The Actor/The Environment: Steps for Creating Motion Planning

1) Bound the actor by a cylinder
2) Project all objects on the ground in a 2-D form
3) Shrink the disk representing the actor to a point and grow the obstacles accordingly with this same radius – project everything that actor could possibly collide
4) Put the map on a grid and map out shortest path with algorithm
5) Make the actor follow this path- some sort of walking/motion pattern

Integration of Motion Planning and Motion Capture

- Simulated Vision: only see one portion of environment
  - Plan with local model –will know what it has seen, nothing else
    - Perception-Based Planning
      - Simulated Vision → Fast Path Planner → Path Following Controller
      - Sense→Plan→Act→Sense (repeat)

Configuration Space of a Moving Rigid Object

2-D: (x,y, angle)
C=configuration space; F= free space

- Shrink object to point and grow obstacle accordingly
- Enlarge all obstacles as if traced by disk of rigid object
- Configuration Space of Translating Polygon
  - Reference point – trace the obstacle creating new ones based on path of reference point
  - Not aloud to rotate (different orientation = different Configuration space)
- Configuring Space of a Translating and Rotating Object in 2-D workspace
  - Reference point and reference direction
  - Build forbidden region slide by slide from $\theta = 0$ to $\theta = 2\Pi$] (repulsion for 3-D workspace)
    - Additional edge appears when edge of robot/obstacle are parallel

3-D WORKSPACE

- Closest point of robot to obstacle is repulsion potential
- Change Rotation based on Repulsion/Attraction forces to create a torque

$q = (x,y,z,\Phi,\psi, \theta)$ → 6-D configuration space
Rotation:(n,Φ) $n = [\cos\psi \cos\Phi, \cos\psi \sin\Phi, \sin\psi]$

Metric in Configuration Space

- What is the distance between two configurations? (2-D space)

* $d(p_1, p_2)$ = distance formula (x_1, y_1) & (x_2,y_2)
* $d_2(p_1,p_2) = |x_2-x_1|^2 + |y_1+y_2|^2$

A metric or distance function d in C is a map

$d: (q_1,q_2) \in C\times C \rightarrow d(q_1,q_2) \geq 0$

such that:

Non-degeneracy: $d(q_1,q_2) = 0$ iff $q_1 = q_2$
Symmetry: $d(q_1,q_2) = d(q_2,q_1)$
Triangle inequality: $d(q_1,q_2) \leq d(q_1,q_3) + d(q_3,q_2)$

~~$d = |x_2-x_1| + |y_2-y_1| + |\theta_2-\theta_1|$~~ No b/c get 0

~~$d = |x_2-x_1| + |y_2-y_1| + \min\{|\theta_2-\theta_1|, 2\pi-|\theta_2-\theta_1|\}$~~ No b/c units are not the same

$d = |x_2-x_1| + |y_2-y_1| + \rho\times\min\{|\theta_2-\theta_1|, 2\pi-|\theta_2-\theta_1|\}$ ← characterizes motion of point that moves the most