

22 OCTOBER 2007
MAP BUILDING
-AND-
MOTION PLANNING FOR ARTICULATED OBJECTS

Map building: Robot seeks to acquire information about the environment. No specific target or goal necessary.

Sensing and contour alignment: During map building, robot may roll around, creating samples of the environment, but then the local maps must be merged globally with a smart algorithm.

Dealing with uncertainty in map building

1. Global optimization: Loop in the environment and match local maps. This is the counter to the accumulated error of all local optimizations.
2. Simultaneous Localization and Mapping (SLAM)
3. Next-Best View (NBV) planning
 - a. As robot explores environment, it decides where to explore next.
 - i. Robot: "Assuming there aren't any more obstacles than what I can see from here, where do I go next so that I will be able to get the best view?"
 - b. Criteria for next position ("best view"):
 - i. Field of vision with maximum area
 - ii. Field of vision containing threshold amount of previously-charted territory (in order to keep globally optimizing).

Configuration space of an articulated robot

4. A tuple of non-redundant parameters which specify position and orientation of robot's bodies.
5. Example: Robot arm with 2 joints has parameters q_1, q_2 in radians (the parameters represent joint angles). Euclidean representation of its configuration space is $[0, 2\pi] \times [0, 2\pi]$ where paths in the set "wrap" around the set → Topology of configuration space is realizable as a torus.
6. It is possible to set up obstacle representations in the configuration space as well.
 - a. Can be done algebraically by computing coordinate transformations
 - b. Can be done exhaustively by making a grid of the configuration space and checking every grid cell for collision.
 - i. Both (a) and (b) become incredibly complex as dimensions increase (or, in (b) case, as grid is discretized at smaller intervals)
 - c. Practical approach: Probabilistically select points in the configuration space and check for collisions, and use this to get a good overall approximation of obstacles in configuration space.

