GROWBOT	Title **Workshops, Working Groups, Editorial Initiatives**	Deliverable Number **10.3** Version **0.1**

H2020-FETPROACT-2018-01

GrowBot – Towards a new generation of plant-inspired growing artefacts

Deliverable 10.3

Workshops, Working Groups, Editorial Initiatives

WP10 – Community building

Authors: [Nicholas Rowe (CNRS)]

Lead participant: CNRS

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Revision History

Author Name, Partner short name	Description	Date
Nicholas Rowe, CNRS	Draft	17/12/2019
Nicholas Rowe, CNRS	Final version	30/12/2019

Contents

1 WP and Task introduction

WP 10 is dedicated to consolidate a ground-breaking and disruptive community on plant-inspired robotics technologies, strongly grounded on an inter-disciplinary character. GrowBot lays the foundational activities to make this community active within, outside and beyond the project and within and among specialists in biology and technology.

Task 10.3 "Scientific events and editorial initiatives", led by CNRS (month 12-36), intends to provide opportunities for gathering and exchange of ideas and experiences, promoting discussions on open issues, tracking technical developments and encouraging innovation, fostering the exchange of personnel and collaboration activities, systematizing knowledge relevant for GrowBot.

Expected results: organization of joint and common initiatives, interdisciplinary workshops, and Working Groups open to scientists outside the project. Drawing up working papers, special issues and a book series collecting the knowledge of bioinspired and soft robotics, science on climbing plants and on other issues related to the project.

The aim of the present document is to provide a plan of the GrowBot activities in this field. This document will be updated at month 36 and 48.

1.1) Aims of this document (30th December 2019)

In this document we set out an overview of the main community-building events since the start of the GrowBot project in January 2019.

We present our planning for future events and our initiatives for community building among non-academic communities. In these sections we give recent examples and experiences on which we base our planning for future events.

Our principal aims are to build up a strong understanding of the aims of the project among both the biological and technological communities, and in academic and non-academic spheres. Secondly, we place importance on communication among peers as well as an understanding and visibility to future researchers at undergraduate and post-graduate levels.

2 Organised scientific events (2019)

2.1) 6th June 2019 Conference, "Focus on lianas", AMAP, (CNRS) Montpellier, 6th June 2019.

Organiser: Nick Rowe (CNRS, Montpellier, France)

Invited guest speakers: Dr. Stefan Schnitzer (Marquette University, Milwaukee, Wisconsin, USA). Dr. Patricia Soffiatti (Department of Botany, Federal University Parana State, Brazil).

Aims:

- Present the project GrowBot to home Institute (CNRS) and local colleagues, collaborators and undergraduate and graduate students.
- Give Ph.D. students and local colleagues the opportunity to present their work and exchange ideas on liana biology.
- Set up local and international discussion groups and collaborations.

Results:

The meeting included 8 speakers and was well attended by approximately 55 attendees with undergraduates, local faculty and staff. One of the speakers, Begum Kacamak is now a GrowBot prize holder for her work on the ecology of lianas in Central Africa. The meeting was successful in attracting collaborators and students to the GrowBot project who are now actively engaged in the project.

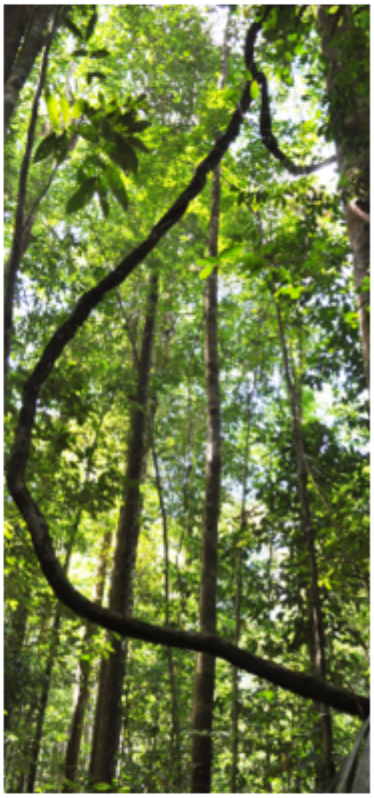
(See flier and conference details below)

