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Perspective

An Analysis of Machine Learning in Terms of Wireless Communication

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ABOUT THE STUDY

An Intelligent Reflecting Surface (IRS) is a programmable device that may be used to vary the surface's electric and magnetic characteristics in order to regulate the propagation of electromagnetic waves. For the sixth Generation (6G) of communication networks, IRS is therefore regarded as a smart technology. Additionally, as the computing power of devices has risen, Machine Learning (ML) techniques are increasingly commonly used in wireless communication. We provide a comprehensive introduction of the state-of-the-art in Machine Learning (ML), focusing on Deep Learning (DL)-based IRS-enhanced communication, because it is a growing area. We concentrate on their underlying operational concepts, Channel Estimation (CE), and machine learning applications to IRS-enhanced wireless networks. Additionally, we conduct a thorough analysis of current wireless networks with IRS enhancements. The addition of IRS and other cutting-edge technologies for applications to next-generation wireless communication also raises significant problems and research possibilities.

For the transformation of communication systems, DL is a possible and crucial approach. DL may be used in many aspects of IRS-enhanced wireless networks because of its ability for learning. The wireless communication system's ability to communicate effectively with MIMO requires fast acquisition and the right CSI. The estimate of CSI becomes more challenging and sophisticated in large MIMO communication systems due to the high number of antennas present. Many academics have undertaken DL-based research for measuring CSI to get around this problem, particularly for DL-based IRS communication systems.

In order to identify the significant number of undefined IRS parameters, the study presented a DL approach for training the IRS reflection matrices using sampling channel information without any control over the IRS geometrical array. The main concept is to extract environment descriptors that record details of a signal's multi-path signature as it travels in the direction of IRS. The DL model may be trained to estimate the channel parameters using this information. Using a single antenna UE time division duplexing mode system, author in suggested a DL technique for improving the Key Generation Rate (KGR) in the physical layer key generation. For frequency band feature mapping to produce a reciprocal channel feature between communication partners, the author propose KGNet.

The study in presented a deep denoising neural network to estimate the compressive CSI for IRS-assisted mmWave systems with a small training overhead. Real and fictitious sections of the channel matrix can be processed simultaneously using the suggested DL approach. For SNR=10 dB and various numbers of multipath signal components, the simulation results show a reliable outcome. In this manner, the DL approach may be used to calculate the CSI of an IRS-aided wireless network. A Deep Neural Network (DNN)-based technique in the interior communication environment was presented in as an additional application of DL in IRS-enhanced wireless networks to estimate the mapping between a UE position and the IRS phase configuration to optimise the received SNR.

Three hidden layers, an output layer, and five input layers made up the proposed DL architecture. The ideal IRS phase setup, user position, and input-output mapping are mostly handled by the hidden layers. Additionally, DL can be used for the ideal IRS phase shift design. By training in an offline stage, the author of suggested a DL-based method for constructing the phase shift of the IRS as efficiently as possible. The effective benefit of the reflecting route grows with the number of reflecting pieces. Additionally, the user's increased antenna count may improve performance. Additionally, signal detection may be implemented using DL-based IRS wireless networks. In signal estimation and detection in wireless networks with IRS assistance were performed. A DL-based method was presented for calculating the channels and phase angles of a reflected signal received by an IRS. By using the DL approach in an IRS-based wireless communication system, the bit-error-rate is also reduced.

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