RoboMaster 2022 University AI Challenge Technical Proposal

Northeastern University (China) Team Alkaid

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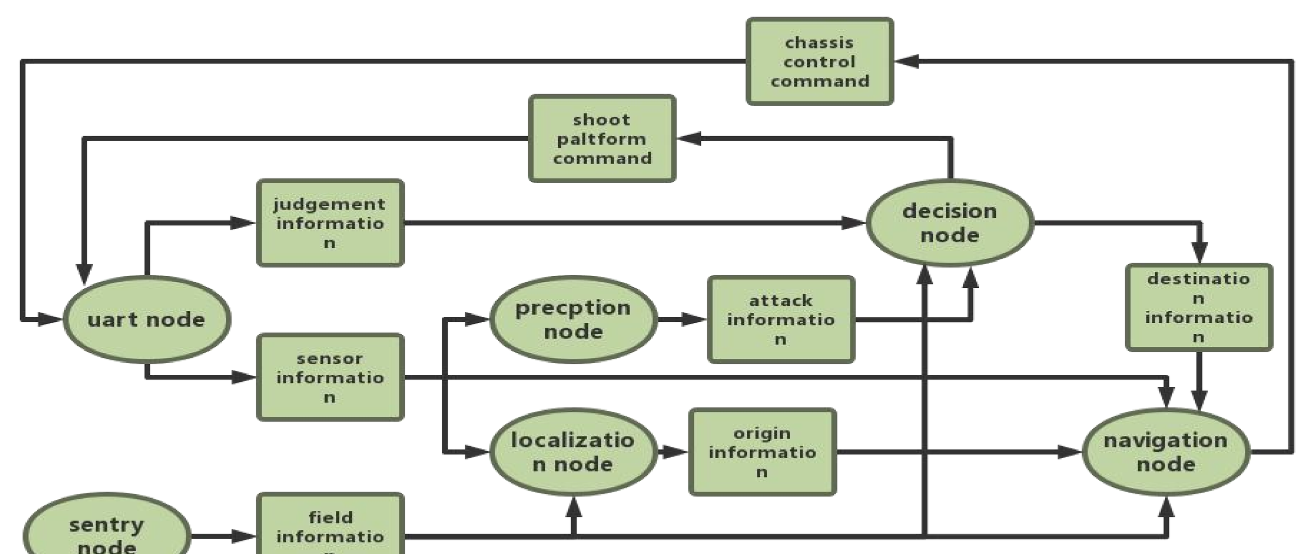
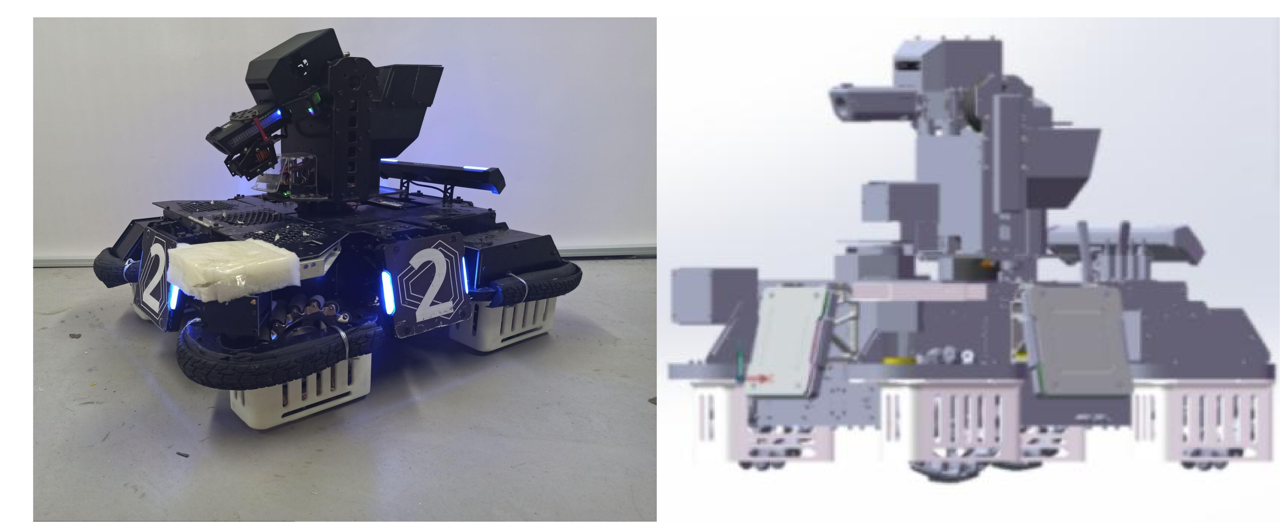
* Indicates equal academic advisor

Abstract

In RoboMaster University AI Challenge, we propose an algorithm framework for RoboMaster 2019 AI Robot Platform, the algorithm workflow and hardware are as follows.



