Model Free Reinforcement Learning

Application to Area Coverage Optimization

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Outline

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

Area Coverage Algorithm

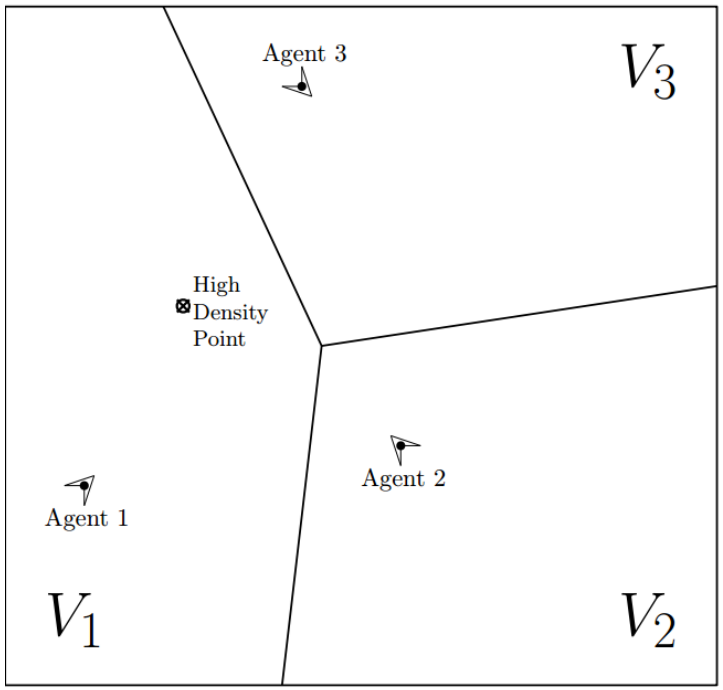

Figure: Voroni regions

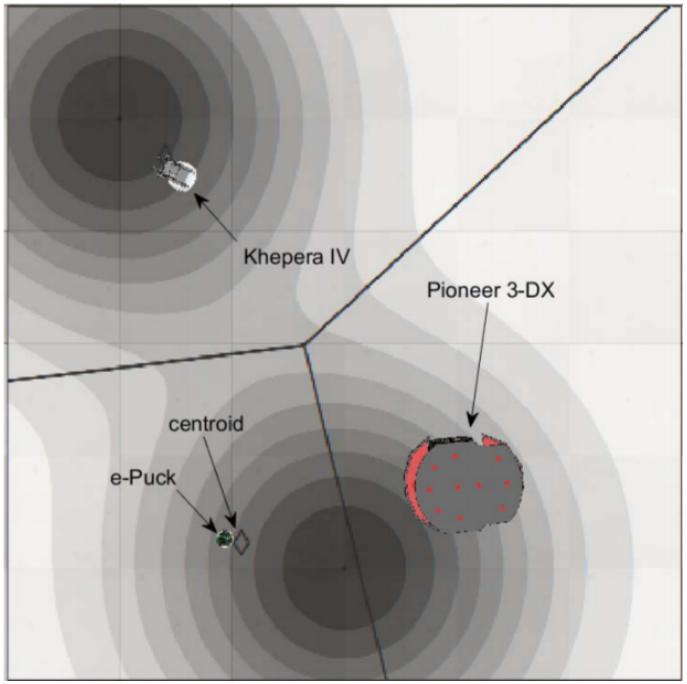

Figure: V-rep simulation

Problem Setup

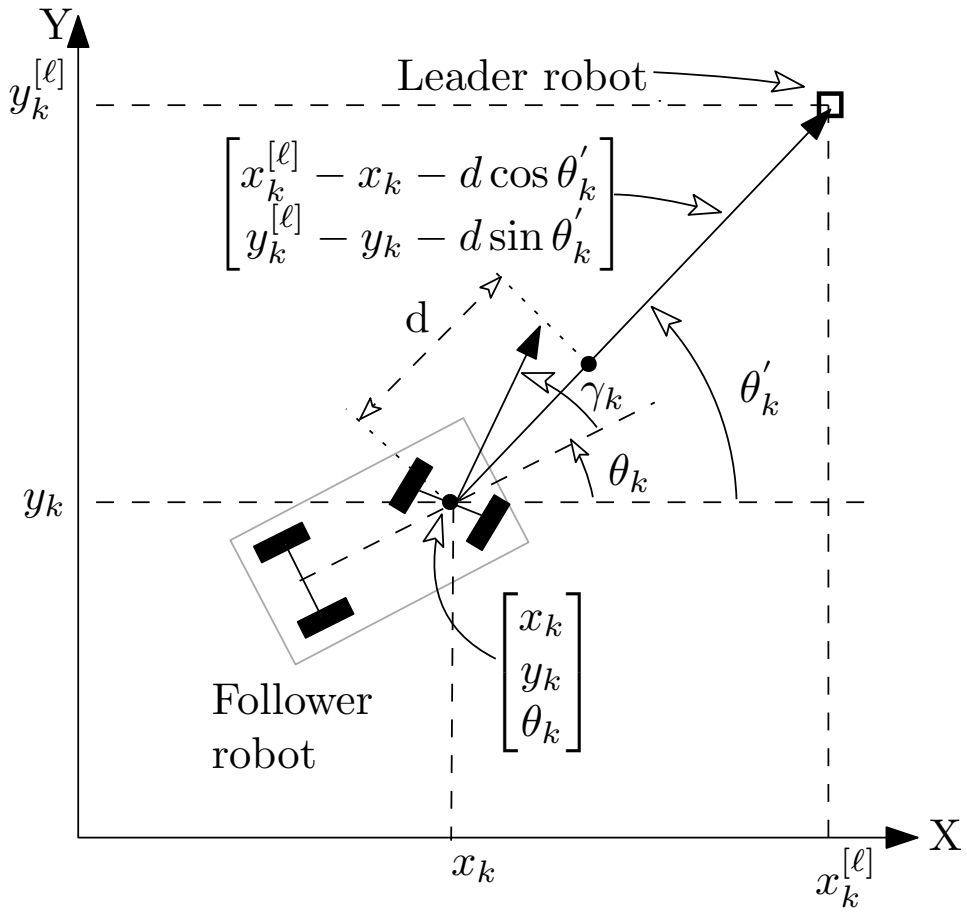

Figure: Problem Setup

Equations

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

