ABSTRACT

Modulation in the fifth telecommunication new generation radio (5G NR) has been standarized by the third generation partnership project (3GPP) to support transmission with high data rates. The modulations of 5G NR technology on TS 38.211 are $\pi/2$-binary phase shift keying ($\pi/2$-BPSK), BPSK, quadrature phase shift keying (QPSK), 16-quadrature amplitude modulation (16-QAM), 64-QAM, and 256-QAM, but the demapper is not standarized and is left to the manufacturer. The best demapper is soft demapper, a demapper using soft value in the form of log-likelihood ratio (LLR) providing better performances because large and small values with the same sign are not considered as the same value. This undergraduated thesis proposes an optimal soft demapper for each 5G NR modulation to be implemented in practice by industry.

Soft demapper needs to be optimized because hardware in the industry has practical limitations. The practical numbers considered in this undergraduated thesis are +709 and -709 as the highest and lowest LLR values, respectively, such that the exponent value of the LLR does not go to infinite. Each modulation has different sensitivities to the limited LLR values, therefore, an optimal LLR threshold for a particular modulation is not necessarily being optimal for other different modulations.

This undergraduated thesis uses a series of computer simulations and orthogonal frequency division multiplexing (OFDM) to evaluate the proposed demapper. The proposed demapper is evaluated under multi-path fading channels to provide practical real-field 5G performances.

The results confirmed that the proposed optimal demapper provides good bit error rate (BER) performances as the theoretical BER and has no error-floor since the +infinite or -infinite values are avoided. This demapper is expected to help the industry in the design of 5G NR hardware.

Keywords: 5G NR, soft demapper, log-likelihood ratio, infinite number, channel coding