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## Review

# The secret Life of Plants

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## **Simulating the natural growth of plants depends on mimicking the actual life cycle of plants, as David Chadwick discovers**

From a single seed a mighty oak will grow! Elementary biology. The seed contains the genetic code of the species that conditions the height, the branches, the shape of the leaves and the growth and reproductive cycles, subject, of course, to weather and soil conditions.

Trees are a tremendously important part of our lives. They are the lungs of the planet, provide a widely used, sustainable, material for buildings, furniture, paper, and they provide shade. They are also a highly decorative resource, softening the harsh contours of buildings and imbuing open spaces with re-assuring, even mystical, properties that console the human spirit.

That is why landscaping is such an important, integral, part of project development, and why architects populate their concepts with greenery. The public, the clients of the architect, feel less threatened by the expansion of concrete and steel if it is balanced with an equal amount of foliage..

As we strive for increased realism in our designs, we aspire to heightened naturalism in our landscapes, to extend beyond the mere placement of static images. Trees are living entities - they grow, they bend in the wind, they shed leaves.

Architects already use digital light sources to show their designs during the day and at night. Now they are able to plant trees and shrubs, and step forward some years, to show how a project would look as vegetation approaches maturity.

But hold on, you say, this is not new. Such a technology has been available for some time, and we are already filling our landscapes with natural looking trees.

Except for one, jarring, note. All of the trees look the same! The foliage has a distinctive, artificially induced look and feel that doesn't quite exist in nature - a fact that subconsciously registers on our mind!

Now, if we were able to simulate the growth of each tree separately, from a single seed containing, like nature, its genetic code, we could generate a whole forest digitally, from that seed, with each tree uniquely different from its neighbour.

Far-fetched? No, as Bionatics, a French company that has been working on the simulation of plant growth, has developed a new technology that does just that.

AMAP (Plant architecture and Modelling Workshop) was developed from research carried out by the founders of Bionatics at the Centre for International Co-operation in Agronomic Research for Development (CIRAD). It was developed for computer graphics professionals to enable them to create plants with a high degree of realism, using software tools like Wavefront and Softimage. Architects, landscape designers and city planners soon got to hear of the software and quickly realised its value for their particular specialisations.

### **EASYnat**

Bionatics has developed three separate tools to cater for architects (EASYnat), Defence, Civil Engineering and Entertainment (REALnat) and 3D animators (natFX). The one that we are obviously most interested in is EASYnat, now available for Architectural Desktop 2004, providing a plant growth simulator capable of reproducing, at a 'botanically coherent level', growth and seasonal changes of more than 300 different plants, selected from around the world.

Using EASYnat, architects will be able to generate photo-realistic plants and trees in 2D or 3D within an ADT template. They will then be able to set the height or the diameter of the tree in ADT and EASYnat will calculate its' age. The tree can then be viewed at any age in any season, the tree aging and the seasons changing its appearance to mimic its natural life cycle.

The process is very easy. A 2D EASYnat traced plant symbol is dragged and dropped into an ADT scene, Autodesk VIZ Render is then launched, and through automatic association, EASYnat generates the natural looking 3D plant for each species, even to the extent of reproducing leaf and bark textures. The plant symbol is generated by the virtual seed containing the mathematics and the botany to grow the plant. The architect selects the parameters that establish species, age and season, and the number of plants that he needs. These are generated individually, and placed in the 3D scene.

The plants can be generated in a number of modes - 2D, 3D or by using a hybrid mode that combines 3D geometry with 2D billboards. 2D trees are fine for background effects, saving considerable space as they have very low polygon counts. 3D trees obviously come with much more detail, but there are occasions, when trees are to be seen from limited viewpoints, when hybrid effects can provide heightened detail whilst maintaining the lowest polygon count possible. The 2D billboards provide a detailed background to the foreground 3D growth of each individual tree.

Plants can, thus, be optimised for detail, enabling the architect to place detailed plants in the foreground, and simplified plants in the back.

Bionatics supplies four virtual plant seeds when the user buys and downloads the basic version of the software - 1 pine, 1 tree, 1 bush and 1 flower. To add to the variety, additional virtual seeds can be purchased and downloaded, to build up a virtual nursery of over 300 plants. Bionatics also supply, currently free-of-charge, a library of 500 plant symbols for use within ADT, downloadable from their website.

The plants have associated symbols for placement within 2D drawings, associated with the virtually generated trees. Should the user wish to produce 3D visualisations, the software will look for the virtual tree. If it is not there, it will ask whether the user wishes to purchase the seed.

REALnat is aimed at developers of real-time 3D simulation - computer games and defence contractors, whose needs are slightly different from architects. The plants are needed to populate high speed digital sequences, such as flight and battle simulation, and do not require the absolute accuracy of detail found in EASYnat.

After generating the trees, REALnat models the plant in 3D geometrical shapes, virtually photographing it from each angle, including above. The structures can be adjusted repeatedly by modifying the luminosity, resolution and format of the model, and saving the results of each adjustment to create further variety.

REALnat gives a perfect illusion of a 3D plant that can be observed from all angles, even from above (for realistic flight simulation) with shadows - an aerial view impossible to reproduce until now.

Once the plants have been created, it can be exported to the main formats used in this industry - Openflight, VRML1 and 2, 3D Studio and Wavefront.

natFX comes in two versions - 1.8 for 3ds Max and 2.0 for Maya. Developed for 3D special effects studios and 3D animators, providing the maximum amount of realism with the minimum number of polygons!

The same botanical laws are used, combined with the hybrid 2D/3D technology that combines 2D Billboards with 3D generated plant models. If only the front of the tree is to be seen, there is little need to generate it entirely in 3D.

The 3D artist can determine how many billboards to generate, where they will appear on the tree, their LOD (level of detail), and the LOD of the wood geometry. Max users can utilise the dynamic capabilities of the software to age the trees, have wind blow them about, change their seasons and their level of detail optimising the computers resources and calculation speeds. One of the most fascinating features of the software is the ability to select the strength of adhesion of the leaves to the tree, so that, in high winds, the artist can simulate the blowing of the wind, the bending of the tree in that wind - and the falling of leaves in autumn. Truly amazing effects! *CU*

[www.bionatics.com](http://www.bionatics.com)

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