Chapter 1

Introduction

The problem of plant growth simulation has been extensively studied since the first mathematical model called L-system was proposed by Aristid Lindenmayer in 1968 [1]. The system is based on a context sensitive rewriting expression with conditional and stochastic rule selection. The plant is viewed as a set of fractal units, which are trunk, branch, stem, flower, root, fruit, and leaf, connected together under the guidance of the rewriting system rules.

The structure of each component of the plant is very complex. The modeling of each component of plant has been received widely study. Leaf is one of very interesting component to model the shapes and simulate its growth.

This chapter is composed of two sections. The first describes the motivation of the thesis. The second section is the objectives of the thesis including the details of work process.

1.1 Motivation

Modeling leaf shapes and simulating of leaf growth are interested. There are many shapes of leaves that can greatly help identify plants. The leaf is one of components that are important to the plant growing. Many methods of the leaf modeling have been proposed by researchers in recent years, but mostly by means of computer graphics.

In this thesis, the concentration is on two problems. Firstly, it is how to define an outline of leaf shape and mathematically model the structure of a leaf network within the outline of leaf shape. Is it possible to construct different structure of the leaf network using only the same set of equations? And the second, can we simulate the growth of a leaf by using the collected data?

This thesis had developed a prototype of leaf modeling, which can be used to simulate its growth. Only the leaves of dicotyledonous plants were considered in this work. The structure of a leaf model consisted of two components: the entire leaf margin was represented in form of the outline of the leaf shape, and the leaf skeleton was described by primary vein (midrib) and secondary vein (branch) of the leaf network. The structure of leaf is observed on the mature size of leaf. Growth function was approximated by sample growth data in [2], which worked on the soybean. This prototype can be used to generate six shapes of leaf and is proposed for simulate the growth of the leaves of dicotyledonous plants. The modeling of leaf shape and simulating of leaf growth will be illustrated in chapter 4.

1.2 Objectives of the Thesis

The main objectives of this study are the followings:

1. To model the leaf, which is defined by two components: leaf shape and the leaf skeleton.
2. To develop an algorithm for generating the leaf skeleton with respect to the leaf shape.
3. To develop an algorithm for simulation and visualization of leaf shape and growth.

To obtain the results of this work, we divided the work plan into six steps. The details of the work plan are shown as the following:

1. Reviewed the previous works concerning the leaf modeling, the branching structure, and the leaf growth simulation.
2. Observed and studied the structure and the growth of leaves.
3. Developed an algorithm for construct the leaf shape and the leaf skeleton.
4. Approximated growth function using raw data collected from the soybean.
5. Studied computer graphics, and Delphi programming.
6. Visualized six types of the leaf shape model and simulated growth of soybean leaf by writing a computer program.

This thesis is organized into six chapters. Chapter 2 reviews some previous works in field. Chapter 3 contains the basic leaf terminology and some definitions of the parameters, which use in this thesis. Leaf shape modeling is illustrated in chapter 4. Chapter 5 shows the method of the leaf growth modeling. The results and conclusions of the thesis are discussed in chapter 6.