$$e_k^T = \left[x_k^{[\ell]} - x_k - d\cos\theta_k', y_k^{[\ell]} - y_k - d\sin\theta_k', \theta_k' - \theta_k \right] \tag{2}$$

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

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

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

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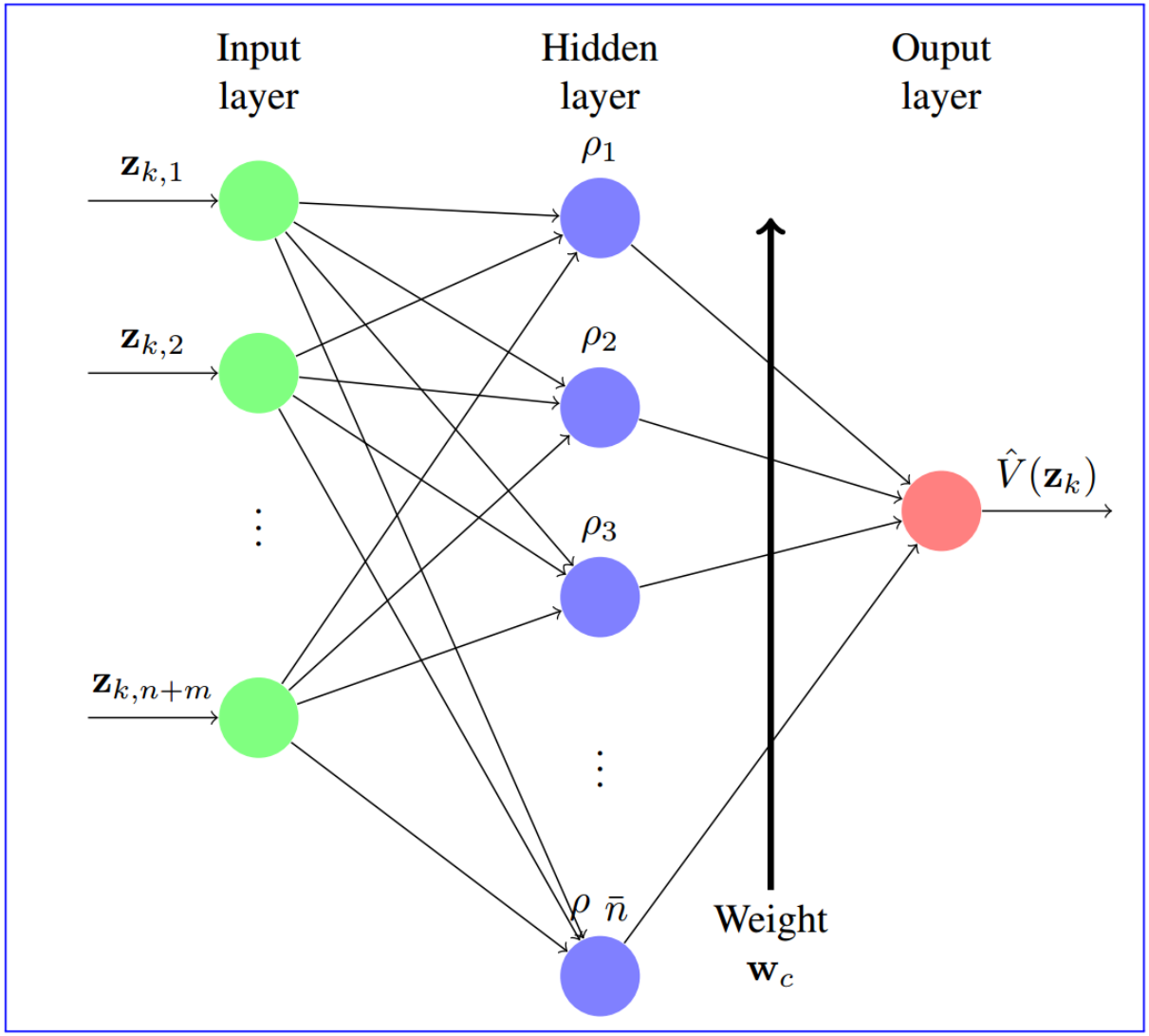

Figure: Neural Network Architecture

Milestones

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

Questions?