Boosted HTWK - Extended Abstract

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Abstract. We present key insights from Booster Robotics and HTWK Robots in RoboCup Soccer, focusing on fall resistance, decision speed, and robot platform development. By combining reinforcement learning with robust hardware, we enhance stability and performance. Fast decision-making and strategic coordination further strengthen gameplay. Our new K1 robot, merging Booster's hardware expertise with HTWK's AI strategies, aims for a strong RoboCup 2025 entry.

Keywords: RoboCup Soccer · humanoid robotics · reinforcement learning · fall resistance · decision speed · robot platform · AI strategy · hardware resilience · team coordination · autonomous robots

1 Lessons Learned and Paths Taken

Through extensive experience of both Booster (as Tsinghua Hephaestus) and HTWK (as Nao-Team HTWK and HTWK Robots), we gained a lot of insight into what makes a successful robot soccer team. We intend to further apply our learnings to accelerate the advancement of Robocup Soccer leagues within the Robocup competitive envelope.

1.1 Fall Resistance

It is imperative for robots to remain balanced, even if pushed by opponents or negatively influenced by other outside factors. Reinforcement learning provides a path forward in ensuring the robot doesn't fall. However, hardware-based solutions are necessary to ensure that a robot can function even after falling down or experiencing strong contact with an opponent, as those situations can happen somewhat frequently in actual games. We are addressing this issue in multiple ways by ensuring a stable locomotion, detecting and avoiding opponent players, and developing hardware that can structurally withstand falls and collisions.

1.2 Decision Speed

As soccer is a very fast-paced sport, making correct decisions instantly vastly improves the strength of a team. Combining reinforcement learning for low-level motions around the ball (dribbling, shooting, etc) with a high-level strategy that makes use of all 4 players on the field will provide a solid foundation. With HTWK's experience in playing 7 vs 7 games in the SPL league and Booster's experience of training quick and efficient motions, we are uniquely suited to employ efficient and effective team and game play.

1.3 Robot Platform

Booster's T1 robot platform has proven to be a highly competitive entry into humanoid soccer. A slightly smaller, kid-size-compatible, K1 platform based on the same principles and similar hardware is currently being developed and will be the entry of this team. Combining the intricate hardware experience of Booster Robotics with the championship-winning high-level performance of HTWK Robots will provide a very competitive entry at Robocup 2025 in Salvador.