Agrocampus Ouest, Centre d'Angers
Institut National d'Horticulture et de Paysage
Dépt. STPH
UMR1345 Institut de Recherche en Horticulture et Semences
(IRHS), Equipe Arboriculture Fruitière
2, rue André le Nôtre, 49045 Angers cedex 01, France
https://www6.angers-nantes.inra.fr/irhs/

University of Göttingen
Chair for Computer Graphics and Ecological Informatics
Büsgenweg 4, 37077 Göttingen, Germany
http://www.uni-goettingen.de/en/67072.html

Final Programme:

Tutorial and Workshop

"Functional-Structural Plant Modelling with GroIMP and XL"

combined with the 7th GroIMP user and developer meeting

co-funded by

ANR DFG

Date: 5 – 7 May 2015
(Start and Introduction: 5 May, 15:00; Workshop: 5 May, 15:00-18:30, and 6 May, 08:30-09:00, Tutorial: from 6 May, 09:00, until 7 May, 12:00)

Location: Agrocampus Ouest, Centre d'Angers
2, rue André le Nôtre, **Angers**, France

Announcement:
This event is open for all who want to learn how to work with the software tool GroIMP – Growth-grammar based Interactive Modelling Platform – and to write models in the rule-based programming language XL (see **`www.grogra.de`**). Particularly, it is open for M.Sc. and Ph.D. students in Applied Computer Science, Botany, Agriculture, Horticulture or Forest Science with focus on information processing and modelling, and also for interested guests from other disciplines.

The accompanying workshop will provide a forum to present some results for those who have already made some experiences in XL.

The GroIMP user and developer meeting, which will be integrated in the workshop, will provide an opportunity for exchange concerning the future development of the language XL and the software GroIMP.

The language will be English. No congress fee is required.

Please send your request for registration to gerhard.buck-sorlin (at) agrocampus-ouest.fr. Do not forget to indicate if you want to participate in the *workshop*, in the *tutorial*, or in the whole event.

Programme:

5 May (Lecture theatre C "Rosalind Elsie Franklin") - Workshop -

15:00 Introduction to the Workshop (Gerhard Buck-Sorlin and Winfried Kurth) [pdf]

15:25 Brief introductory round of every workshop participant

15:35 Junqi Zhu: Process-based grape model for simulation of berry development and composition in response to climate change

16:05 Emna Bairam: Modeling carbon transport within the carrier branch of apple

16:35 Franca J. Bongers: Game theoretical analysis of phenotypic plasticity: a case study of shade avoidance responses in *Arabidopsis thaliana*

17:05 Coffee break

17:35 Jorad de Vries: Modelling plant plasticity; disentangling complex and dynamic interactions one step at a time

18:05 Ningyi Zhang: Optimizing ornamental crop production using functional-structural plant modelling: the case for lily

18:20 Martin Sikma: Functional-structural plant models for climate change studies: quantifying feedbacks between rice architecture, physiology, and microclimate

18:35 END of the workshop programme of the day

19:30 – 22:00: Workshop dinner (Restaurant Palais de Kashmir, 11 pl. Mendes France)

6 May (room B201)

Workshop (contd.)

08:30 – 9:00: Lifeng Xu: Simulating genotype-phenotype interactions using FSPMs with GroIMP (via Skype)

Tutorials (6 & 7 May)

6 May, 9 – 12:30, 14:00 – 17:00 (parallel)

Beginners (room B201)	**Advanced (room B202)**
9:00 – 10:00: Winfried Kurth: Introduction to rule-based programming, L-systems and the programming language XL [pdf]	9:00 – 10:00: Gerhard Buck-Sorlin: Modelling physiological processes with GroIMP
10:00 – 10:30: (Team session 1) Simple branched structures modelled with XL	10:00 – 10:30: Special modelling questions (on user demand)

10:30 – 11:00: Coffee break

11:00 – 12:00: Winfried Kurth: Programming in XL [pdf] 12:00 – 12:30: (Team session 2) Using interpretive and instantiation rules	11:00 – 12:30: Jorad de Vries: About the use of queries in GroIMP

12:30 – 14:00: Lunch break

14:00 – 14:45: Gerhard Buck-Sorlin: How to model a daisy in 45 minutes 14:45 – 15:00: (Team session 3) Improving the daisy model	14:00 – 15:00: Michael Henke: Advanced light modelling with GroIMP 15:00 – 15:30: Michael Henke: GroIMP 1.5 – A closer look at the new features

