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REINFORCEMENT LEARNING FOR DYNAMIC RESOURCE ALLOCATION IN 6G NETWORKS

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ABSTRACT

With the evolution toward 6G networks, the demand for efficient resource allocation mechanisms becomes very critical in meeting the requirements of ultra-reliable low-latency communications, massive machine-type communications, and extreme network capacity. The traditional resource allocation strategies are incapable of dealing with the 6G system's dynamic nature and high complexity, amid varying traffic loads, unpredictable user behaviors, and diverse application needs. Reinforcement Learning (RL), a subset of machine learning, has been considered a very promising approach to dynamic resource allocation in these advanced network architectures. By using RL, networks can automatically learn the best resource management strategies through interactions with the environment to improve the decision-making process over time.

This paper envisages the application of RL techniques for dynamic resource allocation in 6G networks, discussing various RL models, together with DRL, for optimizing spectrum management, power control, user scheduling, and interference mitigation. This article also discusses the implementation challenges of RL in 6G, which include the scalability of algorithms, real-time adaptation, and network environmental complexity. To that end, we point out the advantages of RL in improving network performance, fairness, and energy efficiency. Finally, we put forward a framework of integrating RL algorithms into the 6G network architecture by emphasizing real-time data feedback in the next-generation network collaborative design. In so doing, our approach will offer a guideline and lay down a path that is crucial in developing future generations of resource allocation paradigms in 6G networks.

KEYWORDS: *Reinforcement Learning, Dynamic Resource Allocation, 6G Networks, Deep Reinforcement Learning, Spectrum Management, Power Control, User Scheduling, Interference Mitigation, Network Optimization, Energy Efficiency, Real-Time Adaptation, Network Performance, Autonomous Learning.*

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