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Theme Thesis:

Applying Deep Reinforcement Learning for Autonomous Driving in CARLA Simulator

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Abstract

In this thesis, we propose a Deep Q-Network (DQN) approach to develop an autonomous vehicle system enabling path understanding and collision avoidance. The purpose of this work is to simulate a scenario and train a DQN algorithm in a virtual environment using the CARLA simulator.

We create a reward function to simulate human driving behavior using a continuum equation designed specifically for this case.

The results show that the proposed method can navigate to the goal without colliding with obstacles. Furthermore, by analyzing the behavior of the DQN algorithm, it is clear that increasing the number of training sets leads to better results.

This approach, involving non-global path planning, is effectively implemented on virtual environment platforms. This differentiation sets it apart from other autonomous vehicle designs because it can be easily tested in simulations and opens up opportunities for additional experiments in future research.

ملخص

في هذه الأطروحة، نقترح استخدام نهج Deep Q-Network (DQN) لتطوير التحكم الذاتي نظام المركبات التي تمكن من تصميم مسار الرحلة و تجنب الاصطدام. الغرض من هذا العمل هو محاكاة سيناريو و تدريب خوارزمية DQN في بيئة افتراضية وهي محاكاة CARLA .

قمنا بأنشاء وظيفة مكافأة لمحاكاة سلوك القيادة البشرية باستخدام معادلة متصلة مصممة خصيصًا لهذه الحالة. تظهر النتائج أن المركبة يمكن أن تنتقل إلى الهدف دون الاصطدام بالعقبات. علاوة على ذلك، من خلال تحليل سلوك DQN

من الواضح أن زيادة عدد مجموعات التدريب تؤدي إلى نتائج أفضل. يتم تنفيذ هذا النهج الخاص الذي ينطوي على تخطيط المسار غير العالمي بشكل فعال على منصات البيئة الافتراضية. يميزها هذا التمايز عن تصميمات المركبات المستقلة الأخرى لأنه يمكن اختبارها بسهولة في عمليات المحاكاة وتفتح فرصًا لتجارب إضافية في البحث المستقبلي.

Résumé

Dans ce memoire, nous proposons une approche Deep Q-Network (DQN) pour développer Systèmes de véhicules permettant de concevoir la trajectoire et d'éviter les collisions. Le but de ce travail est de simuler un scénario et de former un algorithme DQN dans un environnement virtuel utilisant le simulateur CARLA. Créer une fonction de récompense pour simuler le comportement de conduite humaine en utilisant une équation de continuum conçue spécifiquement pour ce cas.

Les résultats montrent que la méthode peut naviguer vers le but sans entrer en collision avec des obstacles.En outre, en analysant le comportement de DQN, il est clair qu'augmenter le nombre de jeux de formation conduit à de meilleurs résultats.

Cette approche particulière qui comprend la planification des voies non mondiales est mise en œuvre efficacement sur les plateformes d'environnement virtuel. Cette différenciation la distingue des autres modèles de véhicules autonomes parce qu'elle peut être facilement testée dans des simulations et ouvre des possibilités d'expériences supplémentaires dans des recherches futures.

Acronyms

- **DRL:** Deep Reinforcement Learning
- **RL:** Reinforcement Learning
- **CARLA:** Cooperative Autonomous Robotic Learning Agent
- **GPS:** Global Positioning System.
- **DQN:** Deep Q-Network
- **DDPG:** Deep Determined Policy Gradient
- **ML:** Machine Learning

- **DDQN:** Double Deep Q-Network
- **PPO:** Proximal Policy Optimozation
- **DL:** Deep Learning
- **SAE:** Social of Autonomous Engineers
- **CNN:** Convolutional Neural Network
- **FPS:** Frames Per Second
- **ITS:** Intelligent Transport System
- **MDP:** Markov Deci-sion Processes
- **TD3:** Temporal Difference
- **AD:** Autonomous Driving

- **AV:** Autonomous Vehicle

- **DNN:** Deep neural network

- **SAC:** Soft Actor-Critic