"Focus on lianas"

AMAP 6th June 11:00-17:30

Salle 201, Bâtiment PS2, CIRAD-UMR AMAP, Boulevard de la Lironde

Lianas are an iconic growth form in many tropical ecosystems where they play important roles in community composition, vegetation dynamics and likely responses to climatic change. This informal meeting focuses on some of the diverse approaches and projects centred on lianas at AMAP and will kick off with a key note lecture by our guest speaker Stefan Schnitzer. We will be covering a diverse range of subjects from overarching studies on the ecology and evolution of lianas to new approaches of studying lianas in the field, detailed functional traits, biomechanics, modelling at the community level and finally using lianas as models for bio-inspired new technologies.



Stefan Schnitzer (Marquette University, Milwaukee, Wisconsin, USA) – *Ecology of Lianas*
Thomas Couvreur (IRD, DIADE) – *Evolution*
Begum Kacamak (Forestry Club de France) – *Liana communities in northern Congo*
Sebastien Levionnois (EcoFog & AMAP) – Anatomical and morphometric approaches
Fiston Nininahazwe (AMAP) – *Imaging spectroscopy for distinguishing lianas in canopy*
Isabelle Maréchaux (INRA – AMAP) – *Functional strategies and modelling*
Patricia Soffiatti (UFPR, Brazil) – *Biomechanics of climbing cacti*
Nick Rowe (CNRS - AMAP) – *Biomimetics*

This meeting has been organised under the aegis of the theme "BIOMIME" at AMAP . For further information please contact Nick Rowe (nrowe@cirad.fr). This as an initiative of the project "GROWBOT" https://growbot.eu/ which has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824074.

2.2) 22nd June 2019, Generation GrowBots: materials, mechanisms and systems design for adaptable and growing robots inspired by plants;

Special Workshop, Robotics Science and Systems (RSS) Conference, Freiburg.

Organizers: Barbara Mazzolai, Ian Walker

Aims:

- The workshop aimed to bring together a cross-disciplinary panel of scientists and engineers
- including experts in material science, soft robotics, plant biology, and architecture.
- to present new scientific discoveries on plants relevant to continuum, soft, adaptable, and growing robots.

Results: As a result of the workshop, **Barbara Mazzolai**, **Ian Walker**, and **Thomas Speck** launched a **special issue** in **Frontiers in Robotics and AI** for gathering the contributions presented at the 2019 Robotics Science and Systems (RSS) workshop (See below).

2.3) Activities linked to the RSS workshop:

(1) Project meeting of partners Freiburg, CNRS & Helmholtz-Zentrum

Included a project meeting hosted by Thomas Speck and Marc Thielen at the Botanischer Garten, Freiburg on the 20th to 21st of June.

Attendees: A. Lendlein, N. Rowe, T. Speck, M. Behl, P. Soffiatti, M. Thielen, M.

Balk, N. Rodriguez.

(2) Social evening including barbeque and tour of the Botanischer Gardens lead

by T. Speck.

Both events greatly advanced the development of projects between biologists and technology researchers and the understanding of forming bridges between biology and new technologies.

RSS 2019 – Robotics Science and Systems – Workshop

Generation GrowBots: materials, mechanisms and systems design for adaptable and growing robots inspired by plants

June 22, 2019
Faculty of Engineering, University of Freiburg, Freiburg, Germany
WS1-4, Building 101, Room 01 013