15:00 – 16:00: Winfried Kurth: Programming in XL (continued) [pdf]	15:30 – 16:00: Case studies of advanced users I (Q & A session)

16:00 – 16:30: Coffee break

16:30 – 17:00: Winfried Kurth: Programming in XL (continued; link see above)	16:30 – 17:00: Case studies of advanced users II (Q & A session)

GroIMP User and Developer meeting (room B201)

17:00 – 17:30: Users' questions and suggestions for improvement

7 May, 9 – 12:00 (room B201):

9:00 – 10:30: Winfried Kurth: How to develop a simple FSPM with GroIMP [pdf]

10:30 – 10:45: Coffee break

10:45 – 11:15: Solving ordinary differential equations in XL [pdf]

11:15 – 11:45: Modelling multiscale structures in XL [pdf]

11:45 – 12:00: Questions and answers, final discussion.

Further links:

www.grogra.de

Summer school in Prague, 2013

Dissertation Ole Kniemeyer
Dissertation Reinhard Hemmerling
Dissertation Yongzhi Ong

Publications of the Plant Modelling group, Göttingen

Venue

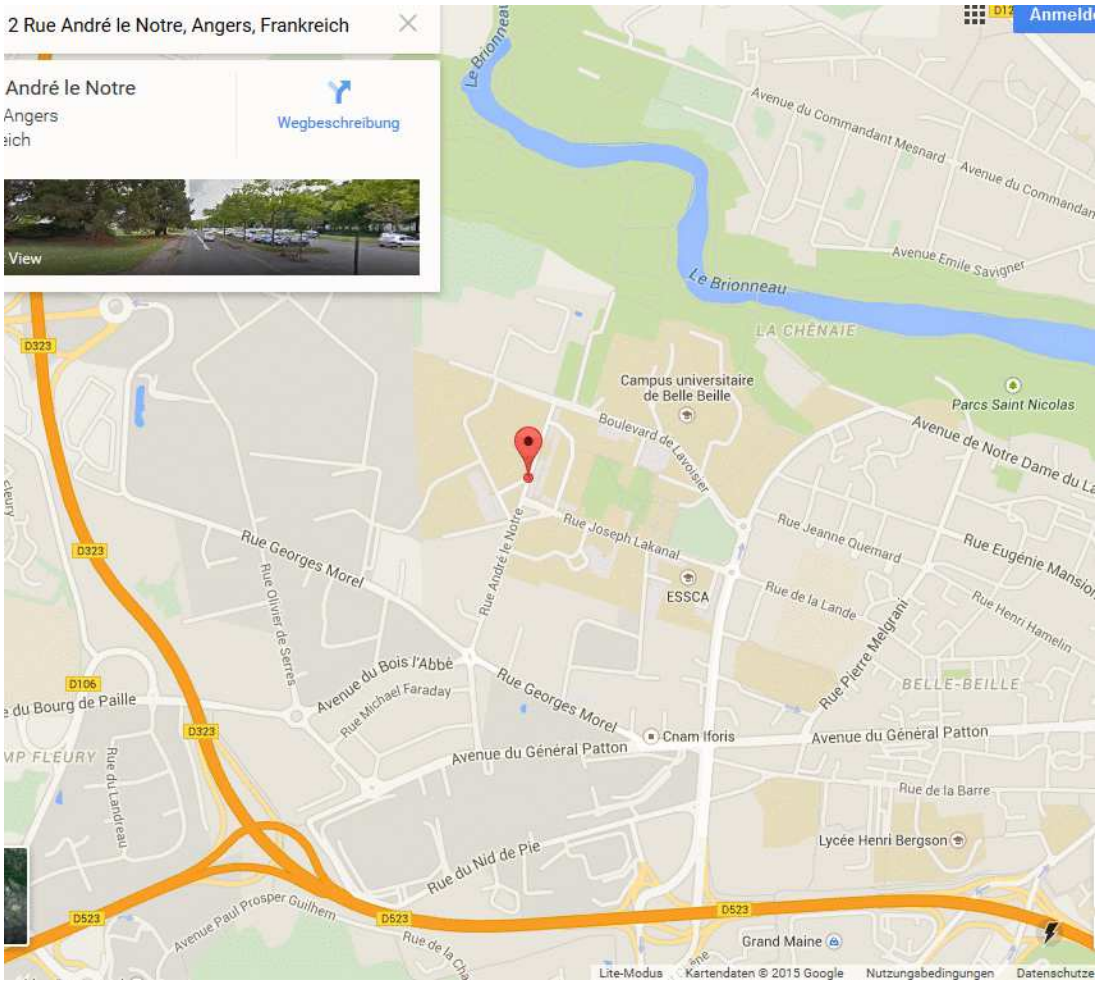
The workshop and tutorial will take place at Agrocampus Ouest, the national institute of Horticulture, located in Angers, a city of art and history renowned for its quality of life, historic capital of Anjou, gateway to the Loire Valley, and listed as a UNESCO World Heritage Site since 2000.

