

Collision prediction based genetic network programming-reinforcement learning for mobile robot navigation in unknown dynamic environments

ABSTRACT

The problem of determining a smooth and collision-free path with maximum possible speed for a Mobile Robot (MR) which is chasing a moving target in a dynamic environment is addressed in this paper. Genetic Network Programming with Reinforcement Learning (GNP-RL) has several important features over other evolutionary algorithms such as it combines offline and online learning on the one hand, and it combines diversified and intensified search on the other hand, but it was used in solving the problem of MR navigation in static environment only. This paper presents GNP-RL based on predicting collision positions as a first attempt to apply it for MR navigation in dynamic environment. The combination between features of the proposed collision prediction and that of GNP-RL provides safe navigation (effective obstacle avoidance) in dynamic environment, smooth movement, and reducing the obstacle avoidance latency time. Simulation in dynamic environment is used to evaluate the performance of collision prediction based GNP-RL compared with that of two state-of-the art navigation approaches, namely, Q-Learning (QL) and Artificial Potential Field (APF). The simulation results show that the proposed GNP-RL outperforms both QL and APF in terms of smooth movement and safer navigation. In addition, it outperforms APF in terms of preserving maximum possible speed during obstacle avoidance.

Keyword: Collision prediction; Genetic Network Programming with Reinforcement Learning (GNP-RL); Mobile robot navigation; Unknown dynamic environment