ABSTRACT

Internet-of-Things (IoT) has potential applications and big impact on economy in the near future. This thesis proposes Raptor codes based on Low Density Generator Matrix (LDGM), called LDGM-Raptor codes, to support IoT using single carrier transmission systems (SC-IoT). The achieve maximum performances, this thesis optimizes degree distributions based on computer search for LDGM-Raptor codes suitable for uplink communications of SC-IoT devices, the applications of which are for low bit rate but high reliability. To 'eliminate' the error-floor, we also design LDGM-Raptor codes with an accumulator, resulted Tornado codes, to provide best performances.[1] All encoding schemes in this thesis are followed by an efficient decoder using sum-product algorithm by exchanging log-likelihood ratio (LLR) value between the decoder components. The optimal degree distributions are obtained based on computer search to find best matching extrinsic information transfer (EXIT) curves. A series of computer simulations are conducted to verify the proposed LDGM-Raptor codes using the obtained degree distribution. This thesis considers both additive white Gaussian noise (AWGN) and block-Rayleigh fading channels, where the considered modulation is complex binary phase shift keying (C-BPSK) of the fifth telecommunication generation (5G) with soft demapper.

The results are categorized into: (i) degree distribution, (ii) coding performances, (ii) computational complexity. The results on degree distribution show that LDGM-Raptor codes with irregular distribution provide better performances, indicated by bit-error-rate (BER) performances close to the Shannon limit. The results on coding performances show that the proposed LDGM-Raptor codes improve significantly to the performances of LDGM codes, indicated by closer the performances to the Shannon limit. This thesis also present the proposed Tornado codes to provide best BER performances without error-floor.

In terms of computational complexity, this thesis also show that the proposed LDGM-Raptor codes, and Tornado codes have low computational complexity, and have lower memory than Turbo codes. Tornado codes, and LDGM-Raptor codes provide better performances compared to Turbo codes and repetition codes. The proposed codes are expected to provide significant contributions for transmission suitable for future communication technologies.

Keywords: *Raptor Codes, EXIT Chart, Optimal degree distribution, Accumulator, SC-IoT.*

[1] The error-floor may not be eliminated completely. Hence, we refer the meaning of 'eliminate' in this thesis as to reduce significantly to a value far below 10^{-5}.