CHAPTER I
INTRODUCTION

1.1 Motivation and Problem Description

Papermaking is a huge and multidisciplinary technology that has been tremendously explored in the recent years. According to its vast scale, complicated operation processes and high production speeds, there is little space for error and malfunction. On the other hand, paper quality testing which is concerned as an efficient method to measure properties or features of paper products has also been performed and developed for long decades. The paper quality test and control play essential roles in the paper making industry, which affect the whole operation process and the future paper market. Paper curl is simply the tendency of paper to depart from a flat form and is affected by a number of complex, inter-related factors. Traditionally paper curl has been controlled with limited success using variation in drier temperatures or humidity levels. However, because it may be measured only off-line after an entire roll has been produced, its control is difficult and costly. Although out-of-specification paper may be reprocessed, or even re-pulped, in limited quantities, bad curl is a significant problem, wasting plant time, engineering time and energy.

This thesis presents a paper curl quality-forecasting model based on neural network for the paper making industry with different source data transaction processes.

1.2 The Objective of Research

In this thesis, we focus on the prediction of paper curl. Compared with other paper quality properties some of which can be monitored on-line or easily tested for paper testing laboratory, paper curl could be measured only after a whole roll of paper jumbo reel has been produced. Consequently, traditional curl testing cannot offer engineers or operators the latest curl information when the paper is still in the production process. Paper curl is an important measure of quality in papermaking, where paper exhibiting bad curl is the cause of customer dissatisfaction, may lead to expensive reprocessing, or in some extreme cases must be scrapped. Bad paper curl is the major cause of sheet-feeding problems in laser printers and photocopiers. Usually, the

recycling caused by curl quality defects cost much manpower and material resources, which will directly affect the whole industry profit. Furthermore, paper curl is the most obvious paper property that can be easily checked and found by customers in their everyday printing jobs.

Excessive curl causes the loss of several hundreds of tons of board every year, and it is one of the most complicated quality variables to handle for the operators and process engineers. Therefore, in order to stabilize, enlarge customer market, improve accuracy of the paper property testing, and save the cost of paper making process, it is vital important to explore good solutions for the paper curl forecasting.

1.3 The Scope of Study

In the last ten years, several novel methods based on neural networks or statistic prediction have been applied in paper quality forecasting. Edwards et al [1] firstly provided a paper curl prediction method using pure neural networks in papermaking areas, they presented parameters charactering the current paper reel as inputs to a neural network and train the network to predict whether the resulting level of curl will be within a required specification, but their input data are lack of observations and variables. Bortolin et al [2] offered a grey-box modeling strategy to predict curl and twist for multi-ply paperboard, and the main equations that they using are based on classical lamination theory of composite materials. Achiche et al [3] created a FKB (Fuzzy Knowledge Base) system using genetic algorithm to predict the ISO brightness with measurements obtained from the chip management system. Elo et al [4] predicted the relations between paper quality properties and drying parameters with neural network models. Bisserssur et al [5] applied the classification methodology based on neural network to monitor the whole papermaking process.

This thesis aims to describe initial research forecasting paper curl property with large-scale imperfect data using MLP neural networks in a real paper industry environment. Chapter II provides the introduction of source data state and related working environment, and offers a designed neural networks modeling. Related methodology and theory will be explained, such as Quasi-Newton algorithm, Double

Dogleg algorithm, and several neural network optimization skills, etc. A detailed experimental process will be shown in Chapter III. The result of the experiment implementation and related discussion will be organized in Chapter IV. Chapter V will highlight the conclusions attained from the real work and outlook the future work.