(a) Workflow

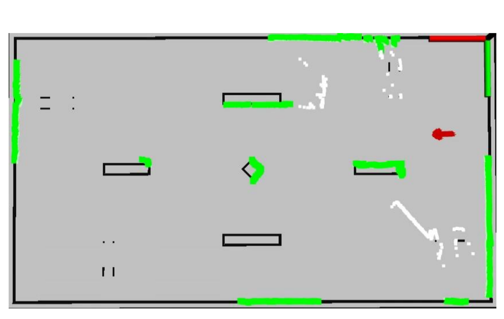


(b) Hardware

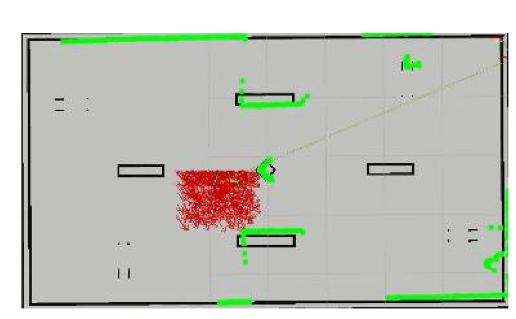
Fig. 1. Algorithmworkflow and hardware

Localization

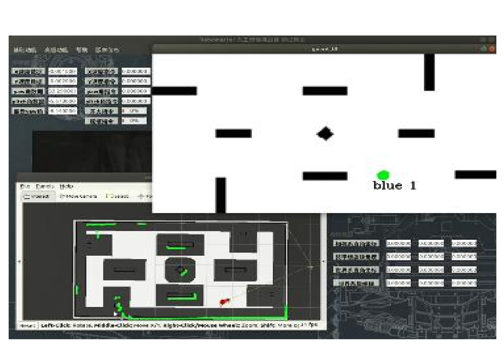
The localization algorithm is based on AMCL with improvements adapted to the requirements of the competition, so that the algorithm efficiency and algorithm robustness meet the requirements. The specific focus is on the a priori data processing part and the particle dispersion part.



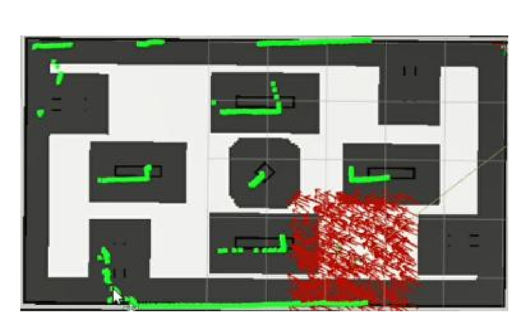
(a) Correction of the LiDAR a priori data based on the posteriori data of the positioning algorithm



(b) Particle local dispersion guarantees fast positional recovery and symmetry problem handling



(c) Global localization of sentry information

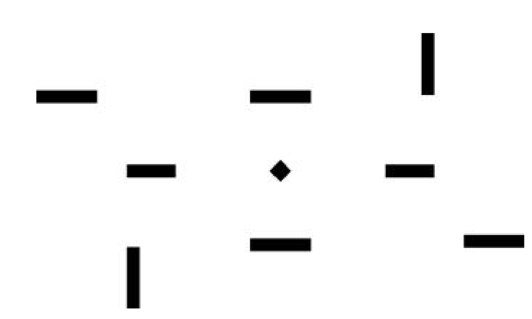


(d) Particle divergence constraints provided by IMU global angle information

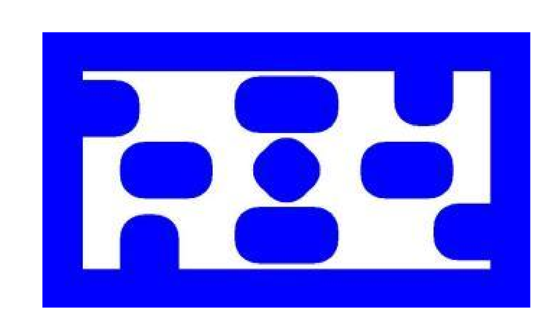
Fig. 2. Localization algorithm demo

Navigation

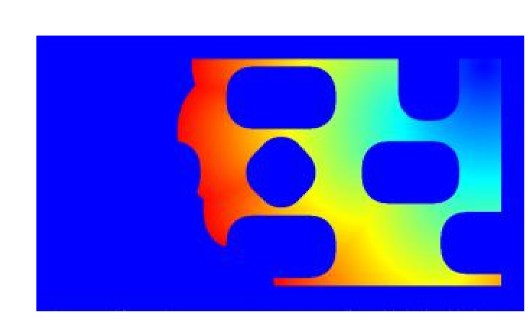
Mainly refer to Btraj[1] from the HUKST Aerial Robotics Group. Using fast marching method as front-end, minimum jerk as back-end and gazebo to verify the algorithm of path planning and trajectory optimization.



