Kinodynamic Motion Planning

February 21, 2022

Problem statement

$$RRT : (X, \theta, f, \epsilon) -> \text{path}$$

X - map. It is splitted into free space and obstacles.
The map is rectangular and is defined by its height and width:

$$X \in \mathbb{R}^2$$

Each obstacle is a polygon defined by its vertices:

$$X_{o_i} \in \{\mathbb{R}^2\}$$

Thus, free space can be defined as follows:

$$X_f = X \setminus X_o$$

θ - turning radius. It is defined as forward velocity divided by maximum angular velocity:

$$\theta = \frac{v_f}{v_a}$$

f - steering function. A function (ex. Dubins, Reeds-Shepp) taking two points as input and returning either a path or none (if no path can be constructed)

$$f : \mathbb{R}^2 -> \text{path}$$

ϵ - precision, error level that will be ignored. It is defined as a tuple with error values for x, y and θ respectively:

$$\epsilon = (\epsilon_x, \epsilon_y, \epsilon_\theta)$$

Goal control function $g(p, \epsilon)$ checks if position p can be treated as final within ϵ precision:

$$g(p, \epsilon) = 1_3\Big[(\epsilon_x - p_x \geq 0) + (\epsilon_y - p_y \geq 0) + (\epsilon_\theta - p_\theta \geq 0)\Big]$$