Bit-Bots Extended Abstract 2025

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1 Lessons learned in previous RoboCup competitions

At RoboCup 2023, we showed the general functionality of our robot system. However, we noticed major issues with the reliability of some soft- and hardware components. Therefore, we concentrated on steady improvements without relying on large algorithmic changes. Once a satisfactory level had been reached, we were ready to experiment with new ideas and even introduce and validate new features during the competition. Focusing on reliability also meant improving our maintenance procedures: We regularly and thoroughly checked the robot's hardware and replaced parts that we previously deemed acceptable.

Our efforts to simplify game preparations and adhere to our processes helped reduce errors and stress immediately before a competition; this included tools to enable software deployment to all robots by one person simultaneously and automatic verification of correct software versions. Additionally, we assigned fixed roles to our members (deployment, monitoring, robot handler, note-keeper, repair, recording) and assigned protocols to quickly make an informed decision and execute. We developed live monitoring tools, which proved vital during the competition. Monitoring enabled us to better understand what went wrong during failures, as we had detailed notes and recordings. Using this knowledge, we could find and fix problems more quickly.

All these changes showed worthwhile at the 2024 competition.

2 Major problems the team is trying to solve for RoboCup 2025

During the 2024 competition, we faced some hardware problems. While we could reduce these compared to the previous competition, much time was still invested in maintenance.

As the Hamburg Bit-Bots are a student team, there is a fluctuation in members as they graduate. We focused our efforts this year on acquiring and introducing new team members to ensure future participation in the competition.

Our vision pipeline performed exceptionally well in previous years in the context of the robot's overall functionality. This year, we noticed that we can improve object detection in edge cases (especially for very close or far away objects).

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3 Plans for the major changes the team expects to have implemented for RoboCup 2025

We are replacing our Wolfgang Robot platform with a new platform called BitBan based on team Rhoban's Sigmaban platform [1]. It will feature the same kinematic structure as the Sigmaban, but we will use our custom solutions for electronics. We have mostly finished development and prototyping and are now manufacturing and assembling the robots.

Our particle filter-based localization platform performed reasonably well in previous competitions. Due to processing time in the vision pipeline, updates are calculated on delayed measurements. While we already compensated for this in the inverse perspective mapping, we are now also accounting for it in the particle update. We have implemented this change and are currently testing its robustness.

We are upgrading our vision pipeline YOEO [3] to be based upon the more modern YOLOv7 [4] architecture. We have prepared previously recorded and additional training data and started the implementation.

Furthermore, we already implemented a proper throw-in motion and behavior that will be used instead of the previously kick-in.

In addition to that, we are in the process of moving our path planning from a grid based to a visibility graph based approach implemented in Rust.

Recently, the paradigm of zero-shot transfer RL policies for robot motion from simulation has emerged [2]. We are currently developing simulation environments and reward functions to enable this for our robot platform. We plan to have a working prototype, which, depending on performance, may be employed in the 2025 competition. As this is an experimental approach, we are also investing some effort in the continued development of our current walking algorithm.

References

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