9:00 – 9:15	***Welcome and overview of the event: Barbara Mazzolai and Ian Walker***
9:15 – 9:45	Robert Shepherd, Dept. Mechanical and Aerospace Engineering, Cornell University "Soft robotics: an emerging field"
	Fundamentals of plant biology for new technologies and robotics
9:45 – 10:15	Thomas Speck, Plant Biomechanics Group, University of Freiburg "Plants as role models for (inter-)active mobile technical systems: inspiration for soft-robotics and architecture"
10:15 – 10:45	Nicholas Rowe, Botany and Modelling of Plant Architecture and Vegetation, CNRS "Diversity, performance and developmental strategies of climbing plants in tropical forests"
10:45 – 11:00	***Coffee Break***
11:00 – 11:30	Yasmine Meroz, Meroz Lab, Tel Aviv University "What plant behavioral processes teach us about control strategies for growing robots"
	Plant-inspired technologies, growing robots and bioinspired robotic construction
11:30 – 12:00	Petra Gruber, Biomimicry Research and Innovation Center, University of Akron "A living architecture - how growth in biology informs building design"
12:00 – 12:30	Virgilio Mattoli, Center for Micro-BioRobotics, Istituto Italiano di Tecnologia "Conducting polymers for soft robotics and electronics"
12:30 – 13:00	***Q&A and discussion***
13:00 – 13:45	***Lunch break***
	Plant-inspired technologies, growing robots and bioinspired robotic construction
13:45 – 14:15	Barbara Mazzolai, Center for Micro-BioRobotics, Istituto Italiano di Tecnologia "GrowBots: a new generation of plant-inspired growing robots"
14:15 – 14:45	Ian Walker, Dept. of Electrical and Computer Eng., Clemson University "Plant-inspired continuum robots"
14:45 – 15:15	Marwa ElDiwiny, Robotics and Mechatronics, University of Twente "Modeling, design, and simulation of Knitted and Weaved Ionic Electroactive Polymer for the smart garment"
15:15 – 15:30	***Coffee Break***
15:30 – 16:00	Thrishantha Nanayakkara, Morph Lab, Imperial College London "Conditioning the body to reduce entropy of perception"
16:00 – 16:30	Yasmin Ansari, The BioRobotics Institute, Scuola Superiore Sant'Anna "Control strategies for robots based on soft materials"
16:30 – 17:00	Mirko Kovac, Aerial Robotics Lab, Imperial College London "Construction with robots and what we can learn from biology"
17:00 – 17:30	***Closing discussion: perspectives for growing robots and sustainable architecture***

Organizers: Barbara Mazzolai and Ian Walker
Contact email: barbara.mazzolai@iit.it

3. 22nd June 2019 Group meeting of partners IIT-CMBR and ALU-FR, Host institution: ALU-FR, Botanischer Garten, Freiburg. Attendees: Fabian Meder, Barbara Mazzolai, March Thielen, and Thomas Speck.

4. 24-28th June, 2019, Visiting researcher to ALU-FR Fabian Meder (IIT)
Aims: Carry out experiments related to plant energy harvesting.

3 Prospective scientific events (2019-)

3.1) June-July 2020, Field Summer School and Field Laboratory in the Tropical Rain Forest, French Guiana.

CNRS partner is planning summer field work opportunities for undergraduate and post graduate students in French Guiana for 3 to 4 weeks. The event will include data gathering and field measurements for Work Package 3 of the GrowBot project. It will provide a working experience for students in the tropics and will give hands-on experience in field craft, identifications, and field measurements in biomechanics. As well as being involved in scientific projects, students will be encouraged to produce their own blogs, links to social media and visual documentaries of their experience. The event will train students how to work on scientific projects in the tropics and boost their CV credentials for applying for masters and thesis subjects in this and related fields.

3.2) March 2020 GrowBot lectures and Tutorials for students of the German Academic Scholarship Foundation

Staff of ALU-FR will provide lectures and Guest lectures from other GrowBot partners with the aim of creating a workshop for students from this Foundation to consider GrowBot forms and functions.

3.3) March 2021, GrowBot meeting and Field excursion hosted in French Guiana.

CNRS is planning a GrowBot meeting and field excursion in French Guiana. The event will last for one week and will involve two days of meeting, talks and workshops in the scientific Institute in French Guiana. The event will give both biologists and technology researchers the opportunity to meet researchers based in French Guiana. A second part of the event will involve visits to Tropical rain forest sites where all GrowBot partners will be able to observe the full functional and biological diversity of vines and lianas at first hand. Visits and overnight stays will be planned at sites including the forestry research station at Paracou and the more remote field camp at the Piste de St Elie.

3.4) GrowBot will be event sponsor for Living Machines 2020, Freiburg, Germany – July 28-31, 2020.

