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## Introduction to OpenAlea, a platform for plant modeling

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# Intoduction to OpenAlea, a platform for plant modelling



Thomas Cokelaer, Christophe Pradal, Christophe Godin  
on behalf of the OpenAlea project

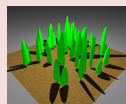
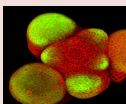


IHC 2010, Lisbon, 25 August

# Background: plant modelling at a glance

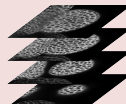
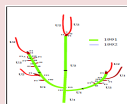
- Different scales:

- cell
- branch
- tree
- forest



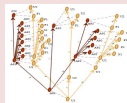
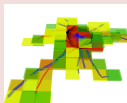
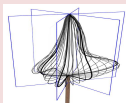
- Heterogeneous data:

- raw data
- digitised data
- tree databases
- 3D images



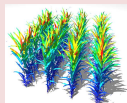
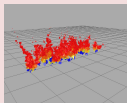
- Many tools required:

- topology
- Geometry
- simulation



- Many models possible:

- theoretical
- mechanical
- probabilist



# Outline

- 1 OpenAlea in a nutshell
  - Goals
  - Architecture
  - VisuAlea: a Visual Programming Environment
  - Packages
  - Community
- 2 Applications
  - MAppleT
  - TopVine
- 3 Conclusions

# The OpenAlea project

## An open source project to

- address the needs of Plant research community
- develop new models rapidly

## A common platform to

- share developments between various labs
- share databases
- share training efforts

## A common software = efficiency + quality + reproductibility

- Reuse **existing** software and tools
- Enhance accessibility to data and software (via common web sites)
- Set quality rules

# OpenAlea Architecture

## OpenAlea is not

- an application

## OpenAlea is

- a set of components (or packages, or tools)
  - Common language is Python → multi-platform
  - Models components may be written in other languages

## OpenAlea provides

- easy access to many packages from various labs
- easy access to other applications like GroIMP, LPy, cpfg, ...
- a common platform **VisuAlea** to allow dynamic composition of models using components available.

# VisuAlea and Visual Programming

## Advantages

- Interactive creation and modification of flexible workflows
- Visual representation of the structure of a model
- Dynamic composition of software components

The screenshot displays the VisuAlea interface with several key components highlighted by blue callouts:

- Package Manager:** Located on the left, it shows a list of installed packages such as 'Catalog Model', 'Catalog Python', 'Dome Stand Forestry', and 'PlantGL Visualization'.
- Data Pool:** Located at the bottom left, it displays a table of data points with columns for 'x', 'y', and 'stand\_data'.
- Dataflow:** The central workspace shows a visual programming graph with nodes like 'read', 'Spatial Distribution', 'Stand Positioner', 'Tree Shape', 'PGL Dresser', and 'Stand Dresser' connected by arrows.
- Widgets:** Various control panels are visible, including 'PaintLine Style' and 'PGL Dresser', which allow for configuring the visual appearance of the model.
- Interpreter:** Located at the bottom right, it shows a terminal window with command-line input and output, such as '>>> get\_data()' and '>>> display()'.

Additional visual elements include a 'Figure 0 spatial distribution' window showing a scatter plot of blue points and a 'PlantGL 3D Viewer' window showing a 3D rendering of green trees on a grid.

# Packages samples

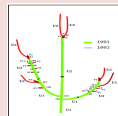
## PlantGL (Boudon, Pradal et al.)

Plant Geometrical Library and 3D viewer



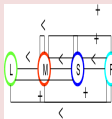
## MTG (Godin et al.)

Multiscale Tree graph library (MTG).



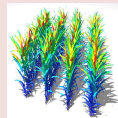
## Stats (Guedon et al.)

Statistical Analysis, data exploration.



## Caribu - (Fournier, Chelles et al.)

simulation and radiative transfer - (Fournier, Chelles et al.)



