1 Abstract

This is just the abstract, which explains what it is that this project is about.

2 Literature Review

2.1 Reinforcement Learning

2.1.1 Definitions

Agent Environment State Action Reward

2.1.2 Markov Decision Processes

2.1.3 The Bellman Equation

Equation that represents the value of being in a particular state, based on the reward given for being in that state and the value of the best possible adjacent state that can be reached by taking one action, usually multiplied by a discount factor. This results in a recursive equation, as the value of the state depends on the value of its surrounding states. Typically, one can start from the goal state and propagate the state values "backwards". .

2.1.4 Q Learning

Replace the state value function in the Bellman equation with the Q function. This can be interpreted as "action quality".

2.1.5 Q learning with neural networks

Instead of using a table to store the policy, the policy is "stored" in a neural network. This has consequences for stability.

2.1.6 Types of reinforcment learning

3 Problem Formulation

In a navigation problem, one generally has a destination that you wish to get your system to. If the environement is deterministic, using some kind of path planning method like A* works well, as long as the "obstacles" are known. When the environement is dynamic and unknown, this is not as easy. The "global" path may still be there, but there might be many small local obstacles that need to be avoided. A local avoidance system is therefore needed.

Potential fields might lead to oscillatory behaviour.

Dynamic window assume no sideways velocity, which is difficult in the context of ocean currents. Also computationally heavy, but works well with COLREGS.

4 Questions

4.1 What is a Serret Frenet Frame?

Signes master

4.2 What is set-based control?

Signes PhD says:
Signes

4.3 how can you show that set-based control laws will always be followed?

The project has the following steps:

1. Perform a literature review on the topic of marine surface vessel modeling and control, as well as deep learning techniques used in tandem with control problems.
2. Set up a simulation environment for the surface vessel, incorporating difference levels of disturbances.
3. Set up a baseline using the established control algorithms
4. Apply reinforcement learning to the system and figure out how to train the system effectively.
5. Analyse the performance of the machine learning controllers, compare the computation time (the expensiveness) between the two algorithms, and explore the stability consequences of using machine learning techniques in control. machine learning