

# **TeamNanyang 2010 Standard Platform Robot Team**

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## **Abstract**

This document serves as the team description paper for the RoboCup 2010 Standard Platform League World Championship competition in Singapore. A brief history of TeamNanyang and its research interests will be described. Future work based on the standard platform robots will also be discussed.

## **1. Introduction**

Team Nanyang was officially formed in May 2009 in the School of Mechanical and Aerospace Engineering as part of the program to train students' hands-on engineering and system integration capability and nurturing future robotics and mechatronics researchers. Currently the team has 6 NAO robots V3+ academic edition and 4 NAO Robocup version robots and a dedicated lab space and competition field for practicing matches and research.

The School of Mechanical and Aerospace Engineering has a strong robotics research program with more than 15 faculty members from different disciplines, more than 40 full time researchers, and current active research funding more than S\$8 millions. RoboCup 2010 will be our first appearance in Robocup SPL. Prior to RoboCup 2010, we have contested in many local robotics competitions like Singapore Robotics Games many years. Of importance note is the participation in the TechX Robotics Challenge hosted by Ministry of Defense of Singapore in 2008 on an intelligent robotic platform that can autonomously navigate in outdoor and indoor environments with stair climbing and elevator operation capabilities. The final winning award was S\$1 million which was not claimed by any of the contesting teams due to the high complexity of the required tasks. However, among the 6 final qualified teams (out of the 24 contested teams), our team was the best performed one that was closest to the final targets. In terms of research capabilities, we are strong in robot vision, navigation, locomotion, control, and system integration.

Unlike other SPL teams, our Standard Platform League team comprises mostly 3<sup>rd</sup> year Mechatronics undergraduate students from School of Mechanical and Aerospace Engineering, supported by faculty, research students, and lab technicians. The mechatronics students in School of MAE are trained not only with fundamental mechanical engineering subjects but also in electronics, embedded systems, computer programming, and control. Hence, they have very good knowledge about robotics and passion to pursue robotics projects.



tested repeatedly (Fig.1). We have investigated basic and hierarchical robot soccer functions on the field based on the robot kinematics, namely:

- Looking for ball
- Going to ball
- Attacking
- Defending
- Goalkeeping
- Penalty shoot-out

For each soccer robot behavior, a number of robot functional movements are designed, such as standard walking, kicking, getting up from the fall, and diving. A software architecture based on the complete player behaviors will be designed and implemented for robotic soccer competitions.

### **Robotic soccer vision**

We are investigating implementation of Partial OpenCV on NAO to perform all the necessary vision functions required by the robotic soccer. Our NAO robot vision has 4 basic functions: detecting the ball, detecting the goal post, detecting and identifying teammates, and detecting lines on the field. The ball detection will purely be based on color. The detection of the goal post and the teammate will be based on color and feature extraction due to the use of similar colors. The identification of the field lines will incorporate a novel localization function that can be used for robot coordination tasks, such as attacking and defense. All the field players and the goal keeper will implement all 4 vision functions. However, the different motion/behaviors will be incorporated with the vision functions to give distinctive player roles.

### **Game coordination and strategy**

An important area that we are investigating is the game coordination and strategy under multiple robot scenarios. The game strategy based on strength of opponents is developed. The execution of the strategy will be determined based on a number of factors, such as the pre-determined game pace, mode of communication and coordination with a centralized command (the goal keeper) and status of the robot. Subsequently the robot behaviors will be adjusted according to the game plan.

## **3 Future Works**

Our eventual goal for the RoboCup project is to train the students to develop our own functional and system codes for NAO robots in the locomotion, vision, localization, and task-level coordination so as to provide a much better performed humanoid robot for many different purposes, and one of them is the robotic soccer games. At the forefront of humanoid robot research, we shall embark on the research of using system engineering approach for reliability of robots to enhance the overall NAO performance based on existing hardware limitations. The system engineering approach is used for all complex aerospace systems, such as rockets, space shuttles, space stations, and airplanes, to guarantee the system performance with technology constraints. Similarly, the humanoid robot is a complex system bounded by the capabilities and accuracies of the components (actuators, sensors), the system engineering approach will be a viable approach to enhance robot performance based on current technology envelope. The RoboCup will then be a perfect platform to test out the fine-tuned NAO robots based on the system engineering approach.

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