MS Robotics and Intelligent Machine Engineering

ASSIGNMENT 1

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Network-Based Learning from Demonstration for an Autonomous Ground Robot

Abstract

This research paper explores the use of neural network-based learning from demonstration (LfD) techniques to enhance the autonomous capabilities of ground robots. The study focuses on developing and implementing neural network models that can learn complex tasks by observing human demonstrations, aiming to improve the robot's performance in real-world scenarios..

Introduction

The advancement of autonomous ground robots has significant implications for various industries, from logistics to defense. Traditional programming of these robots can be time-consuming and inflexible. Learning from demonstration offers a promising alternative by enabling robots to learn tasks through human demonstrations. This paper investigates the application of neural networks in LfD to create a more adaptable and efficient learning process for autonomous ground robots

Related Work:

Previous studies in LfD have utilized various machine learning techniques, including decision trees and support vector machines. However, these methods often struggle with high-dimensional data and complex tasks. Neural networks, with their ability to model non-linear relationships and process large datasets, present a superior alternative. This section reviews existing LfD methodologies and highlights the advantages of neural network-based approaches.

Methodology

The proposed method involves collecting demonstration data from human operators performing specific tasks with a ground robot. This data is then used to train a neural network model. The network architecture is designed to handle the high-dimensional input data and output control commands for the robot. The training process includes preprocessing steps such as normalization and augmentation to enhance the model's robustness.

Experiments and Results

Experiments were conducted using a ground robot equipped with sensors and actuators to perform tasks such as navigation and obstacle avoidance. The neural network model was trained on a dataset of demonstrations and tested in various environments. The results showed that the robot successfully learned the demonstrated tasks, achieving high accuracy and adaptability. The performance of the neural network-based LfD approach was compared with traditional methods, demonstrating significant improvements.

Discussion

The findings indicate that neural network-based LfD is a viable and effective approach for training autonomous ground robots. The flexibility and scalability of neural networks allow for the learning of complex tasks that were previously challenging for traditional methods. The discussion also addresses the limitations of the current study, such as the need for large amounts of training data and the potential for overfitting.

Conclusion

This research demonstrates the potential of neural network-based learning from demonstration to enhance the autonomous capabilities of ground robots. By leveraging the strengths of neural networks, robots can efficiently learn from human demonstrations, leading to improved performance in real-world applications. Future work will focus on refining the neural network models and exploring their application to a wider range of tasks and environments