Chapter 6

Conclusion and Future Scope

6.1 Conclusion

The current thesis focuses on improving the enormous connectivity and spectrum and energy efficiency of the proposed RIS-assisted NOMA system for next-generation communications. The RIS can change a fast-fading channel to a slow-fading channel by reconfiguring the wireless channel environment and tuning the phase of reflected signals constructively. By implementing superimposed code, NOMA can accommodate more users with the same time and frequency resources. In addition, this thesis is presented in four different aspects, which are as follows: The fundamental concepts of RIS, NOMA, and other cutting-edge PHY approaches were first introduced. Further theoretical analysis of RIS and NOMA transmission models for downlink and uplink. Second, by merging cooperative NOMA with precoded SM, capacity was increased. Thirdly, RIS combines with NOMA and other new technologies, such as IM/SM, to improve connectivity, spectrum efficiency, and energy conservation. Finally, for RIS-assisted hybrid NOMA, combined optimization of transmit antenna beamforming and reflecting elements phase was implemented at BS and

RIS, respectively. The following is a summary of the essential contributions and insights.

In Chapter 2, a precoded SM-aided C-NOMA for the downlink MIMO transmissions has been proposed, in which the near NOMA users are working in half-duplex mode. Therefore, it has two phases, namely: the broadcast phase and the cooperative phase. This system was considered all the channels are Rayleigh-flat fading and i.i.d and more number of transmitter antennas than the receiver antennas was considered to for decrease IUI. Moreover, MI and SER expressions were derived. These analytical results outperformed the conventional C-NOMA.

In Chapter 3, a proposed a RIS-assisted downlink IM-NOMA system for higher spectral and energy efficiencies for next-generation wireless communication has been proposed. This system has supported more users and improved cell-edge performance by assigning index modulation. The proposed system was also support a high data rate and achieves better BER performance at low SNR while reconfiguring the channel environment of users. More importantly, the BER performance improves with the number of reflecting elements at the RIS due to coding gain and enhanced diversity order.

In Chapter 4, the deployment strategy of RIS has been investigated in multiple RISs-assisted downlink NOMA system. It has improved the SEE and network coverage, as multiple RISs creates LoS channels between BS and users. The BEP upper bound expression is derived for NU and FU. The simulation results were verified with accuracy of the proposed analytical derivations. The deployment of RISs panels near BS or users gave a better performance than other positions, and the proposed system model yields superior performance over existing single RIS-NOMA and multiple parallel RIS. Further, it was observed that imperfect SIC at NU degraded the proposed system's performance.

In Chapter 5, a joint optimization of transmit antennas beamforming and reflecting elements phase at BS and RIS, respectively, has been implemented by using SDR and AO techniques. In the proposed RIS-assisted user-pairing hybrid-NOMA (PR-HNOMA), the number of far users were considered as higher than that of the near users' scenario. In this work, sum-rate performance has been maximized with a RIS-assisted hybrid NOMA system for the practical imperfect SIC (ISIC) scenario. A pivotal conclusion was made for the proposed PR-HNOMA system with conventional RIS-assisted HNOMA (R-HNOMA), RIS-assisted NOMA (R-CNOMA), and RIS assisted OMA (R-OMA) system.

6.2 Future Scope

In the preceding research, it was considered that BS and users have access to the ideal CSI. In the future, we will use artificial intelligence (AI)/deep learning to focus on imperfect CSI. Therefore, implementing the current RIS-assisted NOMA system with faulty CSI is hence more intriguing. In addition, THz frequencies are being explored because of their high data rates, although they suffer from obstructions between the transmitter and the receiver because of spreading loss and molecular absorption. The RIS-assisted NOMA, one of my ongoing research projects, mitigates this problem. Additionally, RIS-NOMA concentrates on Wireless Power Transfer (WPT), an exciting technology that holds the potential to extend the battery lives of Internet of Things (IoT) devices in upcoming wireless networks.

In the future, high Doppler shifts will be supported by RIS-assisted orthogonal time-frequency space (OTFS) modulation. Channel-induced Doppler shifts reduce the data rate and communication reliability in high mobility scenarios (such as high-speed trains or IoT, which may go from a static channel to a high-mobility channel). The information bits are first encapsulated within the delay-Doppler in OTFS modulation. The data is then transformed into time domain transmit signals. At the receiver, the received time domain is restored in delay-Doppler, from which extract the original information bits. Consequently, it combats the ISI and ICI. Therefore, RIS-assisted OTFS may be an extremely interesting area of study.