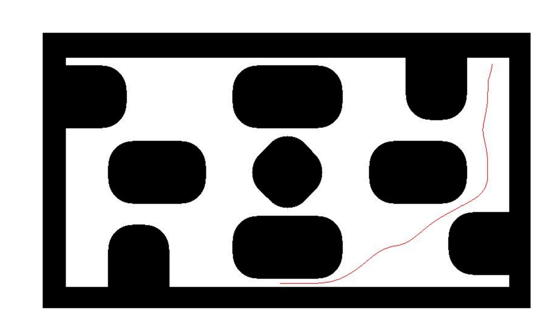
(a) Original Map



(b) The inflation layer of the map



(c) The velocity field of the map

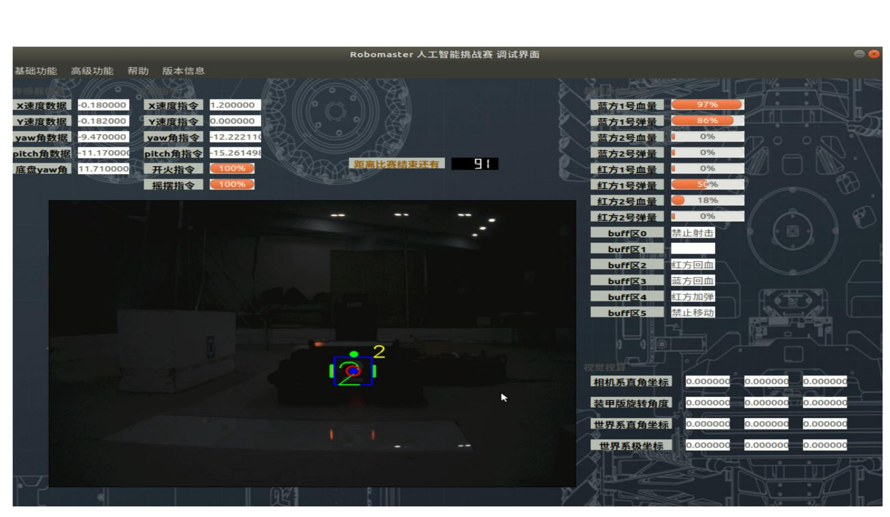


(d) Path found by fast marching

Fig. 3. Navigation algorithm demo

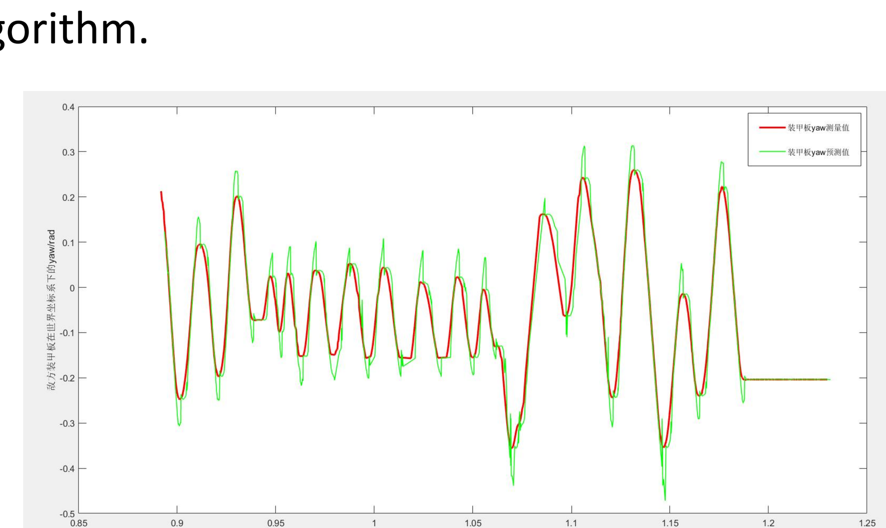
Perception

In the armor plate recognition part, the region of interest is found based on OpenCV detection algorithm, and the image is classified based on Resnet-18.



(a) Recognition Part

In the armor plate prediction part, Kalman filter algorithm is used for prediction. Considering that the prediction model can not solve the rotation problem well, we have improved the algorithm.

