

In this paper, we revisit the design of Raptor codes for binary input additive white Gaussian noise channels, where we are interested in very low signal to noise ratios (SNRs). A linear programming degree distribution optimization problem is defined for Raptor codes in the low SNR regime through several approximations. We also provide an exact expression for the polynomial representation of the degree distribution with infinite maximum output node degree in the low SNR regime, which enables us to calculate the exact value of the fractions of output nodes of small degrees. A more practical degree distribution design is also proposed for Raptor codes in the low SNR regime, where we include the rate efficiency and the decoding complexity in the optimization problem, and an upper bound on the maximum rate efficiency is derived for given design parameters. Simulation results show that the Raptor code with the designed degree distributions can approach rate efficiencies larger than 0.95 in the low SNR regime.