ABSTRACT

The thesis aims to analyze the performance characteristics of single parity check product code. Here two types of problems are considered. One problem deals with the structural analysis of the erasure pattern of single parity check product code and the other deals with the recoverability of erasures. In structural analysis, based on the position of the erasure bits, the erasure pattern is classified into two types namely basic patterns and generated patterns. Based on the number of rows and number of columns of the occupied erasure bits, the basic pattern is classified into recoverable basic pattern and unrecoverable basic pattern.

The mathematical analysis has been carried out to find the number of recoverable and unrecoverable basic patterns for a given number of erasures. The method to find number of patterns generated from all the recoverable basic patterns for a given number of erasures are presented. The numerical solution of single parity check product code has been studied for different number of erasures. Simulation of the post decoding erasure rate has been done under three different conditions namely (i) based on minimum distance (ii) based on the conditions that all erasure pattern up to five erasures are recoverable and (iii) based on the condition that all erasure patterns generated from the recoverable basic pattern are recoverable. The post decoding erasure rate for various boundary conditions are studied graphically.
In the recoverability study of the SPC product code, the structure of the unrecoverable basic pattern has been presented. The algorithm for finding all unrecoverable basic patterns for a given number erasures are presented. Even though the basic pattern is unrecoverable, some of the patterns generated from the unrecoverable basic pattern are recoverable. A detailed mathematical analysis has been carried out to find the number recoverable and unrecoverable patterns generated from the unrecoverable basic patterns. The total number of recoverable patterns generated from both recoverable and unrecoverable basic patterns is evaluated. For the unrecoverable patterns generated from the unrecoverable basic pattern, some of the erasures may be recovered. Hence for those patterns, the average number of remaining erasures after decoding has been evaluated. Based on the mathematical analysis a tight upper bound for post decoding erasure rate is found.

The numerical results of various parameters of the post decoding erasure rate have been studied. The various bounds on the post decoding erasure rate has been studied graphically. Simulation results show that the performance of the single parity check product code is extremely good even though the minimum distance of single parity check product code is less. In order to ascertain the accuracy of our numerical results, the present studies are compared with available theoretical solutions in the literature and they are found to be in good agreement.