Deep Reinforcement Learning Applications For Coexistence in Television Whitespace: A Mini-Review

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Abstract:
The ever-increasing demand for wireless communication services, coupled with the scarcity of available radio frequency spectrum, necessitates innovative approaches to spectrum management. Television White Space (TVWS) and Cognitive radio (CR) technology have emerged as a pivotal solution, enabling intelligent and dynamic spectrum sharing among secondary users while respecting the rights of primary, licensed users. However, a notable challenge to its effective utilization lies in the interference between primary and secondary users, as well as interference among secondary users themselves. In such networks, network entities must make local decisions to optimize network performance in the face of unknown network conditions. Reinforcement learning has effectively been utilised to help network entities choose the best policies, such as decisions or actions, based on their states when the state and action spaces are limited. However, in complex and large-scale networks, the state and action spaces are typically vast. Deep reinforcement learning, a fusion of reinforcement learning and deep learning, has been created to address these limitations. This paper explores the coexistence issue and evaluates the use of deep reinforcement learning (DRL) methods to enhance spectrum sharing in cognitive radio networks.

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I. Introduction
The increasing demand for wireless services and higher data rate applications has led to a growing need for spectrum. The supply of spectrum is clearly finite as it is a limited resource, but the demand for the spectrum is fundamentally unbounded, and traditional static frequency allocation cannot accommodate this ever-growing demand. Studies show that spectrum in frequency bands allocated to licensed services for TV broadcasting are underutilized, especially in sparsely populated areas [1] [2], prompting the exploration of opportunistic usage through cognitive radio (CR) technology. In this approach, primary users (PUs) hold licensed rights for specific spectrum portions in defined geographical areas, while unlicensed secondary users (SUs) access the unused spectrum holes known as TV Whitespace (TVWS) without causing harmful interference to primary users. The

propagation characteristics of TVWS make them attractive for wireless communications, leading various countries, including the United States, United Kingdom, Canada, Singapore, and Mozambique, to formulate regulations for utilizing TVWS in wireless communications.

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