# RoboCup 2023 Submission Survey

## Survey response 1

### Software

| Team Name |
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| Hamburg Bit-Bots |

| Is your software fully or partially OpenSource. If so, where can it be found: |
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| Our software, except for camera drivers (due to license) and ansible configurations, is open source and available at https://github.com/bit-bots/ |

| Do you have a kinematic or dynamic model of your robot(s)? If so, how did you create it (e.g. measure physical robot, export from CAD model)? |
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| We have a kinematic and dynamic model in the URDF and Webots .proto format. The URDF is exported from the CAD software we use, onshape.com, using https://github.com/Rhoban/onshape-to-robot. We used https://github.com/cyberbotics/urdf2webots to convert the URDF to a Webots .proto. Manual adjustment was required. |

| Are you using Inverse Kinematics? If so what solution (analytic, (pseudo)inverse jabcobian, etc...) are you using? |
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| We are using BioIK for inverse kinematics: https://github.com/PickNikRobotics/bio_ik/tree/ros2 |

| Are you simulating your robot? If so what are you using simulation for? |
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| We use Webots and PyBullet. We use simulation for training Reinforcement Learning policies and optimizing parameters of our motion generation algorithms. The Reinforcement Learning policies are not in use yet. |

| What approach are you using to generate the robot walking motion? |
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| We use an approach based on Rhoban's IKwalk, but heavily modified. It is based on quintic splines generating Cartesian trajectories. Parameters defining these splines are optimized in simulation and adapted by an expert in the real world. The approach is described in: Marc Bestmann, and Jianwei Zhang "Bipedal Walking on Humanoid Robots through Parameter Optimization" RoboCup Symposium 2022, Bangkok, Thailand |

| What approach are you using to generate motions for standing up? |
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| We use quintic splines to define the trajectories of the arms and legs during standing up. The parameters defining these are optimized in simulation and tuned by an expert in the real world. It is described in: Stelter, Sebastian, et al. "Fast and Reliable Stand-Up Motions for Humanoid Robots Using Spline Interpolation and Parameter Optimization." 2021 20th International Conference on Advanced Robotics (ICAR). IEEE, 2021. |

| What approach are you using to generate kicking motions? |
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| We use quintic splines to define the trajectory of the torso and flying foot during a kick motion. The parameters of the splines are based on the direction of the kick as well as manually tuned by an expert. |

| Do you use any other motions than the previously mentioned? If so, what approaches are you using to generate them? |
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| Which datasets are you using in your research? If you are using your own datasets, are they public? |
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| We use the TORSO21 dataset (https://github.com/bit-bots/TORSO_21_dataset) we published ourselves. We also use the Whistle dataset from BHuman (https://spl.robocup.org/datasets/). |

| What approaches are you using in your robot's visual perception? |
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| We use a Deep Learning approach based on YOLO called YOEO described in: Vahl, Florian, et al. "YOEO–You Only Encode Once: A CNN for Embedded Object Detection and Semantic Segmentation." 2021 IEEE International Conference on Robotics and Biomimetics (ROBIO). IEEE, 2021. |

| Are you planning with objects in Cartesian or image space? If you are using Cartesian space, how do you transform between the image space and cartesian space? |
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| We plan in cartesian coordinates, depending on application relative to the robot or relative to the playing field. We do inverse perspective mapping (https://github.com/ros-sports/soccer_ipm/) |

| How is your robot localizing? |
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| We use a particle filter whose particles are updated based on line measurements. |

| Is your robot planning a path for navigation? Is it avoiding obstacles? How is the plan executed by the robot (e.g. dynamic window approach)? |
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| Our robot plans a path through the environment around obstacles. A* is used for generating a global plan. A carrot planner is used to execute this plan. |

| How is the behavior of your robot's structured (e.g. Behavior Trees)? What additional approaches are you using? |
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| We use our own behavior framework called Dynamic Stack Decider described in: Poppinga, Martin, and Marc Bestmann. "DSD-Dynamic Stack Decider." International Journal of Social Robotics 14.1 (2022): 73-83.<br>Furthermore, we employ a potential field method incorporating detected opponent robots to decide if we should dribble or pass. |

| Do you have some form of active vision (i.e. moving the robots camera based on information known about the world)? |
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| Our head moves based on the state of the behavior. Several head modes such as looking around to detect obstacles or tracking the ball are implemented. |

| Do you apply some form of filtering on the detected objects (e. g. Kalman filter for ball position)? |
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| We apply a Kalman filter on the detected ball position to smooth out the measurements. |

| Is your team performing team communication? Are you using the standard RoboCup Humanoid League protocol? If not, why (e.g. it is missing something you need)? |
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| We are performing team communication using the standard Protobuf based protocol. |

| Please list contributions your team has made to RoboCup |
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| 2 members of the Hamburg Bit-Bots are TC members<br>Open-sourcing our code has allowed several teams to use our algorithms (e.g. NUbots using our walking)<br>Our dataset TORSO21 includes 10464 fully annotated real world images to allow for comparing vision approaches in RoboCup soccer. |

| Please list the scientific publications your team has made since the last application to RoboCup (or if not applicable in the last 2 years). |
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| Marc Bestmann, Jianwei Zhang "Bipedal Walking on Humanoid Robots through Parameter Optimization", RoboCup Symposium 2022<br>Sebastian Stelter, Marc Bestmann, Norman Hendrich, Jianwei Zhang "Fast and Reliable Stand-Up Motions for Humanoid Robots Using Spline Interpolation and Parameter Optimization" IEEE ICAR 2021.<br>Florian Vahl, Jan Gutsche, Marc Bestmann, Jianwei Zhang "YOEO – You Only Encode Once: A CNN for Embedded Object Detection and Semantic Segmentation", IEEE ROBIO 2021. |

| Please list the approaches, hardware designs, or code your team is using which were developed by other teams. |
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| Our walking is based on IKWalk from Rhoban.<br>We use the onshape-to-robot tool for converting our CAD model to a URDF<br>We use the rot_conv_lib from Nimbro for using Fused Angles in our code.<br>Whistle detection dataset from SPL team BHuman |

| What operating system is running on your robot and which middleware are you using (for example Ubuntu 22.04 and ROS2 Galactic)? |
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| We are using ROS2 Rolling on Ubuntu 22.04. |

| Is there anything else you would like to share that did not fit to the previous questions? |
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| If you have a description document of your software you would like to share, you may do so here. |
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| filecount - If you have a description document of your software you would like to share, you may do so here. |
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