IMPLEMENTATION OF KITE CROSS DIAMOND SEARCH (KCDS) ALGORITHM FOR MOTION ESTIMATION USING MATLAB

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This work is dedicated to my family, lecturer and also to all my friends

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ABSTRACT

The purpose of this project is to implement Kite Cross Diamond Search (KCDS) algorithm, which uses kite and diamond search patterns to achieve the fast searching process. Full Search (FS) algorithm is the initial method to search the block with minimum distortion but it requires substantial amount of computational workload. To overcome this problem, many fast Block Matching Algorithm (BMA‟s) have been designed and developed, where KCDS algorithm is the one of these fast BMA. The KCDS algorithm was tested using several video sequences and have a better performance in search points and elapsed time compared to other algorithms. The simulation results indicate that KCDS algorithm is suitable for all fast and slow motion video sequences.

ABSTRAK

Projek ini bertujuan untuk melaksanakan algoritma „Kite Cross Diamond Search‟ (KCDS), yang menggunakan corak pencarian „Kite‟ dan „diamond search‟ untuk mencapai proses pencarian yang cepat. Algoritma „Full Search‟ (FS) adalah kaedah awal untuk mencari blok dengan gangguan minimal tetapi ianya memerlukan beban kerja perkomputeran yang tinggi. Untuk mengatasi masalah ini, banyak „Block Matching Algorithm‟ (BMA) yang cepat telah direka dan dibangunkan, di mana algoritma KCDS adalah salah satu BMA yang cepat. Algoritma KCDS diuji dengan menggunakan beberapa video dan mempunyai prestasi yang lebih baik dari aspek titik pencarian dan masa simulasi berbanding dengan algoritma-algoritma yang lain. Keputusan simulasi menunjukkan bahawa algoritma KCDS sesuai untuk video yang mempunyai gerakan cepat mahupun gerakan lambat.

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BDM	-	Block Distortion Measure
BMA	-	Block Matching Algorithm
BMME	-	Block Matching Motion Estimation
DS	-	Diamond Search
FS	-	Full Search
HEXBS	-	Hexagon Based Search
KCDS	-	Kite Cross Diamond Search
KSP	-	Kite Search Pattern
LCSP	-	Large Cross-Shaped Pattern
LDSP	-	Large Diamond-Shaped Pattern
MAD	-	Mean Absolute Difference
MB	-	Marcoblocks
MBD	-	Minimum Block Distortion
ME	-	Motion Estimation
MSE	-	Mean Squared Error
NCDS	-	New Cross Diamond Search
PSNR	-	Peak Signal-to-Noise Ratio
SCSP	-	Small Cross-Shaped Pattern
SDSP	-	Small Diamond-Shaped Pattern
TSS	-	Three Step Search

CHAPTER 1

INTRODUCTION

1.1 Introduction

Block Matching Motion Estimation (BMME) is known as a technique to achieve high compression ratio in video coding and it has been generally adopted in various coding standards. This technique is implemented conventionally by exhaustively testing all the candidate blocks within the search window. Full Search (FS) Algorithm is the type of implementation which provides the optimum solution. However, this algorithm requires substantial amount of computational workload. To overcome this imperfection, many fast Block Matching Algorithms (BMA‟s) have been designed and developed. In order to find the optimum motion vector with minimal number of required search points, different search patterns and strategies are exploited.

One of these fast BMA‟s, which is proposed to be implemented in this project, is called Kite Cross Diamond Search (KCDS) Algorithm. The student is required to implement the algorithm in MATLAB and then compare its performance to FS algorithm as well as to other fast BMA‟s in terms of the peak signal-to-noise ratio (PSNR) produced, number of search points required and computational complexity.

1.2 Problem Statements

Block matching method is to seek for the best matched block from the previous frame, which is the first single frame, within a fixed-sized of search window, *W*: Initially, this method use FS technique. In order to search the block with minimum distortion, FS matches all possible displaced candidate block within the search area in the reference frame, consequently FS algorithm uses more search point to do the block matching process. It also introduces high and intensive computation of work. Many fast motion estimation algorithms have been proposed to give a faster estimation with similar block distortion compared to FS over the last two decades. Example of these fast algorithms are the three step search (TSS), the hexagon based search (HEXBS), the diamond search (DS), the new cross diamond search (NCDS) and KCDS.

1.3 Objective

The main objective of this project is to implement one of the available fast BMA, namely KCDS algorithm. Detail objectives are as follows:

a) To implement and develop the of KCDS algorithm using MATLAB.

b) To compare the performance of KCDS algorithm with other algorithms.

c) To produce working MATLAB program code for the algorithm

1.4 Scope of Works

The scopes of works in this project are:

a) Background Study:
   Study on video or image compression, Motion Estimation, BMA and KCDS algorithm.

b) Implementation of the KCDS algorithm using MATLAB.
   The proposed algorithm is implemented and simulated using MATLAB.

c) Performance Analysis
   The performance of KCDS algorithm is compared with existing fast block matching motion estimation algorithms.

