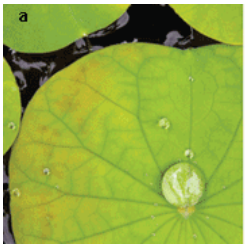
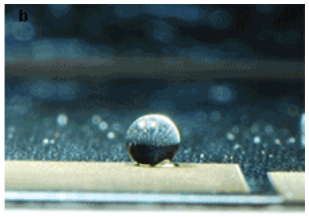
International Society of Bionic Engineering

NEWSLETTER

Vol.3 Issue 1 June, 2014

In this Issue





Highlight Events

- Symposium on Agricultural Bionic Engineering & Technology
- Workshop on Review and Future Perspective of Bionic Engineering
- BioApproNFS-Wett (295224) Workshop was held at Nottingham University, UK

ISBE is an educational, non-profit, non-political organization formed in 2010 to foster the exchange of information on bionic engineering research, development and application.

Our Mission:

The society is dedicated to the advancement of communication and cooperation among all scholars, and the furtherance of knowledge and education in the field of bionic engineering.

MEMBERSHIP

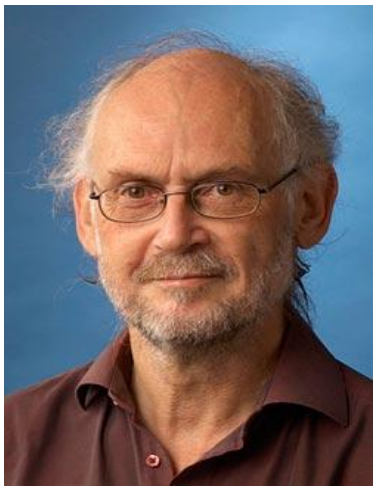
CURRENT MEMBERSHIP

ISBE is made up of 572 Individual Members and 20 Corporate Members. Our members come from over 42 different countries and 6 continents.

ISBE membership is open to those who have manifested a continuous interest in any discipline important to bionic engineering research as evidenced by work in the field, original contributions and attendance at meetings concerning bionic engineering research.

Julian FV Vincent (UK)

President, ISBE



Julian FV Vincent has been a biologist ever since he can remember - or even before. He was only two years old when he was stung by some wasps he was playing with; and by the time he was aged eight he was taking long walks around his home in Cambridge, learning about insects and wildlife. So it was inevitable that his degree at the University of Cambridge was in Zoology, though he arranged his work schedule around rowing and playing music. His PhD in Sheffield (on insect neuroendocrinology) was similarly organised. He played in three bands (six nights a week!) and scraped though his PhD viva - examined by a fellow banjo player (though they didn't realise their common interest until 10 years later). He was appointed lecturer in Applied Zoology at the University of Reading, where he was to spend the next 32 years. It was at Reading that he met JE (Jim) Gordon, a materials scientist and engineer, who had the gift of explaining the complexities of fracture mechanics in language that was simple enough for even a zoologist to understand. Jim's other gift was George Jeronimidis, originally a polymer chemist,

whom he introduced to Reading from Naples. For 30 years Julian and George worked closely together, establishing the first Centre for Biomimetics in 1990.

Fracture mechanics proved to be a very fruitful way of looking at biology. As Jim said, a bat's wings don't go pop when it flies into a rose bush; and when you yawn your cheek skin stores as much strain energy as a piece of mild steel just before fracture. Biological materials are remarkably tough, partly because they are composites and partly because they can accommodate very high strain. They have evolved with the fact that they will break at some time, and so adopt strategies which technical materials have largely ignored. Strain energy is distributed throughout the volume of the material, encouraged by sacrificial structures, and thus biological materials fail gracefully and slowly, allowing the organism to avoid high loads by moving away, and giving the materials outstanding damage tolerance.

Resistance to fracture is a generally useful aspect of materials; its opposite- brittleness and weakness - is important in foods. So Julian found himself drawn into a number of other areas of research, eventually reaching nearly ten distinct areas, in all of which he was being invited to give plenary lectures at international conferences. Although this wide range of interest retarded his promotion by some ten years, the resulting intellectual stimulus and variety of friends provided plenty of recompense.

