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SC627 Assignment_2

Potential Function

Potential functions for attractiveness and repulsiveness is given in the problem shared. We can find their respective gradient to get the attractive and repulsive force.

The following functions are defined for a point on a coordinate plane 'q'. This point is represented in terms of the x, y coordinates. Therefore, $\mathbb{R}^2 \ni q = \{(x, y) \in \mathbb{R} \times \mathbb{R}\}$

Attractive potential and gradient:

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

$$\nabla U_{att}(q) = \begin{cases} \chi(q - q_{goal}), & d(q, q_{goal}) \leq d^*_{goal} \\ \dfrac{d^*_{goal}\ \chi(q - q_{goal})}{d(q, q_{goal})}, & otherwise \end{cases}$$

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

$and\ d(a, b) \Rightarrow euclidian\ distance\ between\ a, b$

$$\therefore\ \nabla U_{att}(x, y) = \begin{cases} 0.8(x - x_{goal}), 0.8(y - y_{goal}), & d(q, q_{goal}) \leq 2 \\ \dfrac{1.6(x - x_{goal})}{d(q, q_{goal})}, \dfrac{1.6(y - y_{goal})}{d(q, q_{goal})}, & otherwise \end{cases}$$

Similarly, the obstacle provides a repulsive potential given by:

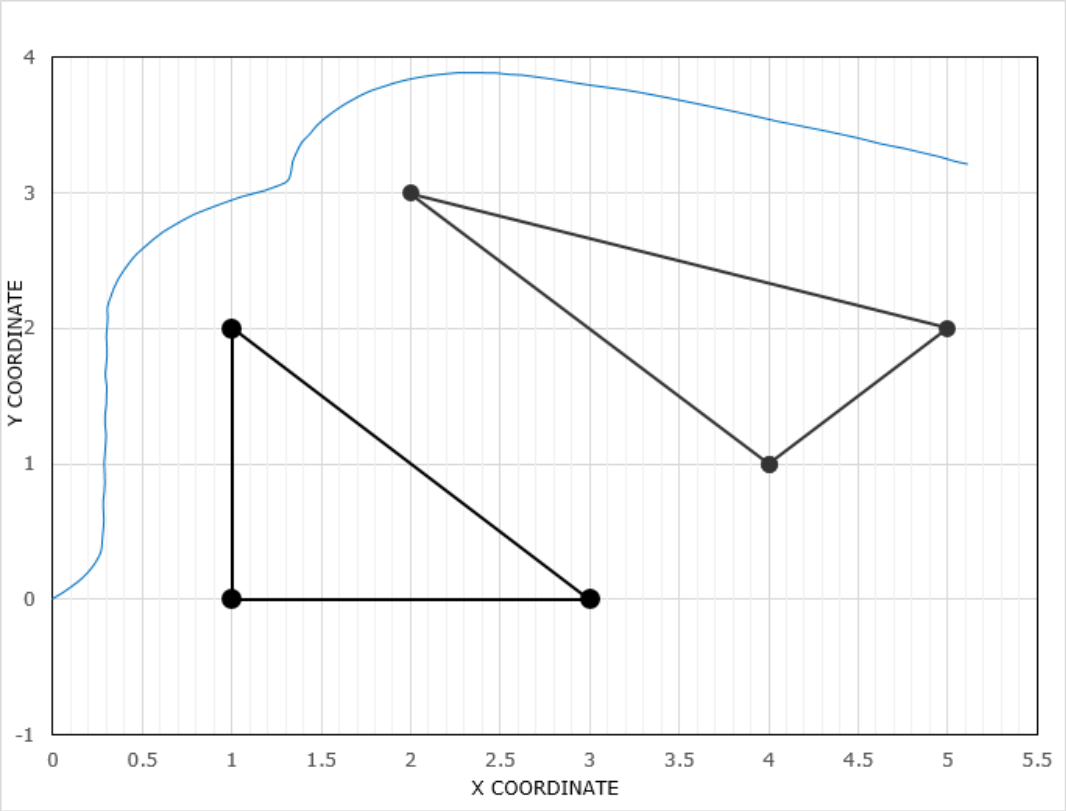
$$U_{rep}(q) = \begin{cases} \frac{1}{2}\eta\left(\frac{1}{d(q)} - \frac{1}{Q^*}\right), & d(q) \leq Q^* \\ 0, & otherwise \end{cases}$$

$$\therefore \nabla U_{rep}(q) = \begin{cases} \eta\left(\frac{1}{Q^*} - \frac{1}{d(q)}\right)\frac{1}{d^3(q)}(q - q_{goal}), & d(q) \leq Q^* \\ 0, & otherwise \end{cases}$$

