

Model Free Reinforcement Learning

Application to Area Coverage Optimization

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Outline

- Concept of Area Coverage Algorithm
- Reinforcement learning
- Equations
- Neural Network
- Milestones

Area Coverage Algorithm

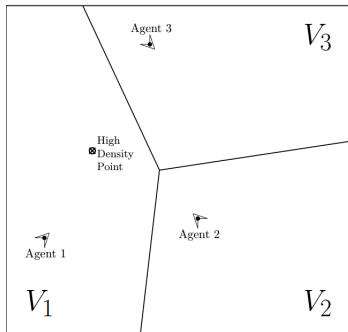


Figure: Voronoi regions

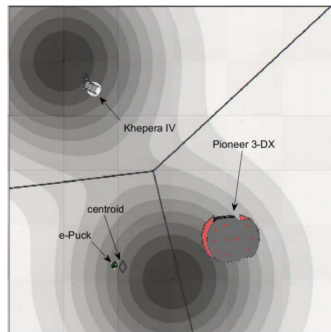


Figure: V-rep simulation

Problem Setup

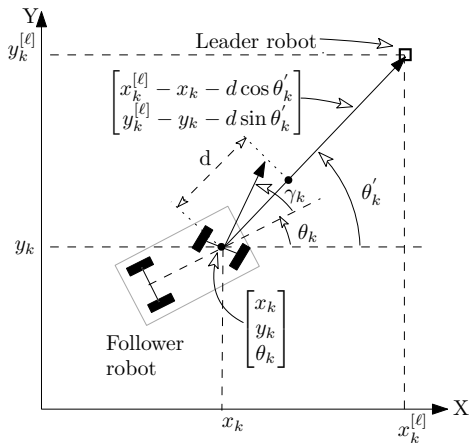


Figure: Problem Setup

$$\mathbf{u}_k = [\nu_k, \gamma_k]^T \in \mathbb{R}^2 \quad (1)$$

$$\mathbf{e}_k^T = \left[x_k^{[\ell]} - x_k - d \cos \theta'_k, y_k^{[\ell]} - y_k - d \sin \theta'_k, \theta'_k - \theta_k \right] \quad (2)$$

$$V(\mathbf{e}_k, \mathbf{u}_k) = \sum_{\kappa=k}^{\infty} \frac{1}{2} \left(\mathbf{e}_{\kappa}^T \mathbf{Q} \mathbf{e}_{\kappa} + \mathbf{u}_{\kappa}^T \mathbf{R} \mathbf{u}_{\kappa} \right) \quad (3)$$

$$\mathbf{z}_k = [\mathbf{e}_k, \mathbf{u}_k]^T \in \mathbb{R}^5 \quad (4)$$

$$\hat{V}(\mathbf{z}_k) = \frac{1}{2} \mathbf{z}_k^T \mathbf{P} \mathbf{z}_k + \hat{V}(\mathbf{z}_{k+1}), \quad (5)$$

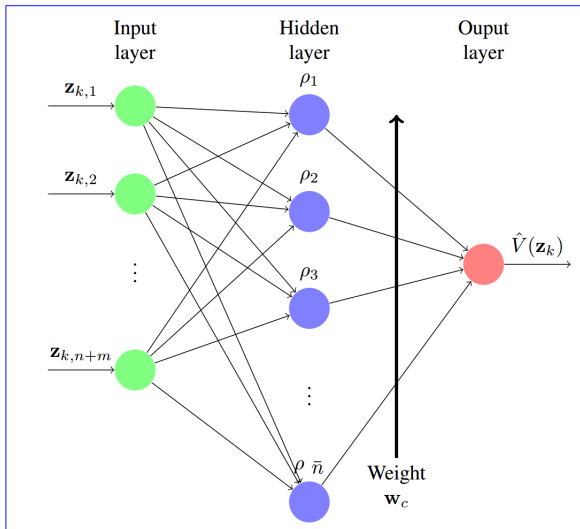


Figure: Neural Network Architecture

Milestones

- Merge the leader follower model free reinforcement learning as a function in the area coverage algorithm.
- Simulate the results in matlab.
- Integrate matlab with CoppeliaSim and perform the simulation.

Questions?