In 2000 he was invited to join the Department of Mechanical Engineering at the University of Bath. His job description: to explain the tricks nature uses! He recruited two Russians to his research team, and together they developed ideas for technology transfer based on TRIZ, the Russian system for solving problems. They set up a company, BioTRIZ (now exclusively run by Olga and Nikolay Bogatyrev) and Julian retired at age 65. He is now developing his TRIZ ideas independently, and spends more time with his family . . . and his banjo.

Luquan Ren (China)

Standing Vice President, ISBE

Professor Luquan Ren is the Member of the Chinese Academy of Sciences (CAS), the deputy director of the Academic Board at Jilin University, Director of the Academic Board of the Key Laboratory of Bionic Engineering (Jilin University) Ministry of Education, and well-known scientist in the field of Bionic Sciences and Engineering in China. In 1967, Professor Ren graduated from the Agricultural Machinery and Engineering Department at Jilin University of Technology. In 1981, he received his Master Degree from Jilin University.

Professor Ren's other service activities include: Standing Vice-President of ISBE, National Secretary for China of ISTVS; Member of Science and Technology Committee of Ministry of Education of China, for which he also assumed the Vice-director on Technological Board; Vice-President of the Chinese Society for Agricultural Machinery (CSAM); Executive Director of the Chinese Society of Applied Statistics etc. Additionally Professor Ren originated the international journal - Journal of Bionic Engineering, which was indexed by EI and served as editor-in-chief in it.

For a long time Professor Ren has been engaging in the research and teaching

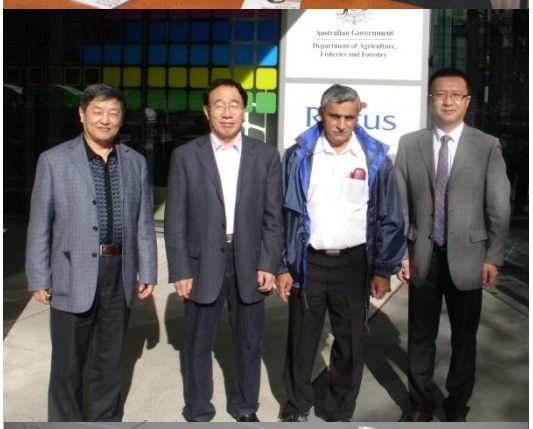
on Engineering Bionics. He discovered the law of soil adhesion, revealed the mechanism of anti-adhesion and resistance reduction of living creatures, built up the basic principle and technical system of non-smoothness of living creatures, proposed the engineering bionic theory such as geometrical non-smooth bionics, materials bionics, electric-osmosis bionics, flexible bionics, configuration bionics and coupling bionics etc. Based on the theories above, Professor Ren initiated a number of design method, processing technique and testing technique used for anti-adhesion and resistance reduction used for soil engaging components. Professor Luquan Ren has undertaken more than 40 research projects on international, national and ministerial levels. As a result of these researches, 31 patents have been declared or conferred, among which 17 patents have been assigned or used, causing vast economic benefit and social effect. So far Professor Ren has published 4 books, over 400 academic papers and reports within which more than 300 papers were indexed by SCI, EI and ISTP.

In 1999, Professor Ren was awarded the title of National Expert with Remarkable Contributions. In 2006, he won the Technical Invention Second Prize by the State Council of China and the Contributing Award for the development of Chinese Agricultural Machinery. In 2007, he received the Special Award for contribution to the development of the Northeast of China and the National Labor Medal. In 2013, “The construct principal and key technology for a bionic coupling multi-functional surface” chaired by Professor Ren was appraised as the second prize of National Scientific and Technological Innovation.

NEWS AND EVENTS

A group visited Australia and New Zealand

On April 5-16, 2014, a visiting group consisting of 3 persons led by Professor Luquan Ren, the Standing Vice President of the ISBE paid a visit to Australia and New Zealand for academic exchange and cooperation at invitation.



