Chapter I

INTRODUCTION

1.1 The Nature of Problems

Many problems in systems engineering, particularly those associated with control systems, may be subdivided into four interrelated parts[1]:

(a) goal identification;

(b) determination of position with respect to the goal;

(c) determination of environmental factors affecting the past, present, and future, and consequent establishment of a system model;

(d) determination of a policy in accordance with the goal definition (a), knowledge of the current state (b), and system model and environment (c).

The system identification is the third part of the above problems. There are many conventional methods used in system identification such as frequency response testing, step response testing, reference model, correlation technique, and so on. The interested method in this study is correlation technique. This method is used to estimate the system impulse response function. In the past, the continuous cross-correlation method was performed by the correlator. This may cause many errors which are the major problems in the identification. The discrete cross-correlation methods with normal sample sizes and with increasing sample sizes are proposed to overcome the problems. These two methods will be discussed in more details in Chapter 2 and Chapter 3.

1.2 Historical Backgound

The correlation technique in linear system identification using white noise input signal, obtained by observations of the normal operational disturbances, was proposed by many authors[7,12]. Later, the pseudo-random signal which is similar to those of white noise are used as the input signal. The most popular pseudo-random signal is the pseudo-random binary maximum length sequence (b.m.l.s.)[3,4,6,11,20,21] which have been used as an input signal in system identification since 1955. Hughes[16] (1962) and Hazlerigg[14,15] (1965) presented the description of the equipments developed to generate the b.m.l.s. and cross-correlate the b.m.l.s. input and the output signal. Most of the above authors used the correlator to perform the continuous method in the determination of the cross-correlation function. The discrete method in the identification of a continuous linear system was proposed by Barker[2] in 1969.

In this research, the measured output signal is sampled and then cross-correlated with the b.m.l.s. input signal by using digital computer to determine the impulse response of a linear system.

1.3 Outline of Research

The objective of this research is to introduce a new method of the discrete cross-correlation technique with increasing sample sizes in linear system identification. The cross-correlation technique using a pseudo-random binary sequence in system identification is presented in Chapter 2. The comparison between the discrete cross-correlation

method and the continuous cross-correlation method is also discussed. The errors and the technique to reduce them are presented in Chapter 3. The computer models are set up in Chapter 4 and the methods of identification and minimisation of errors are applied by using the computer programs to determine the impulse response of those models. The digital computer used in this research is CDC 3600, 64k words core.