## *PROGRAMME*

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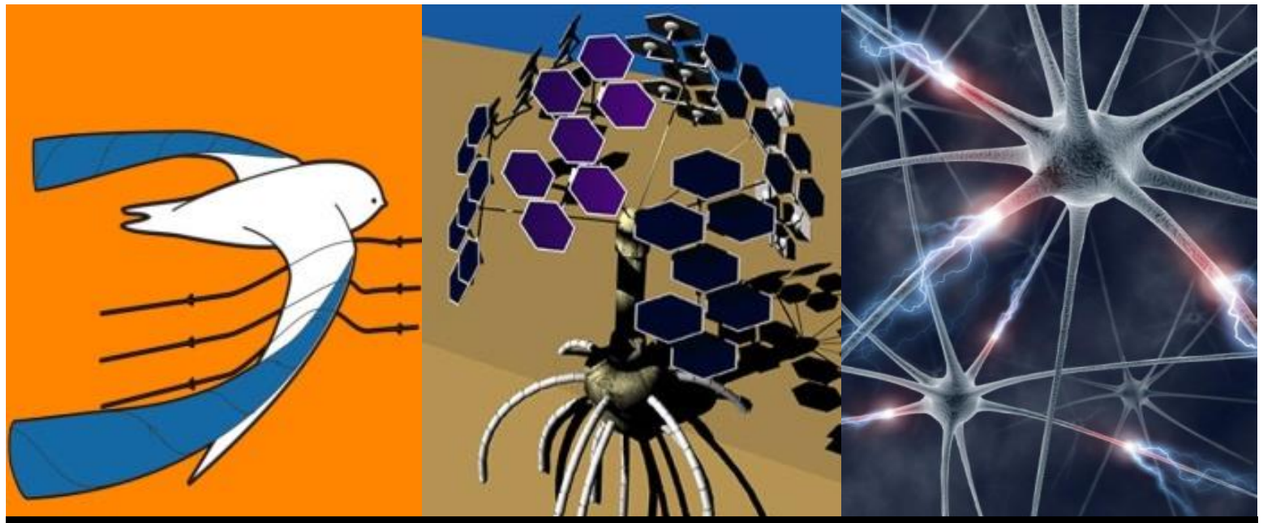
|---|---|
| **08:00** | **Bus departure from Wageningen** |
| **09:30 – 10:00** | **Registration and Coffee** |
| **10:00 – 10:15** | **Introduction by Chair of the Day**<br>*(Koos Biesmeijer, Naturalis Biodiversity Center)* |
| **10:15 – 11:00** | **To boldly go where no one has gone before – Development of squid-based surgical instruments**<br>*(Paul Breedveld, TU Delft)* |
| **11:00 – 11:15** | **Coffee / Tea** |
| **11:15 – 12:00** | **Biomimetic optimization of wind turbines and ship propulsion systems**<br>*(Eize Stamhuis, University of Groningen)* |
| **12:00 – 12:45** | **A materials view on photosynthesis: constructing solar cells with bioblocks**<br>*(Raoul Frese, Vrije Universiteit Amsterdam)* |
| **12:45 – 13:45** | **Lunch** |
| **13:45 – 14:30** | **Can nature teach us to build new machines? A journey into the world of bio-inspiration**<br>*(Barbara Mazzolai, Istituto Italiano di Tecnologia)* |
| **14:30 – 15:15** | **A glimpse into the world's most advanced design lab**<br>*(Saskia van den Muijsenberg, BiomimicryNL)* |
| **15:15 – 15:45** | **Panel Discussion** |
| **15:45 – 17:00** | **Free time to visit Museum of Natural History "Naturalis"** |
| **17:00 – 18:00** | **Drinks** |
| **18:00 – 20:00** | **Dinner and PE&RC Publication Award Ceremony** |
| **20:00** | **Bus departure back to Wageningen** |



# PE&RC Day 2013

# Biomimicry: Unlocking nature's secrets

## 31st October 2013, Naturalis, Leiden

The C.T. De Wit Graduate School PE&RC

PRODUCTION ECOLOGY & RESOURCE CONSERVATION

PPC PE&RC PhD Council

# ABSTRACTS

## 10.15: To boldly go where no one has gone before – Development of squid-based surgical instruments

**Paul Breedveld,** TU Delft

Performing complex surgical interventions through small openings in the human body requires advanced surgical instruments capable of precise steering and manoeuvring along 3D anatomical pathways. Where the medical industry aims to solve this challenge with complex and expensive conventional solutions, nature offers much more elegant approaches such as the muscular hydrostatic skeleton system in squid tentacles, which enables a wide variation of sophisticated motions. Transferring the anatomy of these clever biological systems to the technical domain, a range of steerable instruments has been developed at TU Delft , among which the thinnest and most manoeuvrable in the world. In a close collaboration with a number of clinical specialists, medical companies and biological research groups, the research is currently being expanded to the development of dendritic instruments for Endo-Nasal Skull Base Surgery – one of the most challenging new frontiers of minimally invasive surgery.

