# SYNTHESIS OF FRACTAL MODELS FOR PLANTS AND TREES: FIRST RESULTS

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A particular type of the *inverse problem* for synthesizing fractal models ("*given 2D temporal images of trees and plants, generate the 3D fractal model that best describes them*") is addressed in our research work. In this short paper, the first results and work approaches are presented, along with the obstacles and problems encountered. **LS**ystems, a powerful language for describing fractal figures, is used as language for the description.

## 1 Background and Motivation

Modeling of complex objects is clearly a very important issue from a scientific, educational and economic viewpoints. Thanks to this area and its sisters, *Simulation* and *Visualization*, we are able to observe growth and features of natural organisms that can't be directly studied. Plants are a special case of complex objects that develop in a time-dependant manner, and whose visualization is particularly interesting; the *representation of a plant* is an exciting research question that combines ideas related to computer science as well as to artificial life, and to more *pure* sciences such as biology, mathematics and physics. Plants have been widely represented using a modeling approach called **LS**ystems, which are grammatical rewriting rules introduced in 1968 by A. Lindenmayer [1] to build a formal description of the development of simple multicellular organisms.

From a practical point of view, the detailed study of a set of plants from an agricultural field is a precious source of information about their health, the treatments that the field has undergone and, consequently, about the schedule of treatments required. However, there is a physical impossibility in bringing to the field all the specialized equipment needed to perform such a study. A novel approach to solve this constraint is to build a detailed model of the plant in order to conduct a study using computer methods. As such, the problematic of how to model a plant in a precise manner is of importance.

## 2 Our work

This challenge is addressed here by creating a method that synthesizes a (fractal) model of a plant given geometric and temporal information about it. A graphical scheme of our work is presented in Fig. 1. It is composed of three different steps:

1 "Pictures" are obtained from three-dimensional fractal models of plants. They are obtained from various angles, at different growth stages. Our work database is composed of these *bidimensional temporal representations* of (3D) plants and trees;

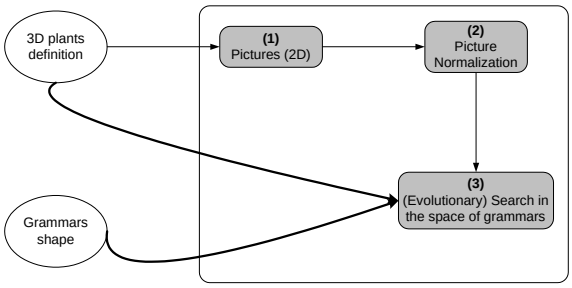


Figure 1. Scheme

2 All the pictures are normalized to be shown from the same point of view;

3 A generic grammar shape $\mathcal{S}$ is defined ; the idea is that every specific grammar defined to represent a particular tree shape would be an instance of $\mathcal{S}$. A two-step evolutionary search through the space of grammars is allowed to find the model that best describes the ones obtained in step 1.

The method and our first results are presented, along with some comments on how they influence our future work (in terms of research objectives).

## References

1. A Lindenmayer. Mathematical models for cellular interaction in development. parts i and ii. *Journal of Theoretical Biology*, 18:280–299 and 300–315, 1968.