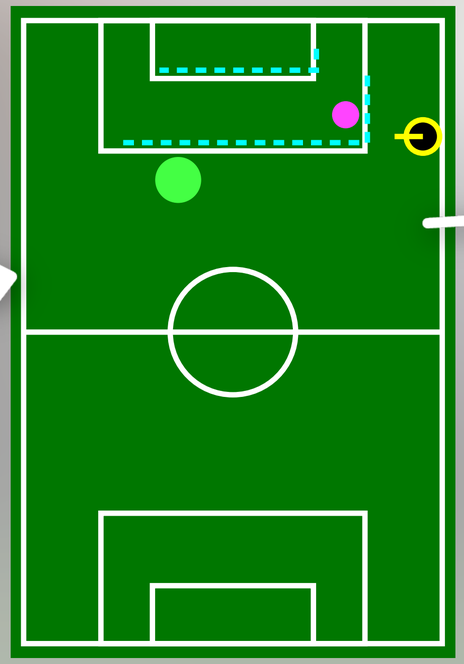
Perception





Joint Positions, Microphone, Accelerometer, Gyroscope, Ultrasonics, Foot Pressure, Foot Bumper

World Model



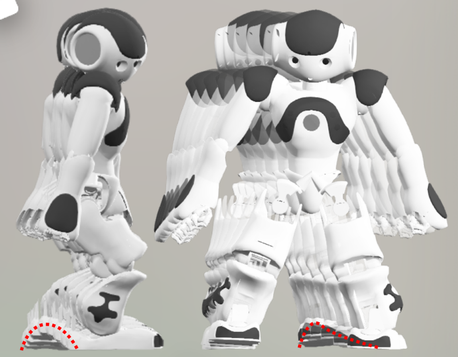
Localization, Ball, Obstacles, Game State, Network

Behavior

Dynamic Roles
Actions
Path Planning
Motion Command

Motion

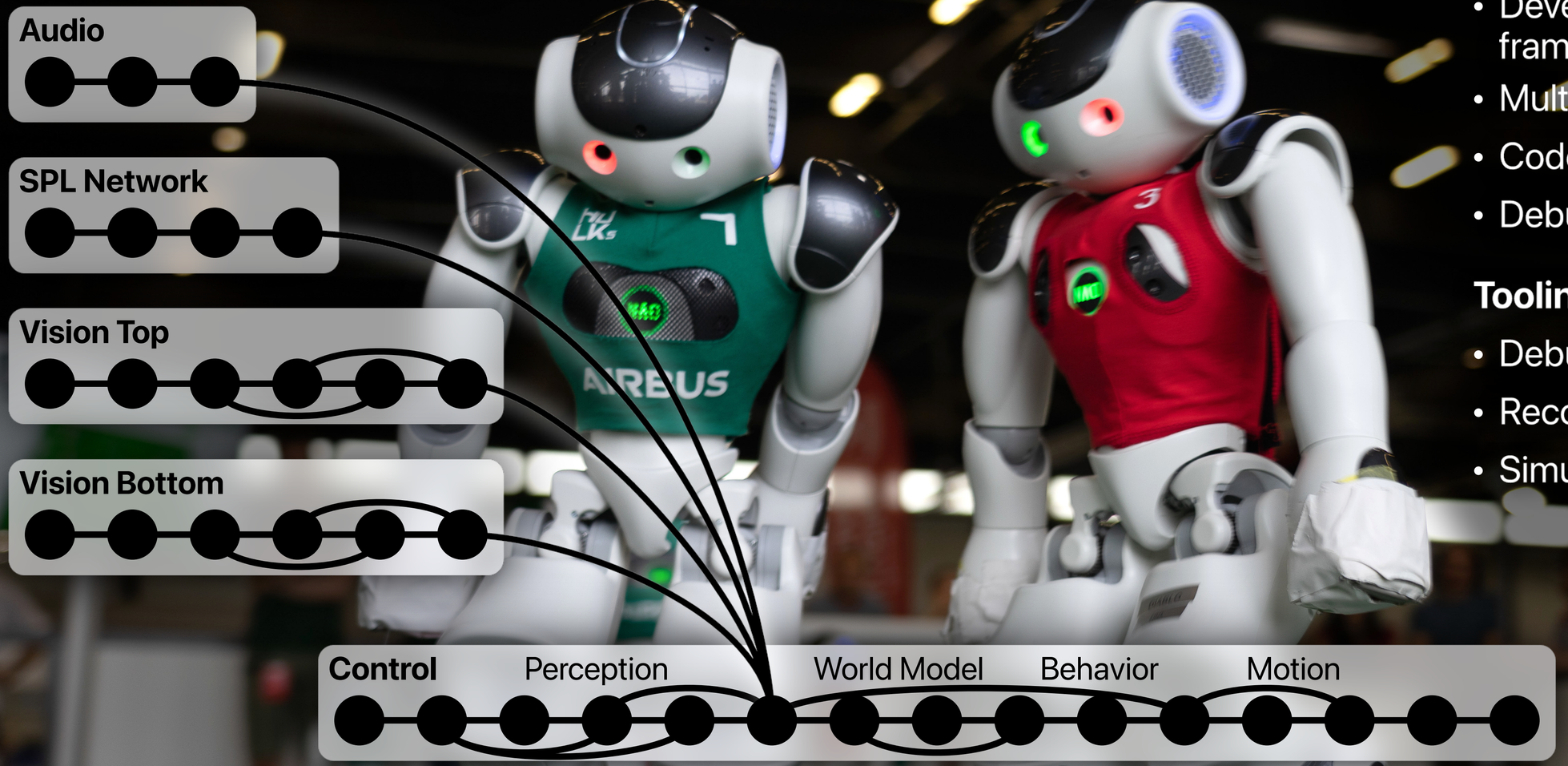
Robust Walking
In-Walk Kicks
Head and Arms
Stand Up
Fall Protection



Hardware Interface + Framework

Yocto Linux

Software Design



Framework

- Developer writes nodes, framework executes
- Multi-threading
- Code generation
- Debugging server

Tooling

- Debugging clients
- Recording & Replay
- Simulators

Transitioning from C++ to Rust

Why?

- Decrease technical debt, rethink main concepts
- Knowledge transfer, newbie motivation
- Learn a new language
- Fun ;)

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Timeline

November 2021:	Start of concept and design
After 2 months:	Working framework prototype
After 5 months:	Technical demonstration at GORE Scored 3 goals! 1 in opponent goal ;)
After 8 months:	Quarter finals reached at RoboCup Scored 17 goals!
Present:	Further iterations of framework

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Learnings

- Compiler + tooling → fearless change, velocity, risk taking
- Language and standard library has richer feature set
- Development feels longer, but then it just wörks
- No SEGFAULT infrastructure, high prototype quality
- Focus on domain and real problems, not optimization
- To infinity and beyond: GUI, Web, Embedded, ...

Current State & Tools

Newbie Education (Rust Introduction, Pairing)

Monorepo + Workspace Dependencies (cargo)

Yocto Integration (depp, cargo-bitbake)

Additional Tooling (clap, indicatif)

CI Setup (test, clippy, rustfmt)

UI Tools (egui, tungstenite + Web)

Profiling (VTune, pprof)

Linear Algebra Libraries (nalgebra)

Coordinate Systems

Error Handling (anyhow, eyre, color-eyre)

Serialization (serde)

Machine Learning (CompiledNN, OpenVINO)

Interfacing to C++ and other stuff (bindgen, mlua)


Live Demo

HULKs Code

https://github.com/HULKs/hulk

Slides and other Talks

https://github.com/h3ndrk/talks

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