

# Localization

In the localization part, we use Monte-Carlo to build our positioning system. We use particle filter with 500 particles to position our robot. The particle filter's input is the image from the robot, and the IMU data for the turning angle. Our system divided into two parts, first part is to find the feature points of the site from the robot camera, and second part is to match the feature points with the information of the of the feature points. Finally we can get the robot position. In the first part, we will get the image from the robot's camera. The image is gray-scale processed and edge detection is performed using Canny algorithm to obtain the edge of the field line. Then we use the scan line which is simulated in our system to get the feature points of the field line. As fig 1, the blue point is the feature point. Recording the pixel position of each feature point in the image and calculate its actual distance from the robot. It can facilitate the matching of the feature points. In the second part, we make a field map (1 pixel equal 1 cm) with the same scale as the actual site first. Then before the robot moves, we use the actual robot as the center, sprinkling random locations and directions on the simulation map within a certain range around. Each particle point represents possible positions after robot moves. The each particle point is scanned for feature points in its field of view to find the feature points. The field of view is the actual field of view of the current robotic camera. As Fig 2, the trapezoid is the range of the view for our robot. After finding the feature point, we calculate the distance between the particle point and the feature point, and then match the feature point obtained in the first part. Use the difference between the actual feature point distance and virtual feature point distance to calculate the possibility that the particle point is the actual robot position. The most likely particle point is the position of the robot. Before the RoboCup 2020, we still have lots things to work on. We will try to add the landmarks, field line, goal post and the center circle of the field to our feature points. Using these landmarks can improve the accuracy of positioning and solve the problem in low positioning accuracy when the robot didn't see any field lines.

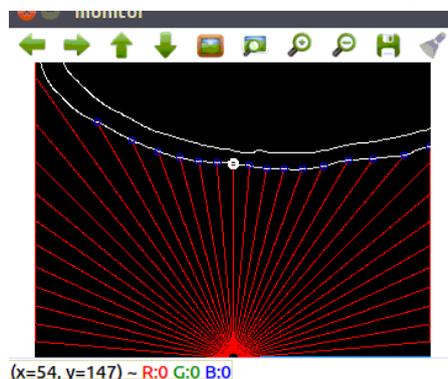


Fig 1. Feature point

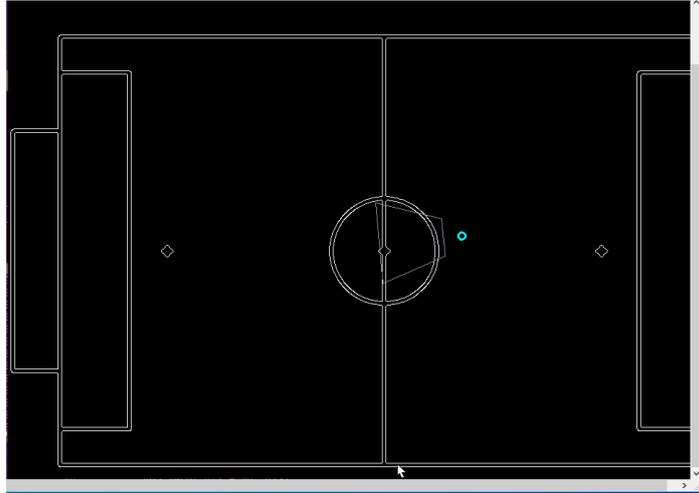


Fig 2. The field of view