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FACULTY OF ENGINEERING

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FREQUENCY HOPPING FOR SECURE COMMUNICATION

A Thesis Submitted in Partial Fulfillments of

The M. Sc. Degree

IN

ELECTRICAL ENGINEERING

BY

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بسم الله الرحمن الرحيم

وَقُلِ ٱعْمَلُوا فَسَيَرَى ٱللَّهُ
عَمَلَكُمْ وَرَسُولُهُ وَٱلْمُؤْمِنُونَ

- سورة التوبة ، ١٠٥

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استخدام القفز الترددى فى
تأمين الاتصالات

أسم مقدم الرسالة

by

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A Thesis
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STATEMENT

This dissertaion is submitted to AIN SHAMS UNIVERSITY for the degree of M. Sc. in Electrical and Computer Engineering.

The work included in this thesis was carried out by the author in the Department of FACULTY OF ENGINEER, AIN SHAMS UNIVERSITY , from 10/11/1986 to 26/09/1990.

No part of this thesis has been submitted for a degree or a qualification at any other University or Institution.

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SUMMARY

Communication links intended for use in hostile environments must incorporate design features that reduce the vulnerability to jamming. To opearte in the presence of jamming, communication systems must employ one or more of the primary electronic-counter countermeasure (ECCM) techniques in their designs such as error control coding, adaptive stearable null antennas, and spread spectrum SS techniques. A spread spectrum system is a system in which the transmitted signal is spread over a wide frequency band, much wider than the minimum bandwidth required to transmit the information being sent.

Spread spectrum modulation techniques are widely used in military and civilian applications for combatting intentional jamming as well as benign interference (e.g. multipath or multiple access crosstalk). Frequency hopping system is one type of SS systems. It offers some advantages over the other types : it can typically achieve much wider SS bandwidth resulting in higher processing gains and it generally use lower pseudonoise spreading code rates, and noncoherent demodulation permitting faster link acquisition.

In addition to the inherent processing gain of the SS systems, the performance can be further improved by adding external circuitry and using different interference suppression techniques which are designed to suppress interference.

These techniques are : autocorrelation-domain (ACD) techniques [14,18,19], diversity combining techniques [11,12,21,24,25,43,46], adaptive filter techniques [17,20], coding techniques [7,15,29,32, 37,45,47], least-square estimation techniques [14,26], and digital whitening techniques [22,23].

The purpose of this thesis is to study different techniques for improving spread spectrum performance under the presence of narrow band interference and additive white Guassian noise (AWGN). This work justifies by means of the digital computer simulation the improvement in anti-jam (AJ) capability of FH system by employing digital whitening techniques prior to frequency dehopping . So an improvement in performance results by filtering the total received signal. Digital computer simulation for FSK/FH has been carried out in the presence of the desired signal, Gaussian noise, and partial-band jamming. The results are illustrated for two different case : with and without filtering. The main results of the simulation tests show that the proposed connection posses superior performance for different values of SJR. It is also shown that there is an optimum value for the bandwidth of the filter ($\mathscr{P}$) used prior to frequency dehopping.

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