Chapter 5
Integration of Reconfigurable Intelligent Surfaces With Antennas for 6G Wireless Communications

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ABSTRACT

The evolution of wireless communication networks towards 6G demands innovative solutions to address the challenges of increasing data rates, network capacity, and energy efficiency. Reconfigurable intelligent surfaces (RIS) emerge as a promising technology that revolutionizes how wireless signals propagate and interact with the environment. In this chapter, the authors explore the integration of RIS with antennas for 6G wireless communications. RIS, comprised of programmable meta-surfaces, can dynamically manipulate electromagnetic waves to optimize signal quality, mitigate interference, and enhance network performance. By providing adaptive beam forming, beam steering, and signal enhancement capabilities, RIS-enabled antennas offer unprecedented flexibility and efficiency in communication systems. This chapter overviews RIS principles, discusses their integration with antennas, and highlights their potential to shape the future of 6G wireless communications.

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1. INTRODUCTION

Reconfigurable intelligent surfaces (RISs) are a potential system for improving seamless connectivity system's spectrum and environment friendly. Fulfilling the user's requirements for future 6G wireless networks is hampered by two major issues: power consumption and hardware expense discussed by Q. Wu (2020). Currently, the emerging reconfigurable intelligent surface (RIS) is being considered a feasible technique for increasing the transmission parameters with the spectrum performance of next-generation networks by exerting affordable active reflecting portions Pan, Cunhua, et al. (2021) shown in their work. These devices can reconfigure the wireless networks by precisely tweaking the Phase transformation of a large number of inexpensive passives reflecting components. However, Current cellular communication theories constrain. The advancement of RIS-assisted 6G networks, posing considerable challenges. In this chapter, we focused on the integration of RIS antenna for 6G with an improvement of network performance and reducing the co-channel interference.

1.1 RIS Background

Meta surfaces, the two-dimensional in-nature equivalents of metamaterials, are artificial structures made from tiny meta-atoms that are often organized in a periodic or aperiodic pattern on a plane. Meta surfaces have advanced rapidly over the last ten years and are now widely used in the creation of novel gadgets and services in the microwave, terahertz, and visible light spectrums. Snell's law describes both the radio wave reflecting and refracting over the point of interaction between two isotropic similar media. A revised version of The theory put forward by Snell asserts that: the presence of the phase differential causes irregular absorption or reflections, was put forth in 2011. At the meta surface, which acts as the interface between the two mediums explained by Hong, (2022).

1.2: Reconfigurable Intelligent Surfaces Significance

RISs are a demanding system in the realm of future communication and signal processing. In Basar E. et al. (2019) they are composed of collections of passive elements, such as antennas or reflectors, which can Dynamically modify electromagnetic radiation that travels across devices. These surfaces can be controlled in real-time to alter the propagation environment of wireless signals. The primary characteristic of RISs is their capacity to adaptively modify the Phase and frequency of the transmission. By doing so, G.C. Trichopoulos, (2022) can optimize the wireless communication links between transmitters and receivers by directing signals, reducing

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