Public

Total path length / Trace of the curve = 7.999 units

Time = 109

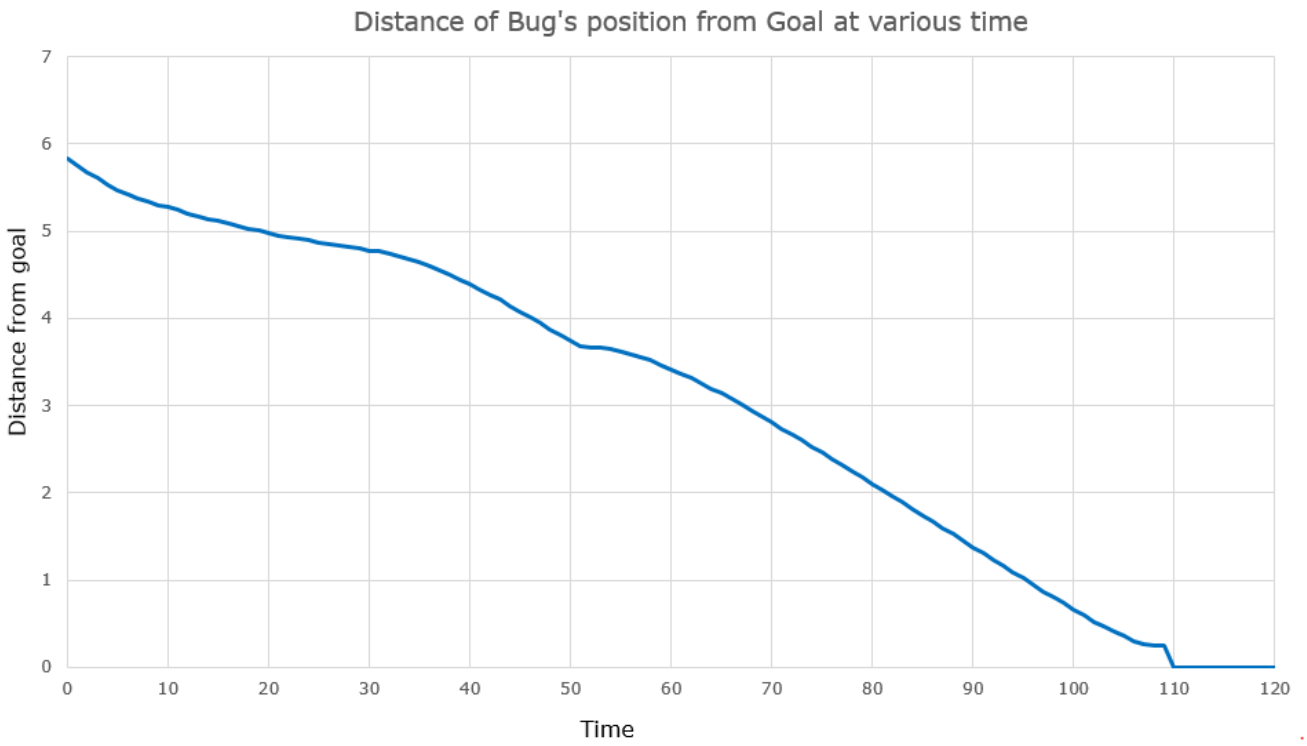


It is evident from the graph above that the goal (5,3) is not reached exactly . It can be explained through attractive and repulsive forces resultant. When $d(q,q_g) <= D^*_g$, the attractive force component decreases linearly.

When it is near to this region then repulsive forces will still be present, so the combination of attractive and repulsive potentials can result in a point location difference from goal.

Also we observe that the path length with this methodology is significantly reduced from 28.09 units to just 7.99units. The distance of bug's position from goal keeps on decreasing in this method and completes in 109 steps which is approximately three times lesser than bug1 time.

Public


Distance of Bug's position from Goal at various time
Distance from goal
Time
0
1
2
3
4
5
6
7
0
10
20
30
40
50
60
70
80
90
100
110
120

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