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<tr><th>title</th><td>Deep Learning-Based Modulation Detection for NOMA Systems</td></tr>
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<tr><th>abstract</th><td>Since the signal with strong power need be demodulated first for successive interference cancellation (SIC) receiver in non-orthogonal multiple access (NOMA) systems, the base station (BS) need inform the near user terminal (UT), which has allocated higher power, of the far UT's modulation mode. To avoid unnecessary signaling overhead of control channel, a blind detection algorithm of NOMA signal modulation mode is designed in this paper. Taking the joint constellation density diagrams of NOMA signal as the detection features, the deep residual network is built for classification, so as to detect the modulation mode of NOMA signal. In view of the fact that the joint constellation diagrams are easily polluted by high intensity noise and lose their real distribution pattern, the wavelet denoising method is adopted to improve the quality of constellations. The simulation results represent that the proposed algorithm can achieve satisfactory detection accuracy in NOMA systems. In addition, the factors affecting the recognition performance are also verified and analyzed. spectral efficiency, lower latency and larger transmission capacity. In the face of the above requirements for higher communication quality, a new multiple access multiplexing method, namely non-orthogonal multiple access (NOMA) was proposed [1] . The research object of this paper is the power domain NOMA, which is the NOMA protocol commonly used at present [2] . In NOMA systems, the base station (BS) exploits the power domain by allocating the same communication resource but different power level to multiple-user (MU) for downlink transmissions. In the downlink NOMA, user terminals (UTs) with poor channel conditions will be allocated larger power to compensate its low channel gain, which are called far UT, and near UT with better channel conditions will be allocated lower power, which is closer the BS than the far UT. Although interference information is introduced in NOMA system, successive interference cancellation (SIC) technology can be utilized at user terminal for removing it [2, 3], and thus higher spectral efficiency can be achieved. From the perspective of modulation scheme, the signals transmitted by the BS contain multiple modulation schemes when each user uses a different modulation scheme to encode the signal. Due to the protocol of NOMA technology, SIC receiver needs to first demodulate the signal desired to far UT, which requires the knowledge of modulation mode for that signal. The general solution is to inform the UT through signaling, which can lead to a higher transmission delay in massive IoT scenarios containing enormous devices. Therefore, the implementation of blind modulation detection at near user can reduce signaling overhead of control channel for SIC demodulation and further improve the quality of service in NOMA systems. The NOMA signal is essentially a time-frequency overlapped modulation signal. Some research has been done for the modulation recognition of overlapped signals in orthogonal multiple access (OMA) systems, such as using cyclo-stationary theory to extract the feature of signal component [4] . However, The NOMA signal is completely overlapped in timefrequency domain, in which case, many existing single channel signal modulation recognition algorithm is often no longer applicable without any prior knowledge information. In [5], the maximum likelihood algorithm is used to implement the modulation detection in NOMA systems, which is extended by the ML algorithm in OMA systems [6] . However, the ML algorithm often has a high computational complexity. The work of [7] studied the detection of interference modulation order in downlink NOMA systems, which extracts feature vector based on Anderson-Darling test, and then classify by logistic regression model, but channel equalization is required for extracting effective feature before blind detection. Artificial intelligence technology provides new ideas for designing the next generation of wireless communication systems, which has become a research hotspot in the industry [8, 9] . A deep learning (DL)-aided NOMA system is designed by using long short-term memory network, which can detect the channel characteristics intelligently [10] . In [11] , the deep neural network is used to construct the precoder and SIC decoder in MIMO-NOMA system. Both precoding and SIC decoding of the MIMO-NOMA system are jointly optimized, which enables the received signal to be accurately decoded. The application of DL into signal recognition, especially on modulation classification, has attracted most research interests due to its strong feature learning ability [12] [13] [14] . The baseband signal is acted as the input of the neural network, and the classical deep network architecture is used for modulation detection in [12] , whose results show that further advances for DL-based modulation detection likely come from improved training algorithm and novel network design. The key to the improvement of recognition performance is to find more discriminative representations of Ji Wang received the B.S. degree from the</td></tr>
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Jinxia Yang
Xin Peng
Chao Yu
Peng Zhu</td></tr>
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<tr><th>abstract</th><td>Since the signal with strong power should be demodulated first for successive interference cancellation (SIC) demodulation in non-orthogonal multiple access (NOMA) systems, the base station (BS) should inform the near user terminal (UT), which has allocated higher power, of modulation mode of the far user terminal. To avoid unnecessary signaling overhead in this process, a blind detection algorithm of NOMA signal modulation mode is designed in this paper. Taking the joint constellation density diagrams of NOMA signal as the detection features, deep residual network is built for classification, so as to detect the modulation mode of NOMA signal. In view of the fact that the joint constellation diagrams are easily polluted by high intensity noise and lose their real distribution pattern, the wavelet denoising method is adopted to improve the quality of constellations. The simulation results represent that the proposed algorithm can achieve satisfactory detection accuracy in NOMA systems. In addition, the factors affecting the recognition performance are also verified and analyzed.</td></tr>
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