SC 627

Assignment 2

21323600 1

Smit Kesaric

a) Plan a path using given potential planner

$$U_{att} = \begin{cases} \frac{1}{2} \chi\, d^2(q, q_{goal}) & , \quad d(q, q_{goal}) \le d^*_{goal} \\ d^*_{goal}\, \chi\, d(q, q_{goal}) - \frac{1}{2} \chi\, (d^*_{goal}) & , \text{otherwise} \end{cases}$$

where $\chi = 0.8$, $d^*_{goal} = 2$

$$U_{rep} = \begin{cases} \frac{1}{2} \left(\frac{1}{d_i(q)} - \frac{1}{Q^*} \right) & , \quad d(q) \le Q^* \\ 0 & , \quad \text{otherwise} \end{cases}$$

To plan path using potential function, we need to find the gradients of attractive and repulsive function and minimize the attractive gradients and repulsive gradients

$$\nabla U(q) = \left\{ \frac{\partial}{\partial x} U(q) , \frac{\partial}{\partial y} U(q) \right\}$$

gradient gives a vector in the increasing direction of the function

$$\therefore \nabla u_{att} = \begin{cases} 0.8\,(x - x_g),\ 0.8(y - y_g), & d(q, q_{goal}) < L \\ \dfrac{1.6\,(x - x_g)}{d(q, q_{goal})},\ \dfrac{1.6\,(x - x_g)}{d(q, q_{goal})}, & \text{otherwise} \end{cases}$$

$$\nabla u_{rep} = \begin{cases} 0.8\left(\dfrac{1}{2} - \dfrac{1}{d_i(q)}\right)\dfrac{1}{d_i^3(q)}(x - x_g),\ 0.8\left(\dfrac{1}{2} - \dfrac{1}{d_i(q)}\right)\dfrac{1}{d_i^3(q)}(y - y_g) \\ \qquad \text{if } d_i(q) \le L \\ 0 \qquad \text{otherwise} \end{cases}$$

$d_i(q)$ is the distance from point q to 'i' obstacle

Final potential path planner is

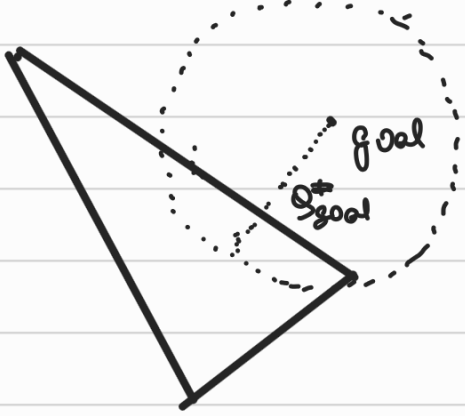
$$Dir = -\nabla u_{att} - \left(\sum_{i=1}^{n} \nabla u_{rep}(i)\right)$$

where $\nabla u_{rep}(i)$ is ∇u_{rep} for i th obstacle

Dir is the direction in which the robot should move step size distance.

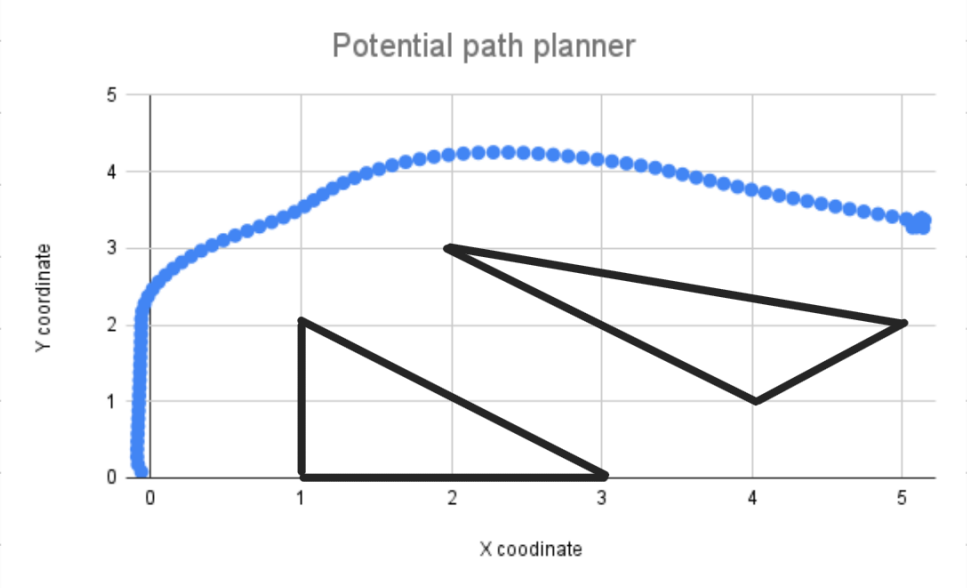
Explanation for oscillations:

The robot should stop at minima of attractive function but here, the quantity q^* affects the minima



The factor Q^*_{goal} says that if the robot is in the distance less then equal to Q^*_{goal}, then it will experience repulsive force. Since our goal point is in the Q^*_{goal} radius from the obstacle, the robot will experience repulsive force, but at the same time it will experience attractive force as it moves away from goal. Hence the robot oscillates around a point far from goal

Path planned and followed by robot:



Distance to goal with time