Agrocampus Ouest Angers is situated at Belle-Beille, a northwestern quarter of Angers. You can reach it by taking the bus no. 1 to “Belle Beille Université” or “Beaucouzé”, and get off at the terminal stop “Angers - Maison de Technopole Belle Beille”. More information on public transport can be found here: http://bustram.irigo.fr/pages/index.php?page=calcul

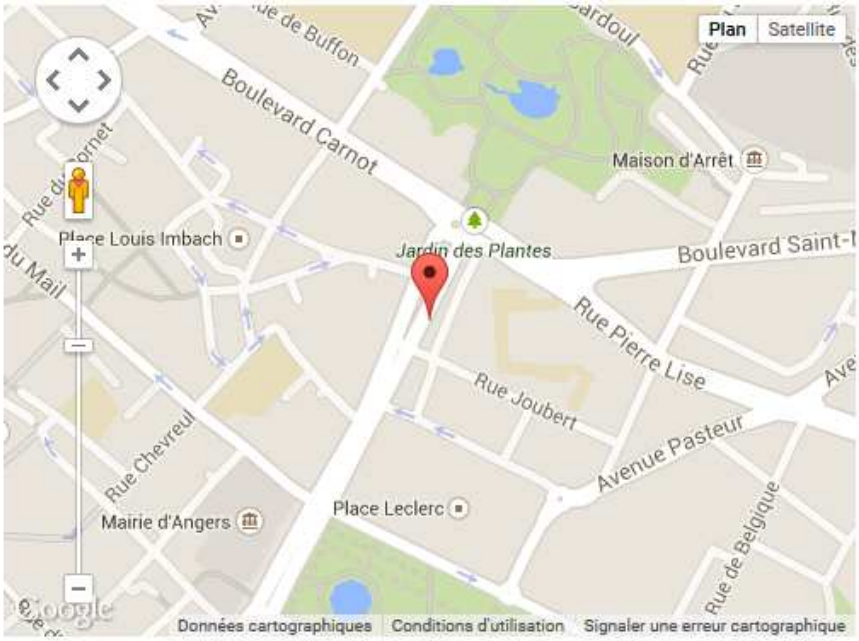
You can find further practical information here:

Angers city council: www.angers.fr
Angers tourist information centre: www.angers-tourisme.com
Angers Urban Community: www.angersloiremetropole.fr

Location: Agrocampus Ouest



Location of the restaurant "Palais de Kashmir" for Tuesday evening:



Abstracts of Workshop Contributions

Process-based grape model for simulation of berry development and composition in response to climate change

Junqi Zhu[1]
Joint Research Unit 1287 EGFV (Ecophysiology and Functional Genomics of Vine), National Institute of Research in Agronomy (INRA), Bordeaux, France

Climate change will affect various aspects of the wine industry and consequently challenge the sustainability of grape production. However, little work has been done on quantifying the response of berry composition to climate change. Process-based models may fill this gap by integrating berry development and quality formation with whole plant status and environmental factors. This ongoing research project provides a novel approach for incorporating whole plant development and berry development via xylem water potential and phloem carbon concentration.

Game theoretical analysis of phenotypic plasticity: a case study of shade avoidance responses in Arabidopsis thaliana

Franca J. Bongers[1,2], Ronald Pierik[2], Jochem B. Evers[1] and Niels P.R. Anten[1]
[1]Centre for Crop Systems Analysis, Plant Sciences Group, Wageningen University, The Netherlands
[2]Plant Ecophysiology, Department of Biology, Utrecht University, The Netherlands

The shade avoidance syndrome (SAS) is one of the best-studied forms of plant phenotypic plasticity, and several studies have showed that SAS increases performance when competing for light with plants that do not show SAS. However, it is unknown how natural selection could have acted on these plastic traits. With a virtual plant model of *Arabidopsis thaliana* we study the effect of specifically the petiole shade avoidance responses on the performance of plants competing for light. The plant is composed of small organ parts (e.g. petiole and the tip or base of the lamina), resulting in all parts being able to perceive signals and respond independently of each other. By also separating the responses in separate factors we can study the responses in detail, and thus get a better understanding of how phenotypic plasticity as traits could have evolved in time.

