Muhammad Abdullah
COM 407 project proposal

Structured-State Deep Q-Learning for Xpilot: Training an Autonomous Survival Agent

Overview

This project aims to design and train an autonomous agent for *Xpilot*, a 2D multiplayer space combat game, using Deep Reinforcement Learning (DRL) with structured-state inputs. Instead of using raw pixel data, the agent will receive structured numerical representations of the game environment, such as positions, velocities, and orientations of players and obstacles. The focus will be on developing a Deep Q-Network (DQN) model capable of learning survival oriented behaviors such as avoiding walls, evading enemy projectiles, and navigating intelligently.

Motivation

Raw pixel-based deep learning methods often require high computational power and extensive training time. By using structured-state information, this project aims to enable faster learning and more stable policy development while still leveraging the adaptability of reinforcement learning.

Objectives

1. Develop a simplified Xpilot environment that provides structured-state data and accepts discrete actions (rotate, thrust, shoot).

2. Implement and train a Deep Q-Network (DQN) to maximize survival time.

3. Evaluate agent performance over episodes and visualize learning trends.

Methodology

The agent will be trained via trial and error, using a reward function that reinforces survival (+ve score per time step alive) and penalizes death (–ve score). The DQN will be implemented in Python using PyTorch, with experiments run over multiple episodes to observe progressive learning.

Deliverables

- Trained DQN model and source code.

- Visualization of training curves and agent performance metrics.

- Project website summarizing design, methods, results, and future improvements.