Model & Tools for synthetic Plant to Landscape image generation

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Gallery : http://pma.cirad.fr/MJ_PICS/

With the contributions and supports of
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Summary

Context: AMAP Unit, GreenLab Project

Reminder: Principles of Computer Graphics

Software developments for 3D plants mockups

Single plant to Landscape visualization: Amap's tools
AMAP UNIT: a joint Unit of 80 permanent positions (CIRAD, IRD, INRA, CNRS, University of Montpellier 2)

3 teams
1 transversal Theme
4 transverse projects

Single plant
Stand/crop to Landscape

http://amap.cirad.fr
AMAP: Plant to Landscape Visualization history

Pioneer: Siggraph 86, 88, 91, 00

Strongly linked to Industry:
SESA (87), ToyoLinks (90), Var SGI (92),
JMG Graphics → Bionatics SA
AMAPstudio is a software suite for plants architecture modelling. It contains applications and models to rebuild, explore, analyse and study the growth of plants from an architectural point of view.

It is targeted to scientists and students in the agronomic and botany fields.

These applications and models may work at the individual plant level like in Xplo or at the scene level like in Simeo.

http://amapstudio.cirad.fr/
Model definition and its formalism

Model applications in agronomy and forestry

Software developments
Multi-scale representations of plants, crops & populations

GreenLab Amap
Modelling Plant Development & Growth

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GreenLab Amap overview

The GreenLab Amap research team created January 2001 stands from a long history on plant growth architecture and functioning modelling: Amap 80’s pioneer work, the Sino-French GreenLab project, the DigiPlante CIRAD-ECP-INRIA EPI

GreenLab Amap aims to build Functional Architectural Plant Models (FAPM), integrating knowledge from plant architecture and ecophysiology. The team builds on a multidisciplinary framework involving applied mathematics, life sciences, environmental science and computer science, organized along three axis:

- Model definition and its formalism
  Modelling the growth and architectural development of plants, from individual specimen to population, in interaction with the environment. Developing the model formalism, thanks to structure factoring and dynamic yield equations

- Model applications in agronomy and forestry
  Developing parameter identification and validation on plant crops. Fine-tuning of optimisation and monitoring methods to ensure the model capabilities to environmental science applications.

- Software developments
  Building growth simulation software tools for plants, crops and functional landscapes. Multi-scale representation of plants, crops and populations for image synthesis and scientific visualization.
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**Principles of Computer Graphics (1)**

*From MJ C.A.S. Courses (2002-2006)*

Generating 2d images from an abstract word (model)

- thanks to 3D space geometrical projection seen by a virtual camera, and colored by an illumination model interacting with object surface materials

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Principles of Computer Graphics (2)

Modelling

Viewer

Light

Surface properties

2D output
Summary

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Single plant to Landscape visualization: Amap's tools
AMAP UNIT: Plant Mock up definition principles

Two ways. 1. By reconstruction (static structure) from

Measurements, (tacheometer)

Digitalizations,

Lidar acquisitions
LI HongJun, Zhang Xiaopeng LIAMA/BJFU
AMAP UNIT: Plant Mock up definition principles

Mesures + MTG encoding

Tacheometer

Other Formats

Xplo: open source software for plant architecture

Input and edition under Xplo

Xplo: open source software for plant architecture. 

In order to:

- build, edit, visualize, extract structural data
- run individual level 3D growth models.

(Sébastien Griffon, Cirad)
AMAP UNIT: Plant Mock up definition principles

Two ways. 2. By simulation (dynamic structure)

Various simulators:

- Structural: AmapSim
- Fonctionnal: GreenLab
- Specialized: Principles
From single plant to Stands... and landscapes

Individuals planting with procedural and editing tools (Simeo).

Simeo (F. de Coligny, INRA)

Procedural seeding: random or rows

Individual ou group fonctions
From single plant to Stands... and landscapes

Imports/Exports plug-ins

Imports

AMAPstudio formats:
- OPF (Open Plant Format)
- OPS (Open Plant Scene)

Others formats:
- MTG
- LIG + DTA

... Add yours ...