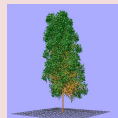
## Lpy (Boudon)

Lsystem in Python run within VisuAlea



## Weberpenn models (Pradal)

Implementation of the Weber & Penn models





# The OpenAlea community

## 3 types of Members

- Computer scientists: maintain OpenAlea core (web site, storage, mailings lists,...)
- Developers: integrate their own models and documentation for users
- Users: create scenarii and provide databases.

## Free community

- OpenAlea Licence: CeCIII-C
- OpenAlea packages are under CeCILL licence
- Components licence depend on developers choices.

## Some partners

INRIA Virtual Plants (Montpellier), UMR Lapse (Montpellier), UMR DAP (Montpellier), UMR PSH (Avignon), UMR EMMAH (Avignon), UMR AIVA (Mpt), UMR EPC (Paris-Grignon), UMR PIAF (Clermont-Ferrand), UMR RDP (ENS Lyon), UMR Labri (Bordeaux), EPI INRIA Mistis (Grenoble), UMR SAGAH (Angers), Calgary U. (Canada), Gottingen U. (Germany), Wageningen U. (Netherlands), California U. (USA), CPIB (UK)

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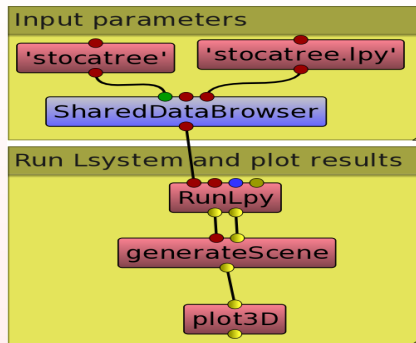
# MAppleT: statistical and biomechanics

## Apple tree model

- Original MAppleT Lsystem (from L-studio) written in LPy
- New implementation can use other OpenAlea packages such as statistical analysis, 3D Geometrical tools, light interception, ...

## reference

Costes et al, Funct. Plant Biol. 10, 2008



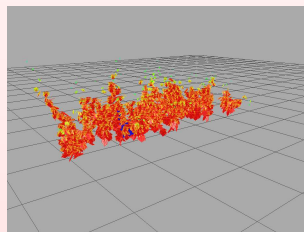
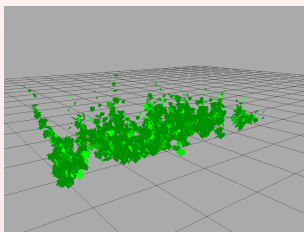
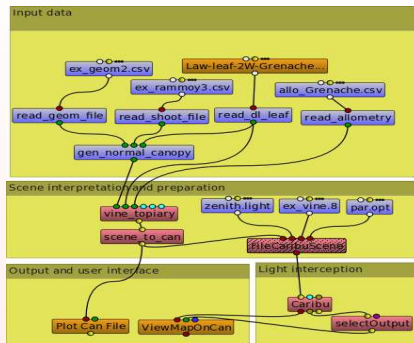
# Topvine: vine grape data

## vine grape model

- Dataflows implemented in VisuAlea combined with PlantGL and Caribu packages
- Interactive selection of the output

## reference

Louarn, G; Lecoer, J; Lebon, E, AOB (101) 8, 2008



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# Conclusions

## OpenAlea and VisuAlea

- OpenAlea is an open source project.
- OpenAlea provides a visual programming environment called VisuAlea
- VisuAlea allows to compose scientific models in a GUI
- Foster components/widgets reuse between labs
- Many packages from co-developers are available: Biophysics models, image processing, statistical analysis, Lsystems

## Modelling and coding sprints

- Sprints are organised so that people from different teams can meet up to work on a common model.

## Documentation

- OpenAlea web site gather technical and scientific information
- Each package has its own web site to provide user and developer documentations

## Thank You!

<http://openalea.gforge.inria.fr>

- +120 000 viewed pages a year
- 160 000 downloads (since 2007)
- 1 200 unique visitors a month
- 20 active developers
- 20 integrates components
- 16 teams involved
- 10 coding and modelling sprints (since 2007)

