شبكة المعلومات الجامعية

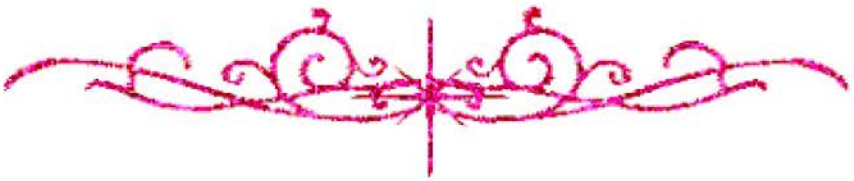
بسم الله الرحمن الرحيم

HOSSAM MAGHRABY

شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم



HOSSAM MAGHRABY

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها

علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

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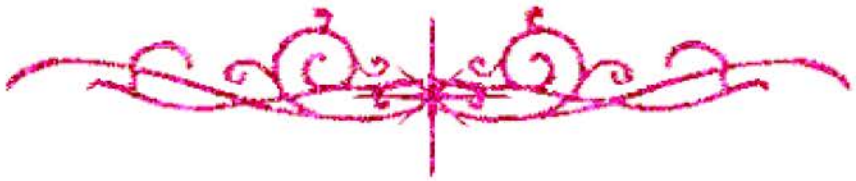
شبكة المعلومات الجامعية

بعض الوثائق الأصلية تالفة



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شبكة المعلومات الجامعية

بالرسالة صفحات

لم ترد بالأصل

HOSSAM MAGHRABY

INTELLIGENT DETECTION OF LAND MINE

By

SAWSAN MORKOS GHARGHORY

A Thesis submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
in
ELECTRONICS AND COMMUNICATIONS DEPARTMENT

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Under the Supervision of

Prof. Dr. Ahmed A. Bahnasawi
Professor at Electronics and Communications Department, Faculty of Engineering, Cairo University.

Prof. Dr. Ayman El. Desouki
Professor at Electronics Research Institute.

Dr. Hanan Ahmed Kamal
Associate Professor, Electronics and Communications Department, Faculty of Engineering, Cairo University

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Approved by the
Examining Committee:

Prof. Dr. Saad Mohamed Ali Eid

Prof. Dr. Mohamed Saad El. Sherif

Prof. Dr. Ayman El. Desouki, Thesis Main Advisor

Dr. Hanan Ahmed Kamal, Thesis Main Advisor

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ABSTRACT

Detection and de-mining of a buried land mine are among the most difficult problems faced during and after the war. Specially, anti-personal mines are still scattered in many countries, preventing the land to agricultural use, and many of civilians are injured from these dreadful threats. The detection problem has become extremely hard due to the large variety of landmine types with minimum sizes and non metal content, different soil conditions, temperature and weather conditions, and the highly clutter environment. Consequently, the detection problem can be tackled in a broad context of efficient sensors, and image and signal processing for the data associated with these sensors.

In the development of sensors technologies, **Infrared** (IR) is an effective approach based on the thermal properties for objects. Over the last few years IR polarization filter was introduced into IR sensors for improving the low target to clutter ratio in infrared image. Currently **Ground Penetrating Radar** (GPR) sensor offers the promise of detecting any object with little or no metal content, and gives information on both the existence and the location of objects. On the other hand, concerning of image and signal processing, lot of research for noise reduction, segmentation, and pattern recognition has appeared regarding the pre-processing and the decision mine or non mine in detection applications.

In this thesis, we handle the problem of mine detection using new efficient techniques of image and signal processing for the data associated with IR, IR polarization and GPR sensors. The work is divided into two parts: **the first part** introduces the mine detection in IR, and IR polarization images in context of pre-processing and segmentation techniques. Principle Component Analysis (PCA) as a dynamic pre-processing is used to extract the whole dynamic information contained in a sequence of images. Also, we propose two new different segmentation techniques for discriminating land mine from background clutter, and focus on evaluating the suitable technique for mine detection. The first one, a new hierarchical segmentation based on watershed is proposed for mine detection application. The second technique

incorporates fuzzy c-means (FCM) and morphological filter to segment the buried mines from background and eliminate the residual clutter from segmented image. The proposed methods are compared with the watershed segmentation based markers.

The second part solves the problem of mine detection via GPR sensor in conjunction with signal analysis scheme for pre-processing, feature extraction, and pattern recognition. A signal processing approach using singular value decomposition (SVD) is presented for resolution enhancement and clutter reduction. The method is successfully evaluated on field- test data using GPR of ultra wide band (UWB), and compared with the eigenvalue decomposition method. Objects best features in time, autocorrelation, and Fourier domains are selected as input pattern to the classifier system. Also, we propose the pattern recognition using the normalized minimum distance classifier to compare the feature pattern with the different class models and determine the likelihood pattern of object. We evaluate the success of this method by comparing it with K-nearest neighbor classifier. Finally, we propose the standard velocity of the signal propagation in a medium with known electrical properties to estimate the burial depth of object under the ground surface.

The results evidently show the efficiency of the pre-processing techniques for reducing the redundancy and enhancing the contrast in IR, IR polarization, and GPR data. The results indicate that the proposed algorithm using the unsupervised clustering technique for both IR and IR polarization data has the ability in distinguishing the buried mines from the clutter and yield accurate detection. Also, the new hierarchy watershed is suitable to segment the outdoor images into noticeable texture region, but it encounters some difficulty in discriminating between buried mines and clutter especially in IR data. FCM proved to be robust and more reliable than the compared technique using the watershed segmentation based marker and could be used for many applications. In recognizing the mine signal in GPR data, the proposed classification method gives 94% accuracy for the performance of the normalized minimum distance classifier with less features compared to the K-nearest classifier. Moreover, the proposed classifier works in given different soils and varying depth of mine. Finally, the proposed method based on the standard velocity and known permittivity gives accurate depth estimation compared to the information accompanied with the measured data.