

A COMPARISON OF TRANSITIONAL BEHAVIOUR OF BASIS COMPOSITON
METHODS OF WAVELET TRANSFORM

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To my beloved family...

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ABSTRACT

The purpose of this project is to study and investigate the suitability of applying certain basis composition in wavelet transform to an image. Thus a program will be created based on the basis composition design to transform and reverse the image and give the analysis result. The analysis would be an analysis on signal to noise rate (SNR) and other analysis to determine the basis suitability to certain type of images. This project mainly has been divided into two main parts, research on basis and software development. Major concentration will be focused on the research since this is the core part of this project. The program, which develop through the Linux platform, will be used C as the programming language. This program will transform the image and used it as the output including the analysis result. The image used is base on standard (SIDBA). It is also grayscale type with the size of 256×256 pixels. A different type of basis composition will be applied through the image and the resultant image and analysis then will be compared by transitional behavior.

ABSTRAK

Tujuan utama projek ini adalah untuk menjalankan kajian terhadap kesan penggunaan beberapa komposisi basis terhadap gambar. Sebuah program dibina untuk tujuan tersebut di mana ia adalah berdasarkan komposisi 'basis' yang dibuat dan program ini akan mengubah komposisi gambar dan memberi analisis terhadap gambar tersebut. Analisis gambar adalah analisis terhadap nisbah isyarat terhadap bunyi dan analisis lain untuk melihat kesesuaiannya terhadap gambar tersebut. Projek ini terbahagi kepada dua bahagian utama iaitu kajian terhadap komposisi 'basis' dan membina program. Tumpuan utama diberikan terhadap kajian terhadap komposisi 'basis' kerana ia adalah teras utama projek ini. Program yang dibina pada pelantar Linux ini menggunakan bahasa C sebagai bahasa pengaturcaraan. Ia akan mendapatkan gambar, seterusnya komposisi gambar ini akan diubah dan ia akan dikeluarkan kembali beserta analisis. Gambar yang digunakan adalah mengikut piawai (SIDBA) dan jenis 'grayscale' dan saiznya adalah 256×256 piksel. Perbandingan akan dibuat terhadap beberapa jenis komposisi 'basis' terhadap gambar.

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CHAPTER I

INTRODUCTION

This chapter will discuss the overview of this project, the aims and specific objectives of the project. The end of this chapter will list the report outline.

1.1 Introduction to project

Wavy signals are usually represented by oscillating functions of time or space, for example sinusoids. Fourier analysis, which is a method of wave analysis which extremely valuable in mathematics, science and engineering, especially for periodic, time-variant or stationary phenomena, expands signals or functions in terms of sinusoids. However, it is not always suitable for transient phenomena, because the basis functions are not localized. In order to avoid this weak point, several methods for non-stationary signals have been proposed. The wavelet transformation is one of them. Wavelets are short waves, whose energy is concentrated in time domain give a tool for the analysis of transient, non stationary or time-varying phenomena. They still have an

oscillating-wave like characteristic but also have the suitability to simultaneous time-frequency analysis. While sinusoids in Fourier transformation have the oscillations with equal amplitude all over $-\infty \leq t \leq \infty$ which have infinite energy, while wavelets in wavelet transformation have finite energy which is concentrated around a time point [1]. From this property, wavelet transformation became a new tool to be applied and used in many fields, for example image processing.

This project will apply the concept of wavelet transform in designing of basis composition that will be applied to the standard image to compare for its suitability. Begin with the concept of transform and reverse which behave the concept of data sent from transmitter to receiver in information theory. Each basis design may have its own characteristic and this matter will be seen from the analysis as comparison to the entire basis designed was made.

1.2 Objective of Project

Through the research of this project, the main goal is the success in designing the basis composition and develops the program. To achieve this, there should be a few objectives to be considered. The main objectives of this project:

- i. To study literature review of wavelet transforms.
- ii. To study image processing and how an image can be transformed and reversed.
- iii. To investigate the suitability of variety basis function.
- iv. To design a program that give output which is the result image and some analysis result.

1.3 Problem Statement

Intermediate basis function has been known in characteristic between multi resolution analysis (MRA) method and direct product (DP) method. This purpose brings to a research in finding the characteristic between both the basic composition methods.

1.4 Scope of Project

This project is divided into two stages, which are:

Stage 1: Literature study

Project begins with the literature study on the concept of wavelet transform. Then further study made to the concept of basis which is the core part of this project.

Stage 2: Software development

A program will be designed using C program based on the basis composition design. Variety of basis composition will be designed and then will be compared through the output image.

1.5 Short Brief of Project Methodology

This project mainly divided into two parts which are research on the basis composition and program development. Research did include the literature study on wavelet transform and the concept of basis which is the main component of this project. The understanding through this part will lead through the designing of the program that

used to transform the image and give the analysis result as the output include the transformed image.

1.6 Outline of report

This report consists five chapters. In first chapter, it discuss about the objective and scope of this project as long as summary of works. While Chapter 2 will discuss more on theory and literature reviews that have been done. It well discusses about basis and brief discuss on wavelet transform. In Chapter 3, the discussion will be on the methodology of this project. This project known to be divided into two parts, which are research on basis composition and program development. The detail process for both part will totally well presented in this chapter. While Chapter 4 is the result part that will be discussed the result of basis composition applied to the image. While the last part is Chapter 5 that will conclude findings from this research and suggestion for future works.

CHAPTER II

LITERATURE REVIEW

This chapter reasons to review and to discuss some of the references makes from the journals, books and the useful website that related to this project.

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2.1 Wavelet System

Wavelet systems used for the expansion of signals that are not unique. There are many different types of wavelet systems that can be used effectively. Wavelets have several general characteristics. A wavelet system is a set of building blocks to construct or represent a signal or function and wavelet expansion gives a time-frequency decomposition of a signal. It is analogous to the Fourier series expansion which represents a signal by a summation of complex sinusoid weighted by a set of coefficients [1]. Also we can say that most of the energy of a transient signal is well represented by a few expansion coefficients. The calculation of the coefficients from the signal can be done efficiently. All so-called first generation wavelet systems are generated from a

single basic wavelet function by the simple scaling and the translation. This two-dimensional parameterization achieved from function of $\psi(x)$. In other words, a wavelet function in the wavelet system is defined by

$$\psi_{j,k}(x) = 2^{-j/2} \psi(2^{-j}x - k) \quad j, k \in \mathbb{Z} \quad (2.1.1)$$

with two parameters j and k , \mathbb{Z} is the set of all integers and the factor is $2^{-j/2}$ for keeping the norm invariant. This parameterizations, where the time or scale location is expressed by k and the scale by j , turns out to be very convenient. Almost all useful wavelet systems also satisfy the multi-resolution conditions. This means that if the signals in a set can be represented by sum of $\psi(x - k)$, then those in a larger set (including the original) can be represented by sums of $\psi(2x - k)$. In other words, if the basic expansion signals are made half as wide and translated in steps half as wide, they will represent a larger class of signals exactly or given a better approximation of any signal. The higher-resolution coefficients can be calculated from the adjacent lower-resolution coefficients according to multi-resolution pyramid structure. This property allows a very efficient calculation of the expansion coefficients and it relates the wavelet transformation to digital filters in signal processing. As a result, wavelet analysis is very suitable for transient and non-stationary signals, though Fourier analysis is suitable for periodic and stationary signals whose statistical characteristics do not depend on the time.