Optimizing ornamental crop production using functional-structural plant modelling: the case for lily

Ningyi Zhang[1,2,3], Jochem B. Evers[2], Leo M.F. Marcelis[1], Niels P.R. Anten[2], Weihong Luo[3]
[1]Horticulture and Product Physiology, Plant Sciences Group, Wageningen University, The Netherlands
[2]Centre for Crop System Analysis, Plant Sciences Group, Wageningen University, The Netherlands
[3]College of Agriculture, Nanjing Agricultural University, China

Unlike food crops and vegetables in which biomass production is the main interest, in ornamental crops morphological traits are also very relevant for economic benefit. Although descriptive models have been developed for ornamental crops to predict morphological traits such as plant height, number of leaves and flower size, there is a demand in predicting morphological traits that are relevant for ornamental quality, through more mechanistic methods for better understanding the physiological control of plant morphology and optimizing ornamental crop production. Functional-structural plant models (FSPM) simulate plant structural development as governed by physiological processes and include visual 3D output of plant phenotype. Lily was chosen for this case study due to its importance in ornamental crop market. A lily FSPM will be developed and used to optimize production in terms of morphological traits in relation to light management and plant density.

Functional-structural plant models for climate change studies: quantifying feedbacks between rice architecture, physiology, and microclimate

Martin Sikma[1,2], Bert. G. Heusinkveld[2], Albert A.M.Holtslag[2], Toshihiro Hasegawa[3], Mayumi Yoshimoto[3], Michaël Chelle[4], Xinyou Yin[1], Niels P.R. Anten[1], Jochem B. Evers[1]
[1]Centre for Crop Systems Analysis, Wageningen University, Wageningen, the Netherlands
[2]Meteorology and Air Quality Group, Wageningen University, Wageningen, the Netherlands
[3]National Institute for Agro-Environmental Sciences, Tsukuba, 305-8604 Japan
[4]INRA, UMR1402 Ecosys, F-78850, Thiverval-Grignon, France

Climate change will modify the interactions between microclimate and plant architecture and physiology by changes in local temperature, CO_2 concentration and light. As these interactions strongly influence crop yield, understanding these modifications and deciphering the involved key

mechanisms are an important issue in the context of food security. To reach this goal, we aim to develop a hybrid FSP-SVAT model that could be used to investigate crop responses to such changes. Data for model calibration will be collected in a FACE experiment near Tsukuba, Japan.

Modelling plant plasticity; disentangling complex and dynamic interactions one step at a time

Jorad de Vries[1,2], Jacob C. Douma[1], Liesje Mommer[3], Marcel Dicke[2], Niels P.R. Anten[1] ,Erik H. Poelman[2], Jochem B. Evers[1]
[1]Centre for Crop Systems Analysis, Wageningen University, Wageningen, the Netherlands
[2]Laboratory of Entomology, Wageningen University, Wageningen, the Netherlands
[3]Nature Conservation and Plant Ecology, Wageningen University, Wageningen, the Netherlands

Plants grow up competing over resources in ever changing environments, being able to react to both competing neighbours and other environmental changes is vital to their survival. The growth-defence trade-off is one example of a dynamic system in which plant responses to light competition and insect herbivory interact on a four dimensional scale. Another example is plasticity in root architecture in response to neighbours or nutrient levels and distributions, the mechanisms driving root plasticity are still a mystery. Both these systems offer a range of opportunities for three dimensional plant modelling.

Modeling carbon transport within the carrier branch of apple

Bairam E., Delaire M., le-Morvan C, and Buck-Sorlin G.H.
UMR 1345 Institut de Recherche en Horticulture et Semences (IRHS), Agrocampus Ouest, Angers, France

In the apple branch, assimilates are carried from the sugar synthetizing organs (sources) to other developing or storage organs (sinks). A sugar transport model for the carrier branch of apple was conceived and built as a Functional-Structural Plant Model using the GroIMP modeling platform. This model was based on water and sugar fluxes in the phloem and the xylem. In this presentation we will discuss how the model could be further parameterized to adjust it using data of observed growth kinetics of apple tree organs.