Topics in Coding, Cryptography and Information Security

Editors:

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Othman Omran Khalifa

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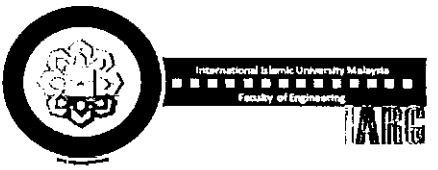

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Chapter 3

Golay Codec: An overview

Othman O. Khalifa

3.1. Introduction

There are different types of codes in coding theory. One category of codes is linear codes. One manipulates these codes via the theorems and methods of linear algebra. Two other codes worth noting are Hamming codes and Golay codes. Hamming codes are designed to correct any single error, while Golay codes corrects three or fewer errors. The Golay code was used to encode pictures from Jupiter and Saturn. The idea of Error Correcting Codes came with the onslaught of computer technology. In the late 1930s Bell Telephone Laboratories built one of the first mechanical relay computers. This computer is unlike anything currently in use. However, the mechanical relay computer while executing a program was prone to errors like today computers. In fact, in 1947 Hamming conducted calculations on the mechanical relay computer at Bell Telephone Laboratories and found himself constantly re-running his programs due to computer halts. Error-correcting codes were discovered in mid-20th century after Richard W. Hamming got irritated by his computer stopping when it encountered an error, causing him to realize that if his computer could detect errors it should be able to locate and correct them. He devised ways to encode the input so that the computer could correct isolated errors and continue running, and his inquiries led him to discover what are now called Hamming codes. Another key player in the birth of Error-Correcting Codes is Marcel J. E. Golay. Golay was an engineer at Signal Corps Engineering Laboratories at FortMonmouth. He became interested in Error-Correcting Codes after reading a paper published by Shannon on the (7,4) Hamming Code. This publication sparked Golay's interest: Shannon's paper gave Golay an entirely new perspective: a geometric perspective of information and coding theory. Golay set out to find perfect single-error-correcting-codes. Codes that have every word associated to a codeword. Therefore these codes correct single errors without any "extra" redundancy. Golay started out to prove first that a perfect code exists. In 1958 Golay stated a necessary condition for the existence of a perfect code:

$$\mathbf{n = ((p^m)^k - 1)/(p^m - 1)} \qquad (3.1)$$

of length n using p^m symbols for some integer k.

In 1948, Marcel Golay introduced some linear codes, denoted by G_{23}, G_{24}, G_{11}, G_{12} that are now called Golay codes. The codesG_{24} is a binary linear (24,4096,8)