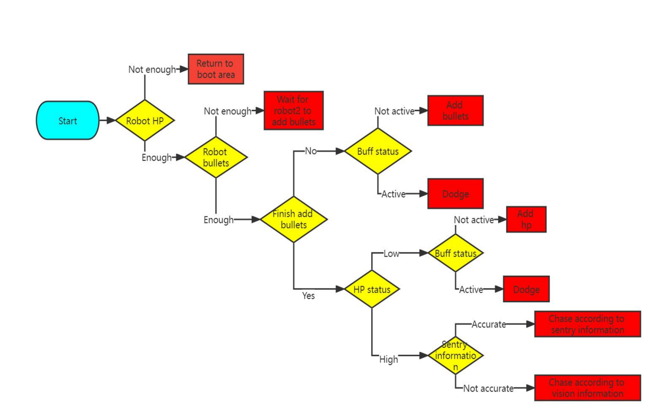


(b) Prediction Part

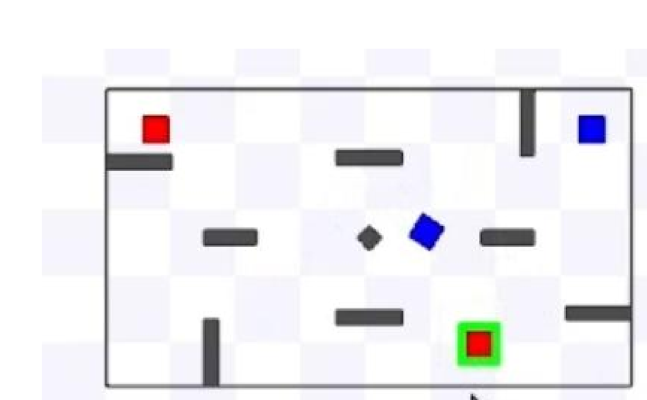
Fig. 4. Perecption algorithm demo

Decision

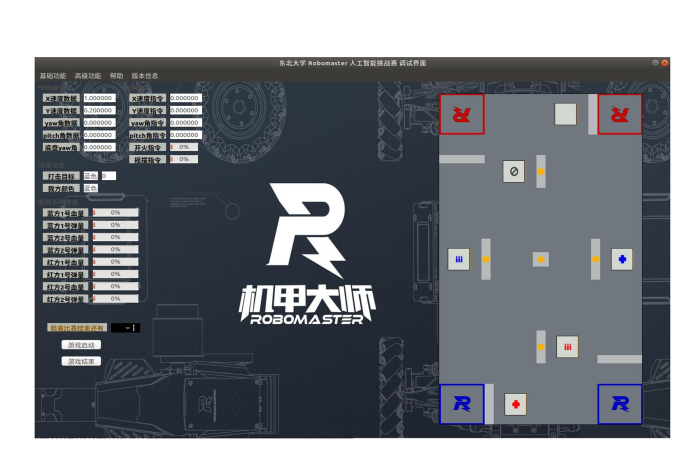
The basic framework of the decision part is based on the behavior tree[2].Through information interaction with MCU and the referee system,we can control the robot to execute the logic of the corresponding cooperative mode and individual combat mode. The main logic block diagram of the robot is shown in the following Fig .5(a).



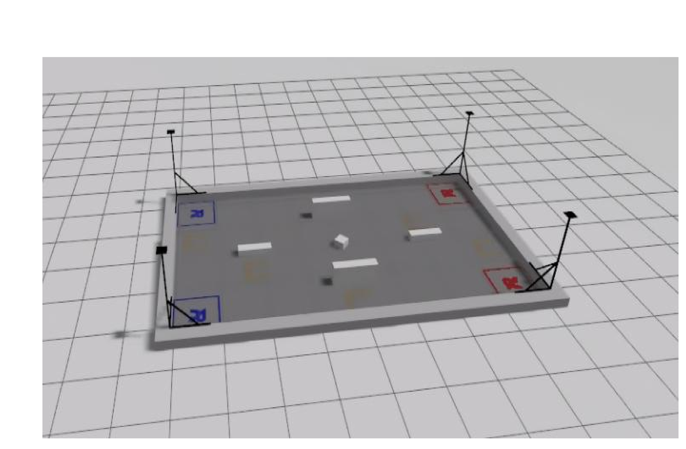
(a) Framework and logic execution



(b) Ros stage simulator



(c) Ros qt gui



(d) Gazebo simulator

Fig. 5. Decision algorithm demo

[1] Gao, Fei et al. “Online Safe Trajectory Generation for Quadrotors Using Fast Marching Method and Bernstein Basis Polynomial.” 2018 IEEE International Conference on Robotics and Automation (ICRA) (2018): 344-351.

[2] Fu, Yanchang et al. “A Reinforcement Learning Behavior Tree Framework for Game AI.” (2016).