SC 627
Assignment 2 - Potential Fields

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Methodology

The implementation is as described in the problem statement and utilizes the same potential functions:

- Attractive Potential

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

with $\chi = 0.8$ and $d^\star_{goal} = 2$

- Repulsive Potential (for each obstacle)

$$U_{rep_i}(q) = \begin{cases} \frac{1}{2}\eta \left(\frac{1}{d_i(q)} - \frac{1}{Q^\star_i}\right)^2, d_i(q) \leq Q^\star_i \\ 0, else \end{cases}$$

with $\eta = 0.8$ and $Q^\star_i = 2$
Total Repulsive Potential = Sum of Repulsive Potentials for Each Obstacle

Convergence near the goal

It was observed that the robot oscillates near the goal right before it attains it. It was due to the presence of a local minima near the goal (on changing parameters). This was causing a jittery path towards the end.
As a consequence to this, a check was introduced into the implementation of the algorithm that would cause the robot to move directly in the direction of the goal when it is within a (pre decided) close range of goal.

Escaping local minima

It is a known fact that potential fields based algorithms have a drawback of getting stuck in a local minima instead of a global one (goal). To counter this, an `escapeLocalMin` method can be implemented that throws the robot towards the goal by a fixed/variable distance. This will be auto-executed if the algorithm recognises that the robot is struck in a local minima which means that it oscillates about a point for a sufficiently long time. A modified implementation of the same can also ensure that the robot does not hit any obstacle when it is thrown towards the goal.

Path Visualization

Here is the planned and executed path followed by the robot by potential fields based path planner