engineering proceedings

Abstract

A Framework for Intelligent Decision making in Network of Heterogeneous System (UAV's, Ground Robots) for Civil Applications

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Keywords: Cyber Physical System; Unmanned Aerial Vehicle; Multi Agent Reinforcement Learning.

Abstract: Cyber Physical Systems (CPS) are connected embedded devices with computing power, networking ability, control, and decision capability. The network connecting these devices is different from the Internet as they can sense their environment, share information, take decisions, and act based on local and global information. These capabilities enable the CPS to improve transportation, agriculture, healthcare, mining industry and surveillance. The remarkable achievement in development of cost effective, reliable, smaller, networked and more powerful systems allow us to build new control and communication mechanisms, as well as cooperative and coordinated motion planning algorithms to enable these devices to assist humans to cope with the real-time problems. In this paper, we proposed a learning-based distributed framework for intelligent decision making in networks of heterogeneous systems, to optimally plan their activities in highly dynamical environment. We leverage the multi-Agent deep Reinforcement Learning (MADRL) technique to develop control and coordination strategies for team of UAVs and group ground moving robots. The developed framework enables the team of Unmanned Aerial Vehicles (UAVs) to observe the defined region above the ground correctly and efficiently, and to share information with ground robots, to perform robust actions. Our main objective is to maximize utilization of the strong abilities of each CPS device. UAVs can observe the environment from top and gather fast and reliable information to share with the rescue robots working on ground, but they cannot perform rescue tasks on the ground; on the opposite, rescue robots cannot gather reliable information due to lack of visual limitation. In this framework, we train several DQN-agents to learn the optimal control policy for the team of cooperative heterogeneous robots in a centralized fashion, performing then the actions in a decentralized way. These learned polies are further transferred in real time to the robots and evaluated against real-time deployment of robots to perform tasks in the environment.

Citation: Imran M, Liberati F. Title. *Eng. Proc.* **2021**, *3*, x. https://doi.org/10.3390/xxxxx

Published: date

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