CHAPTER 2

LITERATURE REVIEW

2.1 Video Compression

Video compression is to simplify the quantity of data used to represent digital video images, and is a combination of spatial image compression and temporal motion compensation. Its plays an important role in digital libraries, video in demand and high definition television which are an example of applications of digital video. To exploit the spatial and temporal redundancy of video sequence, it needs used fewer bits to represent a video sequence at an acceptable visual distortion. Besides that, it also represents the objective of a video compression algorithm [1].

2.2 Motion Estimation

Motion estimation (ME) is the action of determining motion vectors that delineate the transformation from one 2D image to another; usually from adjoining frames in a video sequence. The temporal prediction technique used in MPEG video is based on ME. To send a full frame, the inherently have less energy and can be compressed by sending a encoded difference images, it need to save on bits. This is the idea of ME based video compression. From the video sequence, the ME takes out the motion information.

Besides that, ME is a multistep action that combination of techniques, such as motion starting point, motion search patterns, and modify control to restrain the search, dodge of search stationary regions, etc. To find the most accurate motion vector (MV), the ME algorithm is an embodiment of several effective ideas and it also aim to maximize the encoding speed as well as the visual quality [2].

2.3 Block Matching Algorithm

The temporal redundancy removed technique between two or more successive frame is called BMA. It is an integral part for most of the motion-compensated video coding standards. The frames are being divided into regular size blocks and these blocks are called Marcoblock (MB). The MB is compared with equal block and its adjacent neighbors in the previous frame to create a vector that stipulates the movement of a MB from one location to another in the previous frame. In the current frame, all MBs comprise a frame and this movement is calculated [3].

Block matching method is to seek for the best matched block from the previous frame, usually the first single frame, within a fixed sized of search window (W). The displacement of the best matched block will be described as the motion vector to the block in the current frame based on a block distortion measure (BDM) or other matching criteria.

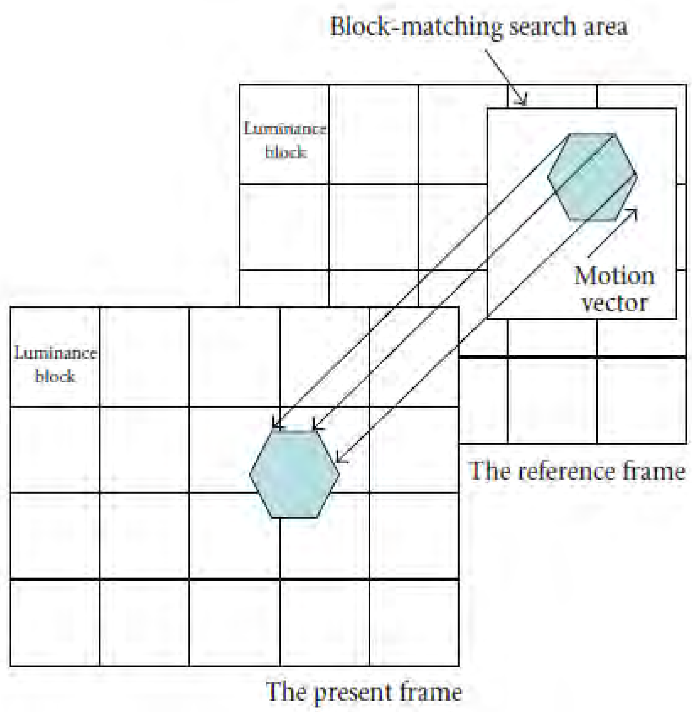

Figure 2.1: The two frames used to determine the motion vector of a given block [3].

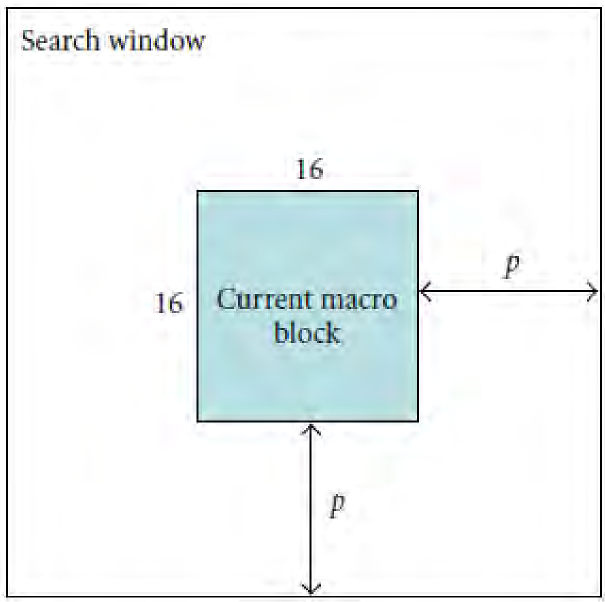

Figure 2.2: Block matching a macroblock