Simulation and Reinforcement Learning with Soccer Agents

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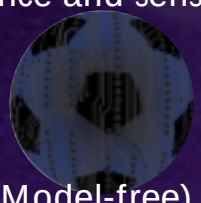
Research Objective

This research presents a novel reinforcement learning technique in stochastic and dynamic environments

- Investigate simulation-based optimisation and reinforcement learning techniques.
- Define the state space reduction methodology for large, stochastic and continuous spaces.
- Analyse and investigate the convergence and sensitivity of reinforcement learning.



Research Methodologies

- Adopt Temporal Difference learning (Model-free) combining dynamic programming and Monte Carlo techniques.
- Utilise eligibility traces for improving the learning speed and a linear approximation function technique known as Tile Coding to avoid the state space growing exponentially.
- Analyse the convergence and sensitivity using statistical techniques.

Simulation System

A soccer game called SoccerBots (Fig.1) is adopted as simulation environment. The learning will involve the following problems:

- Competitive skills: can the individual agents learn to intercept, shoot, dribble, clear, etc.
- Communication and cooperative skills: when and how to pass; when and where to move to receive a pass, etc.
- Learning and agent teaming: is there an interaction between the individual learning and that necessary for the team to perform optimally.

Empirical Results

- Successfully learn the desire skills.
- Convergence to optimality (Fig. 2).
- Improvement on learning speed by analysing the sensitivity of parameters (Fig. 3).

Conclusion and Future Work

- Proved learning abilities for decision-making in stochastic and unknown environments.
- Enhanced learning rate by analysing convergence and sensitivity.
- May combine with Bayesian learning techniques.

Figure 1 *SoccerBots Simulation Environment*

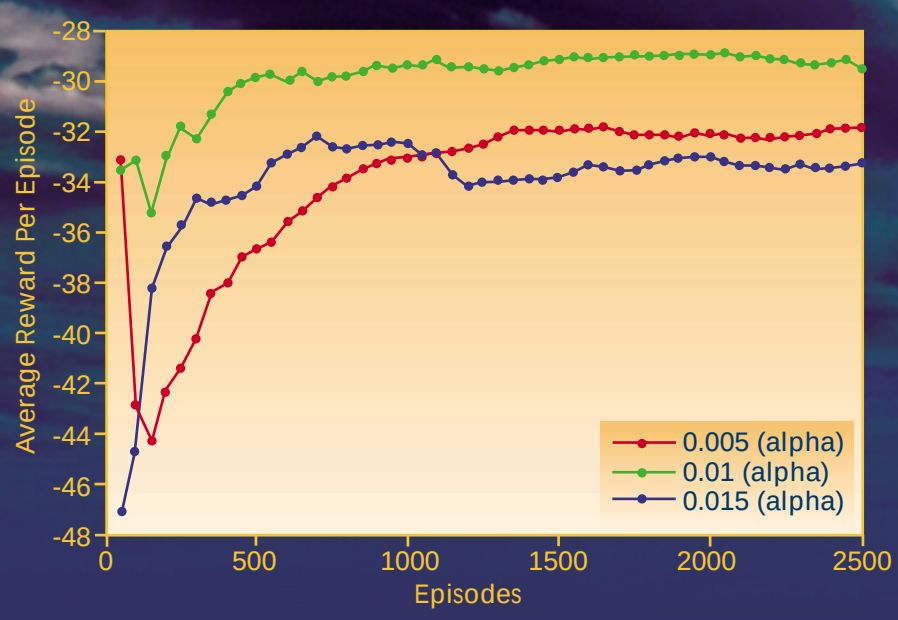


Figure 2 *Convergence with different learning rate*

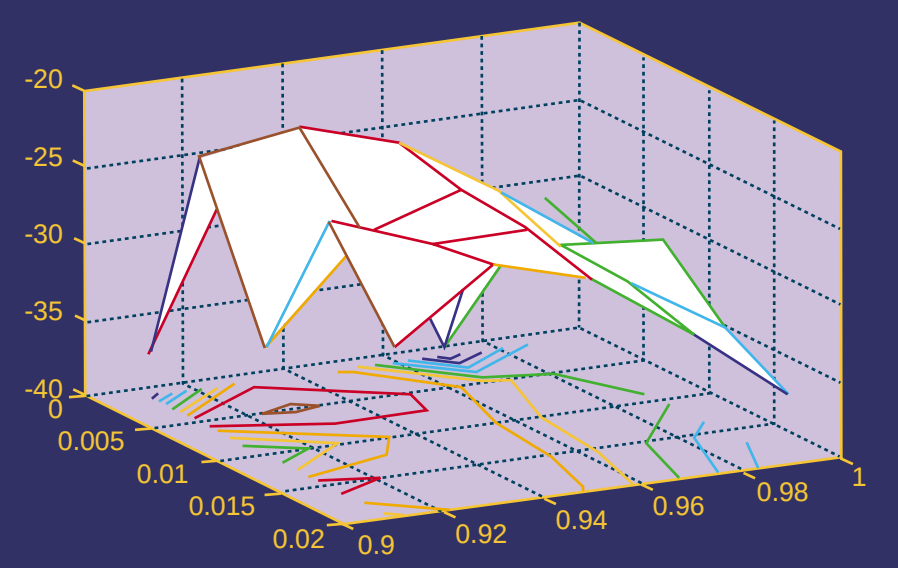


Figure 3 *Optimal values for learning rate and discount rate*