A CONVIVIAL VISUALIZATION ENVIRONMENT FOR LSYSTEMS

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LSystem, a powerful language for describing fractal figures, allows the modelling, simulation, and visualization of the development of plants. In this short paper we present the motivation and design considerations of a simplified **LS**ystem environment, along with its most important features. We also present the expected impact of this development on our research project.

1 Main idea

Modeling, simulation and visualization of the development of plants is an exciting research area; it combines ideas related to computer science (to computer graphics, formal language theory and to simulation), as well as to artificial life and to *pure* sciences as biology, mathematics and physics. Furthermore, as P. Prusinkiewicz notes, "*... modeling of plants has also an artistic flavor, since the beauty of plants presents a constant challenge for creating visually appealing models*".

The question of representation of a plant is approached using the modelling tools created by the community that research fractals' languages; among those, one model is called **LS**ystem, which are grammatical rewriting rules introduced in 1968 by A. Lindenmayer [1] to build a formal description of the development of simple multicellular organisms. This grammatical system is so expressively powerful that there exist languages that can be described by context-free **LS**ystems, but can't be described by Chomsky's context-free class of grammars.

A large portion of the power offered by Lindenmayer's idea comes from the graphical interpretation of **LS**ystem strings based on the notion of a LOGO-style *turtle* [2]; this *classic* interpretation, used in virtually all **LS**ystem-related publications, was originally proposed by Szilard and Quinton [3]; Prusinkiewicz then presented a good number of fractals and plant-like objects using this approach [4,5]

2 Motivation, state of the art

In order to exploit the intuitive nature and the power related to **LS**ystems it is essential to work in a convivial environment, one that ideally would allow to interact simultaneously with the grammatical definition of the object being designed and with its graphical interpretation. The most important creation in this area was by Prusinkiewicz and Federl [6], who conducted the development of *an interactive environment for creating and conducting simulated experiments*. It is called the *Virtual Laboratory* and is focused on graphical applications of **LS**ystems, with an emphasis on the generation of fractals and the modeling of plants.

To pursue our research work [7], we felt the need for an environment that would combine the following: *(a)* intuitive, easy to understand, to navigate, and to dis-

cover, and *(b)* complex enough to fulfill our expectations of visualization and handling of **LS**ystems.

This motivation, along with the ideas expressed in (1) drove us to design and implement a simple environment for visualization of and interaction with **LS**ystems. Its main features are:

- **LS**ystem-grammars of different flavors (parametric/non-parametric, deterministic/stochastic, Context-free/Context-sensitive) can be defined
- Graphic models of objects can be generated in two or three dimensions
- Display of the generated structures is performed following the metaphor of a camera in space; that means that all the parameters of visualization can be changed by the user. The environment continuously sends *hints* concerning the position in space of the camera.
- As the objects exist in 3D space, the environment provides a module to project this object in 2D (equivalent to *taking a picture* from a given position); this projection can then be manipulated as desired. In fact, a visualization module is provided to display the *pictures* taken.
- Available to the research community in an open source code approach.

A complete description of the environment is presented, along with an insight on how this work is helping us in reaching our research objectives.

References

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