MISSION-CRITICAL COMMUNITCATIONS PLANNING OVER CONTESTED RF SPECTRUM WITH DEEP REINFORCEMENT LEARNING AIDED ARTIFICIAL INTELLIGENCE

Milidu Jayaweera, La Cueva High School, Albuquerque

ABSTRACT

Mission-critical communications (MCC) refer to those that support operations involving high risk to human life and property. As RF spectrum becomes highly contested, ensuring mission-success with MCC requires intelligent planning policies. This project develops a novel game-theoretic model for MCC and a Deep Q-Network (DQN) implemented Deep Reinforcement Learning (DRL) based *Mission-Critical Communications Protocol* (MCCP) to learn to complete a mission within given resource-constraints against an adversary. An example critical mission is defined as two radios exchanging messages within a given time-constraint over two oppositely-directed communication links in the presence of a jammer. Mission-planning requires radios to learn when and how to switch directions vs. channels in response to the behavior of the adversarial jammer as well as wireless channel anomalies. Through extensive-form sequential-game modeling, the problem was shown to be too complex to solve analytically and beyond traditional reinforcement-learning due to uncountable state-space. Results on an actual wireless network showed that the DQN-implemented DRL could achieve mission-success with 0.9 probability. A new DRL algorithm called *Deep Policy Hill Climbing* was developed that outperformed the original DQN-DRL algorithm by about 30%. Beyond MCC, this framework can be applied to many other *Planning-Under-Uncertainty* problems such as resource allocation in crop management.