CHAPTER ONE

INTRODUCTION AND OBJECTIVES

1.1 INTRODUCTION

The progress of modern industrial radiography or imaging[1-3] and particularly x-ray imaging can be partially attributed to numerous technological developments and innovations that have occurred within recent years.

In the past eighty years, the radiologic community has witnessed several periods of technical evaluation of x-ray imaging. These periods comprises of at least four eras of x-ray tubes and generators.[4] Present systems offer a number of advantages including higher x-ray output and the use of shorter exposure times.Improvements of x-ray tube and generator continue to occur at a significant rate.

The fifth era in x-ray imaging introduced the lens and mirror optical system which are used to view and record x-ray images. This period was shortly followed by the introduction of images intensifiers, x-ray television and automation.[5]

Refinements in the technology have been so dramatic that the rewards are truly beneficial. Radiologists and technologists alike performed their work with greater speed and accuracy and with less dose to patients.

More recently, a new kind of imaging device has

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become available for radiological investigation of the head and body. This is the unique and revolutionary computed tomography scanner.[6] So remarkable is the technique of computed tomography that, in 1979, Hounsfield[7] of England and Cormack[8] of the United States shares the Nobel prize in medicine for their work in developing a clinically useful machine.

This development marked yet another era in the milestones of industrial imaging and that is, the use of the computer as an aid to radiological analysis, or more specifically, digital imaging technology. Today, applications of the computer in radiology[9-10] have gained widespread attention. These application range from automation of object records and radiologic reporting to imaging applications such as computer aided analysis, automated image analysis and computed tomography. To date, computed tomography has had a profound impact on industrial imaging techniques such as digital radiography[11-12] and magnetic resonance imaging.[13-17]

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These modern trends and techniques require an understanding of new concepts, such as, for example, digital image processing theory and computer technology, which until now were not within the domain of industrial radiology. These techniques result in three categories of equipment for x-ray imaging. The basis for this categorization depends on the type of image that can be generated. They are as follows:

1. RADIOGRAPHIC EQUIPMENT which is designed to produce fixed photographic images.

2. FLUOROSCOPIC EQUIPMENT which permits study of moving or dynamic images on a fluorescent screen.

3. COMPUTER-ASSISTED or DIGITAL IMAGING EQUIPMENT. In imaging, the computer is used to produced a reconstructed image from projection.

The impact of technical developments or industrial imaging has been significant. Without doubt, there will be more and more changes in the future with the ultimate goal of producing optimum image quality with minimal radiation doses. Other goals will be operator safety, comfort ,simplicity and logical operation of equipment.

This thesis is divided into 6 chapterts.Chapters 1 and 2 cover conventional imaging equipment and focus on topics such as x-ray imaging schemes, geometric tomography, digital image processing theory. Chapter 3 take the general principles of computed tomography. Chapter 4, 5 and 6 deal with methodololy, results, conclusion and discussion.

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1.2 <u>HISTORICAL BACKGROUND</u>

The problem of reconstructing two dimensional section of an object from a set of one dimensional transmission projections arose and found solution, independently and more or less simultaneously, in the field of electron microscopy,[18] radioastronomy,[19] and x-ray computed tomography(CT).[20] The common problem may be stated: given a subset of all possible projections of some property of the object, which varies with position within the object and characterises it,estimate the spatial distribution of this property via a mathematical algorithm. For convenience of presentation within this paper, we shall discuss the problem of x-ray CT in which a two dimensional map of x-ray linear attenuation coefficient u(cm-1) is reconstructed.

Historically the solution of this problem has been polarised into very distinct and mathematically dissimilar classes of algorithm. In one approach, a map of the linear attenuation coefficients is reconstructed by backprojecting transmission projection data convolved with a spatial frequency filter (CBP technique).[21-23]

The other approach begins with an arbitrarily chosen sectional distribution which is then adjusted iteratively until the projections of the adjusted picture match the measured projections of subject to a criterion for acceptability.[24] Fortuitously such solutions converge to meaningful image even though there are infinitely many pictures having the same finite projection data and despite the theorem which states that when the projection data are noisy, there is no picture whose projections exactly match the measured projections.[25]

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1.3 OBJECTIVES OF THIS RESEARCH

The object of the experimental part of this research was to carry out a systematic study of image reconstruction technique to obtain reliable data on the behaviour of x-ray radiography.

The second part of the research was to develop workable computer program for image reconstructions.

The final object the research was to apply image reconstruction technique to x-ray radiography.

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