CHAPTER 1

Introduction

1.1 Background

Ultrasound imaging is a noninvasive medical test that helps physicians diagnose and treat many medical conditions which cannot be detected in blood or amniotic fluid. Currently, it plays an important role in obstetrics by replacing irradiation, which has long been used in this field.

Measuring the fetal heart is essential in prenatal diagnosis of various cardiac abnormalities or failures, especially cardiomegaly, an abnormal enlargement of the heart. The determination of heart sizes is helpful in screening for hydrops fetalis, which is caused by hemoglobin Bart's disease and is commonly found in Southeast Asia [1].

Theera Tongsong and Teerapong Tatiyapornkul [1] proposed that the mean CT ratio value at each gestational week should not be higher than 0.50. If the ratio is higher than 0.5, the fetus has cardiomegaly that carries a high risk of being hemoglobin Bart's disease. The CT ratio is calculated by dividing cardiac diameter (Cd) by the thoracic diameter (Td). To measure the CT ratio in a fetus, the heart position has to be on the four-chamber view plane with all ribs clearly visible and the heart is at the end-diastole stage [2]. Fetal CT ratio measurement is relatively difficult. The screening has to be performed by ultrasound specialists; who are rarely available in rural areas where the disease is prevalent [3].

For the first trimester of fetal hearts, ultrasound images are mainly limited by the small size of the hearts and the low signal-to-noise (SNR) ratio of ultrasound images. With these limitations, the detection of fetal cardiac structures is hard especially by the human visual system and nowadays mainly carried out by manual operations from experienced physicians [4]. Therefore, an algorithm should be created to automatically

measure cardiac and thoracic diameter from the four-chamber view ultrasound video. This algorithm will then can help physicians to detect cardiomegaly in fetuses.

1.2 Research Objective

To create an algorithm for automatic measurement of cardiac and thoracic diameter from four-chamber view ultrasound videos.

1.3 Research Scopes

1.3.1 The data input of the proposed algorithm are ultrasound videos (avi) with four-chamber view stage.

1.3.2 Ultrasound videos are collected at Maharaj Nakorn Chiang Mai Hospital, Faculty of Medicine, Chiang Mai University.

1.3.3 The results from the experiment will be compared to the results from at least one expert.

1.3.4 At least 30 abnormal and 30 normal cases will be used in the experiment.

1.4 Educational Advantage

Algorithms for automatic measuring of cardiac and thoracic diameters from four-chamber view ultrasound video will be created.

1.5 Thesis Organization

This thesis is organized into six chapters including this chapter. Chapter 2 reviews the general knowledge of medical imaging from ultrasound, CT ratio measurement technique by physician, cardiomegaly diagnosis, and hemoglobin Bart's disease. Chapter 3 gives detail of image processing theory used in this study. Chapter 4 describes the research designs and methods of the proposed technique. Chapter 5 presents experimental results of our proposed method. Finally, conclusions are drawn in Chapter 6.