## 11.15: Biomimetic optimization of wind turbines and ship propulsion systems

**Eize Stamhuis,** University of Groningen

Wind turbine systems have to deal with a number of challenges in operation: Low wind speeds give rotor start-up problems as well as relatively low efficiency and low yield, whereas in high wind speeds and in particular wind gusts the blades have to deal with very high loads. Efficiency of wind turbines still is not near its theoretical maximum anyway and there is still room for improvement. Large gliding seabirds give a number of clues on how to deal with these problems, potentially resulting in serious increase in efficiency. Additionally, ship propulsion systems do, due to their design with relatively small propellers, not always display efficiencies that we can find in larger swimming organisms such as dolphins and whales. By following the design of an undulating tailfin-like profile, comparable to whales, dolphins and e.g. tunas, efficiency can potentially be increased dramatically. In this contribution the ruling principles will be illustrated, and their potential efficiency increases will be discussed.

## 12.00: A materials view on photosynthesis: constructing solar cells with bioblocks

**Raoul Frese,** Vrije Universiteit Amsterdam

In contrast to human technology where we do our best to make things that are sturdy and withstanding all sorts of stress, biology seems to embrace dynamics. In fact, from a materials point of view, the definition of biology may be the absence of hard connection between materials; biology is fluid and solid at the same time, allowing responsiveness and adaptation on all timescales. Our knowledge and control over biological processes opens up a way to rethink and perhaps, restructure our technology. In this lecture I will address our recent efforts in utilizing biological components from photosynthesis as active materials in solar cells. We do not interconnect photosynthetic proteins in a solid state device, but prefer to maintain the fluidity of membranes in our constructs. We seek to understand and control the self-assembly of the building blocks of photosynthesis and to utilize the dynamics between components to optimize solar energy harvesting.

## 13.45: Can nature teach us to build new machines? A journey into the world of bio-inspiration

**Barbara Mazzolai,** Istituto Italiano di Tecnologia

The concept of taking ideas from Nature to improve technology has been pursued by many scientists and engineers. Over the past 3.7 billion years or so, living organisms have appeared on the Earth and adapted to almost every imaginable environment, as the result of tough selection processes. Consequently, it seems reasonable that researchers look at Nature for trying to solve similar problems appearing in technology, concerning materials, structures, and even mechanisms. In this vision, biologically-inspired approaches have been traditionally widely adopted in robotics. In these approaches, biology represents an inspiration source, which dramatically affects and contributes to the robot design. Bio-inspired approaches can help to develop robots that are more suitable for unstructured environments than today's robots. Moreover, biomimetic robots represent a helpful platform for experimental validation of theories and hypotheses formulated by scientists. For this reason, a biomimetic approach to robotics cannot be limited to a copy of solutions proposed by Nature. A real break-through requires an understanding of the basic building principles of living organisms and a study of their chemical, physical, and mechanical properties, control and behaviour. This talk will show some examples of technological solutions we are developing, specifically soft robots, inspired by soft animals (e.g. octopus), and plant-inspired growing robots, inspired by plant roots for exploration and searching tasks.

## 14.30: A glimpse into the world's most advanced design lab

**Saskia van den Muijsenberg,** BiomimicryNL

Biomimicry is the science and art of emulating nature's best biological ideas to solve human problems. Non-toxic adhesives inspired by geckos, energy efficient buildings inspired by termite mounds, and resistance-free antibiotics inspired by red seaweed are examples of biomimicry happening today. Organisms are the consummate physicists, chemists, and engineers, and ecosystems are economies beyond compare. Biomimicry is about emulating not just form, shapes and blueprints, but also recipes, processes and ecosystem strategies in our designs. Biomimicry is about looking at, and valuing nature differently: not what we can domesticate, extract or harvest, but what we can learn from it. Saskia will give a wide overview of the field of biomimicry through many examples and how nature can inspire us to develop economically viable and more healthy and sustainable products, processes and systems. Once people hear about biomimicry, they don’t often forget it, and they tend to tell others about it. That’s the least Saskia hopes will happen after her talk.