Exports

AMAPstudio formats:
- OPF (Open Plant Format)
- OPS (Open Plant Scene)

Others formats:
- MTG, LIG + DTA
- Sunflow, Abaqus INP
- Obj (Wavefront)

... Add yours ...

Digitized Maritime pine root system with PiafDigit
(F. Danjon - INRA)

Abaqus export for tree overturning simulation
(T. Fourcaud - CIRAD)
Summary

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Single plant to Landscape visualization: Amap's tools
Tool list.

Freeware, Amap's, Professionals

Single image processing: XnView, Gimp, QZIPP

Image with Zbuffer processing: QZIPP

Single tree viewing: Xplo, LigDraw, VRML

3D Editor: Misfit, Blender

Landscape editor: Simeo, LandSim3D

Landscape render: Sunflow, Blender, Pov, LandSim3D
Tool list.

Freeware, Amap's, Professionals

Single image processing: XnView, Gimp, QZIPP

Xnview: Cut, resize, flip, single process, exports, ...

The Gimp: more advanced masks, layers, ...
Tool list.
Freeware, Amap's, Professionals

Image with Zbuffer processing: QZIPP
QZIPP – 2D process. HDR - Rain
QZIPP – 2D 1/2 process. Snow - Dof
Single tree visualization principles

Line Tree: list of components (id, position, orientations [MJ86])

Line tree drawing

- Drawing a line from origine to origin+main direction: skeleton
- Full: Converting the matrix to a affine operator, applied to standardised geometrical patterns
Level of details principles

Minimising the number of components
  – Filtering according to size, or randomly

Advanced features: with Xiaopeng Zhang
  – Component merging
  – Using Impostors
Tool list.

Freeware, *Amap*'s, Professionals

Single tree viewing: *Xplo, LigDraw, VRML*

**Vrml trees:**
- From geometry
- From impostors
Tool list: Lig_Draw / Gloups_Draw

A single tree viewer (capitalizes some results and used also for tests)

- Reads line tree (single or sequence)
- Has a pattern/material menu
- Exports image with / without depth
Specific Features

Tools to rebuild topolgy from line Tree → allows branch Lod
Mix of line and polygon rendering
Allows .obj patterns
Lig_Draw / Gloups_Draw
Tool list: MistFit 3D / Blender

Patterns with MisFit 3D freeware

Advanced: Blender
Lig_Draw / Gloups_Draw / QZIPP
From single plant to Stands... and landscapes
Simeo exports to freeware rendering tools

- Sunflow
- Blender
Tool list. Freeware, Amap's, Professionals

Landscape editor: *Simeo, LandSim3D*

Landscape render: *Sunflow, Blender, Pov, LandSim3D*
Tool list. LandSim 3D (free licence to AMAP)
Tool list: LandSim 3D

Exports 3D geometry or impostors from LigDraw to LandSIM3D
From single plant to Stands... and landscape

Cooperation with Bionatics on LandSim3D

Using LandSim3D in AMAP's projects

Export Trees (billboards from LigDraw) to LandSim3D
A full set of tools from organ to landscape

Freeware, *Amap's*, Professionals

Single image processing: **XnView, Gimp, QZIPP**

Image with Zbuffer processing: **QZIPP**

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3D Editor: **Misfit, Blender**

Landscape editor: **Simeo, LandSim3D**

Landscape render: **Sunflow, Blender, Pov, LandSim3D**
More on: http://pma.cirad.fr/MJ_PICS/

References


QingQiong Deng, Xiaopeng Zhang, Gang Yang, Marc Jaeger. Multiresolution foliage for forest rendering, in COMPUTER ANIMATION AND VIRTUAL WORLDS, 2010, Vol. 21, No 1, John Wiley and Sons, pp. 1-23

