

# Dalian University of Technology DUT Future 2026: AdultSize

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**Abstract.** This paper presents the main work of the DUT Future Adult-Size team for RoboCup 2026, developed based on the open-source Tsinghua Hephaestus framework. The proposed system focuses on high-level behavior redesign, including a multi-strategy decision mechanism, a midfield dribbling function for ball advancement, and systematic tuning of walking parameters. Multiple strategies are deployed for different match situations to improve the overall robustness and performance of the robot system.

## 1 System Overview

The proposed system is developed upon the open-source Tsinghua Hephaestus framework, reusing its vision, localization, and motion control modules. Instead of modifying low-level perception and control algorithms, this work mainly redesigns the high-level behavior module, enabling the robot to select appropriate actions under different match conditions. This approach improves system stability and maintainability.

## 2 Multi-Strategy Behavior Design

To handle diverse match situations such as attacking, defending, ball contesting, and ball advancing, multiple behavior strategies are designed and integrated into a unified finite state machine. Strategy switching is determined by the robot pose, ball position, and environmental information. Compared with a single fixed behavior, the proposed multi-strategy mechanism enhances adaptability and reduces ineffective actions.

## 3 Midfield Dribbling Method

Compared with long-distance kicking, advancing the ball to a favorable shooting position can significantly increase scoring success. A midfield dribbling function is introduced to allow the robot to move forward while maintaining ball control. The robot adjusts its walking direction and step size according to the ball position to ensure continuous ball contact. This method enables smooth transition from the midfield area to the attacking zone and reduces ball loss caused by blind long-distance kicks.

## 4 Walking Parameter Tuning

To improve motion efficiency and positioning accuracy, walking-related parameters, including step length, turning speed, and target tracking gains, are systematically tuned through extensive field tests. Experimental results show that the robot can reach target positions faster and with improved accuracy, providing a reliable motion basis for behavior execution.

## 5 Current Limitations

Several challenges remain in the current system:

- **Strategy Coordination:** Smooth switching between multiple strategies is difficult to guarantee. Improper transitions may cause hesitation or inefficient actions.
- **Dribbling Stability:** Simultaneous walking and ball control increase motion instability, especially under varying ground friction and posture disturbances.
- **Target Positioning Accuracy:** Accumulated errors occur during long-distance movement or frequent target updates, limiting the execution of complex tactics.

## 6 Future Work

Future improvements will focus on the following aspects:

- **Behavior and Strategy Module:** Opponent positions and teammate states will be incorporated into the decision-making process for more reasonable strategy switching.
- **Dribbling and Attacking Strategy:** The midfield dribbling function will be optimized to increase advancing speed while maintaining ball stability and will be integrated with shooting behaviors to form a complete attacking pipeline.
- **Motion and Localization Coordination:** Localization feedback will be further integrated into target tracking to enhance reliability in complex scenarios.

## 7 Conclusion

A preliminary multi-strategy behavior framework has been established, and the midfield dribbling function has been validated on real robots. Walking parameter tuning improves motion speed and positioning accuracy, providing a solid foundation for behavior execution. The system is currently under continuous testing and optimization toward RoboCup 2026.