The main conference will take the form of a three-day single-track oral and poster presentation programme, 28th to 31st July 2020, hosted at the Botanical Garden of Freiburg, Germany

The conference programme will include five plenary lectures from leading international researchers in biomimetic and biohybrid systems, and the demonstrations of state-of-the-art living machine technologies

The full conference will be preceded by up to two days of Satellite Events hosted at the University of Freiburg, Germany.

3.5) 2020 – 2021, Interdisciplinary workshop at historical centre of plant biology and Darwin's climbing plant research at the Linnean Society, London.

We are considering the possibility of organising a workshop at the Linnean Society of London. The venue represents a historically important venue that is linked to Darwin's pathfinding work on climbing plants following his publication of the Origin of Species. We are discussing the possibilities of a broad-scoped meting that will draw together plant biologists, materials scientists, engineers and robotics specialists. The Linnean Society is well placed for attracting scientists from many different fields nationally and internationally. We also

propose to publish the proceedings, which will represent a two/three-year gap from the Frontiers volume (see above); this seems a suitable period with which we can discuss and publish our progress in the project and in the field in general.

4 Recent editorial initiatives (2019)

4.1) "Generation GrowBots: Materials, Mechanisms, and Biomimetic Design for Growing Robots"

Journal: Frontiers Robotics and AI

Editors:

Barbara Mazzolai (IIT, Italy)

Ian Walker (Clemson University, USA)

Thomas Speck (University of Freiburg, Germany)

Aims: The event brings together a multi-disciplinary panel of scientists and engineers, including experts in material science, soft robotics, plant biology, and architecture to present new scientific discoveries on plants and technological advances relevant to continuum, soft, adaptable, and growing robots. Trends, frontiers and potential applications for a variety of high-tech sectors are discussed, including future urban and architectural innovations, clean-energy forms and sustainable robotics ecosystems.

- Plant materials and mechanisms as models for robotics and building construction
- Plant biomechanics and structural architecture
- Climbing plant behaviour

- Moving-by-growing paradigm for robotics
- Novel methodologies for analysis and study in natural environments
- Plant-inspired continuum robots
- Morphological computation, perception and interaction
- Bio-inspired robotic construction
- Living architecture design

Results: The special topic has received 13 submissions and is currently under the review process, with a prospective publication date in March 2020

5 Prospective editorial Initiatives (2019-)

5.1) Multidisciplinary edited volume and State of art reviews in Biological/ interdisciplinary Journal

Following the proposed workshop at the Linnean Society we propose to organise a multidisciplinary volume in a biological / Interdisciplinary Journal. Plant Science journals as well as General high impact Journals have shown much interest in climbing plants over recent years. All of the following biology-based examples are examples where Climbing plant biology has emerged to be of wide interest during Conferences or thematic editorial projects.

In: American Journal of Botany See: Isnard, S., and W. K. Silk. "Moving with Climbing Plants from Charles Darwin's Time into the 21st Century." American Journal of Botany 96 (2009): 1205-21.

In: Current Biology see: Rowe, N. P. "Lianas." Current Biology 28 (2018): 249-52 doi.org/10.1016/j.cub.2018.01.028.

In: New Phytologist See: Rowe, N. P., and T. Speck. "Plant Growth Forms: An Ecological and Evolutionary Perspective." New Phytologist 166, no. 63 (2005): 61-72.

In: Royal Society Interface See: Granados Mendoza, C., S. Isnard, T. Charles-Dominique, J. Van den Bulcke, N. P. Rowe, P. Goetgebeur, and M. S. Samain. "Bouldering: An Alternative Strategy to Long-Vertical Climbing in Root-Climbing Hortensias." Journal of the Royal Society Interface 11, no. (2014): DOI:10.1098/rsif.2014.0611.

In: Science See: Pennisi, E. "Rattans Stuck in a Growth Mode." Science 327 (2010): 776-77.

We will target one Journal for a special volume that will explore how climbing plant research during our project is contributing towards the development of new technological artefacts.

Secondly, we will also plan cross- and multi-partner “opinion point” and “position” papers in the major Journals, when our collaborations make break-through findings.