During the visit, the group went to the Department of Agriculture, Fisheries and Forestry of Australian Government. Dr. Rashid Qaisrani, the member of Board of Directors, ISBE, met them. They had a discussion on the Agricultural Biomimetic and expressed the expectations of their future cooperation. Afterwards, the group visited other research institutions in Australia.

In New Zealand, the group visited Auckland Bioengineering Institute at the University of Auckland. The Auckland Bioengineering Institute is a cross-faculty research centre which deals with the application of mathematical and engineering sciences to biology and human physiology. Dr. Merryn Tawhai and Dr. Iain Anderson met the group at the institute. Prof. Jianqiao Li , the General Secretary of the ISBE, and Mr. Runmao Wang, director of Office of Secretariat, ISBE were invited to make presentations. Both sides exchanged their ideas on biomimetics and reached consensus. They also expressed their wishes of further cooperation in the fields of common interests.

BioApproNFS-Wett (295224) Workshop was held in Nottingham University

On April 15, 2014, Biomimetic Approaches of Natural Functional Surfaces with hierarchical micro & nano structure and the extreme Wettability (BioApproNFS Wett) workshop was held at Nottingham University, UK. This workshop was supported by a Marie Curie International Research Staff Exchange Scheme Fellowship within the 7th European Community Framework Programme.

"BioApproNFS Wett" brings together five leading universities from four different countries to collaborate in the research area of biomimetic approaches to natural functional surfaces and the extreme wettability. More than 30 scholars and specialists attended the workshop. Prof. Yuying Yan from Nottingham University delivered a speech of welcome. Afterwards, the representatives from different universities gave academic reports respectively, including Prof. Thomas Stegmaier from ITV Denkendorf (Germany), Prof. Ana Moita from Portugal High - tech Institute, Dr. Lei Ren from Manchester University (UK),

Prof. Zhiwu Han from Jilin University (China), Prof. Chengchun Zhang from Jilin University (China) among others. The Chief Editor Da He and Dr. He Huang from Journal of Bionic Engineering of Jilin University (China) attended the workshop as well.

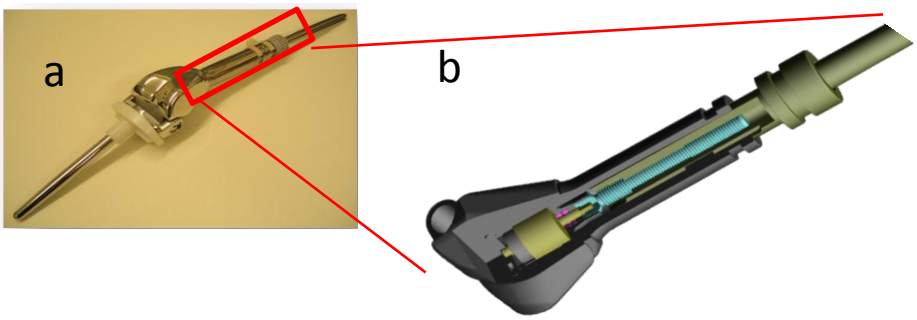
The aim of this workshop is to facilitate research staff exchange between the leading institutions in biomimetics so that complementary and synergistic skills can be acquired as per the needs and skills offered by the respective partners. These can then be exploited in the future through initiatives as part of the international joint laboratory that will be established through this project. The programme will have major benefits for early staged researchers from high education institutes and also the industrial companies from both Europe and China. Through research collaboration and staff exchanges, the state-of-the-art technologies of studying biomimetics (or bionics), such as micro scaled fabrication, functional nanoparticle coating, hierarchical micro & nano structure, and surface wettability will be studied and/or applied. Major programmes of the research staff exchanges include research visits, training for early staged researchers, and organising regular open research seminars, workshops and conferences. The dissemination and exploitation will be based on joint research publications and open seminars where the industrial community will be actively encouraged to attend.