6 Towards a broad community (2019) & (2019-)

6.1) Workshops for Young people and kids (24th October- 4th November 2019)

The IIT organized two workshops for young people and kids in the occasion of the Festival della Scienza (Science Festival) in Genova.

The CMBR organized two workshops in order to introduce the GrowBot project to kids and young people. Both workshops were hosted at the Aquarium of Genoa. “Biomimetics: Let’s inspired by Nature” was organized in collaboration with the Aquarium of Genoa and aimed at introducing Biomimetics to kids and young people of 8-18 years old. Researchers presented innovative technological solutions inspired by natural systems and presented the GrowBot project to young generations. The event was organized for the entire festival duration (14 days) and participants were mainly school students and families.

6.2) Pint of Science, Montpellier, France- Invited lecture to general public in a public bar venue (6th June 2019).

N. Rowe (2019), Biomimétisme et biodiversité des plantes de la forêt tropicale, “*A Pint of Science Festival*”, Nu Bahia, Montpellier,

The event took place in a small under-ground Jazz bar and was attended by approximately 100 people. The lecture was followed by a series of question-answer sessions and a quiz in which the audience participated.

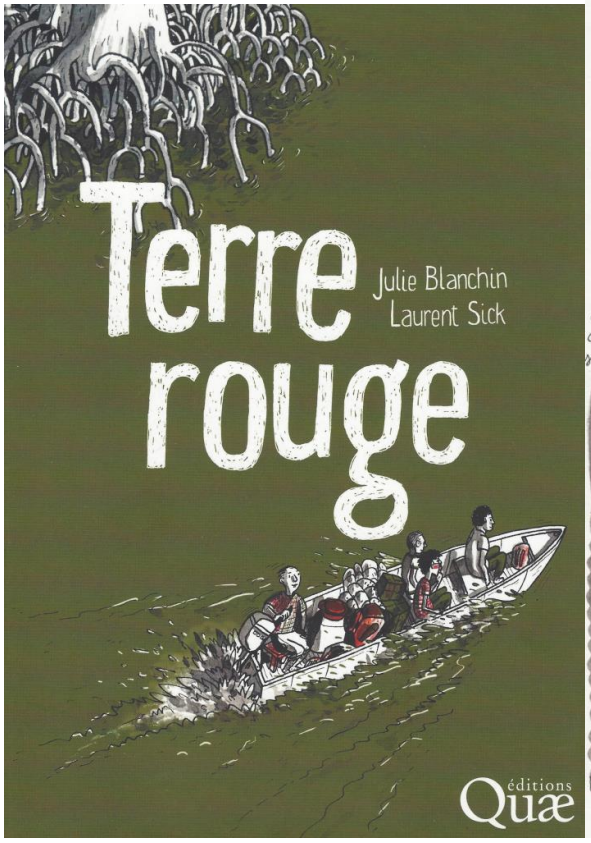
6.3) General public talk on plant biomimetics and the GrowBot project in Brazil (26th September 2019)

Patricia Soffiatti (UFPR, Curitiba, Brazil) is on of the Visiting scholars to the CNRS lab in the GrowBot project. P. Soffiatti (2019) Biomecânica e

Biomimética: as plantas como inspiração. The event was hosted by the UFVJM (Federal University of Jequitinhonha Valley and Mucuri) and attended by approximately 60 people. It included the opportunity for the general public to ask questions about bioinspired trechnologies and how plants and plant diversity can contribute to this. The event is particularly important for us in the GrowBot project since it advertises the interest of plant diversity for new technologies in a country and in communities where climbing plants are an important element of the natural diversity.

6.4) Bande designé – a planned edited account of the GrowBot adventure for the general public, young people and kids.

One of our (CNRS) field work projects in 2005 was visited by two bande designé artists and journalists, Julie Blanchin and Laurent Sick who published a book called “Terre Rouge”. It is an account of what researchers do in the tropical rain forest, why they do it and how they do it.



It was very popularly received and is widely read by many colleagues, staff and students. We are discussing the possibility to organize a similar kind of “Bande désigné” for the GrowBot project. Our experience from Terre Rouge persuades us that a similar treatment of each partner’s involvement and gathering these together to make a story will reach a very wide audience both inside and outside the scientific community as well as for all ages.