ACADEMICS

Bionic Bone Implant – Grow with Child

John Scale Centre for Biomedical Engineering, University College London (UCL)

Osteosarcoma affects more than a thousand children a year in Europe alone, and the treatment for this disease can involve the removal of a section of affected bone from the tibia, femur or humerus. This must then be replaced by a prosthetic bone implant. Because the prosthesis doesn't grow, a child needs further operations to lengthen it to prevent one leg becoming shorter than the other. Although the artificial bone is designed to be extended as the child grows, in the past this involved a series of invasive procedures to expose the implant and lengthen it.



a) The non-invasive extending prosthesis developed at John Scale Centre of Biomedical Engineering (BME) of University College London (UCL); (b) the permanent magnetic rotor inside the prosthesis drives the extension system to "grow". When activated, the prostheses grows at a rate of 0.25mm per minute.

Engineers at John Scale Centre for Biomedical Engineering (BME) of University College London (UCL), an international leading research institution for innovative translational research (http://www.ucl.ac.uk/surgery/research/ioms), have invented "bionic bone" that has changed all of this. Now it can be lengthened remotely mimicking natural growth of the bone. The whole lengthening procedure is carried out in the outpatients department by a specially trained nurse, and takes only 15 minutes. There is no need for surgery or anesthetic.

The secret to the bionic bone is to place a small permanent magnetic rotor inside the patient's arm or leg. The rotor is activated by a specially designed electromagnetic driving box. This drives a prosthetic implant that is effectively a

The prostheses have been used clinically in juvenile cases between the age of 6 and 17 years old and in adults to lengthen the limb.

precision ground miniature lead screw via a very small epicyclic gearbox. The magnetic force activates the gearbox inside the prosthesis extending it by a specified amount. The magnet inside the gear box spins at 3,000 revolutions per minute and 13,000 revolutions are needed to extend the prosthesis by just one millimetre.

This is an excellent example of home bionic engineering principle could be exploited and turns the bionic ideas into reality, in this case improving the quality life of young bone cancer patients.

Now the “bionic bone” is being commercially exploited by Stanmore Implant Worldwide, a global leader in Extreme Orthopaedics who is FOCUS on one customer category – surgeons performing limb preservation implant procedures arising from complex revision arthroplasty, oncology, and trauma.

Bionic Material Inspired by Biological Organs

by Zhiming LIU and Wenjian WU, China

The researches of bionic materials in our group have been carried out on some Biological organs, such as plant leaves, biomembranes and shell nacres etc.

Similar histological structures and compositions may lead to similar reflectance spectra. A bionic model of plant leaves is proposed, which is simplified from plant leaves other than totally imitating. The reflectance spectra of a piece of poplar leaf and a piece of bionic composite material are shown in Figure 1. Their curves overlaps surprisingly. Therefore, the bionic leaf may show itself as a real natural green leaf even under hyperspectral imaging. The bionic composite materials

inspired by plant leaves will help us understand the correspondence between biochemical parameters of plants, and provide us a reasonable model for experimental simulations of remote sensing of vegetation.

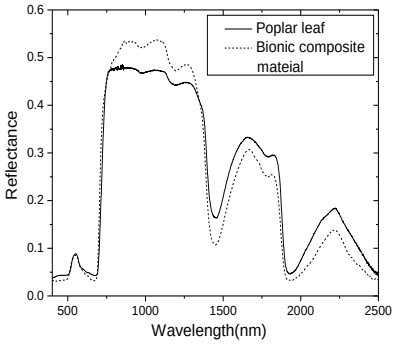


Fig.1 Reflectance spectra of a piece of poplar leaf and a piece of bionic composite material

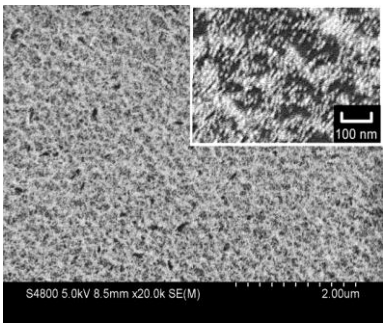


Fig. 2 SEM images of the surface and an enlarged area of a hybrid film

Bilayer lipid membranes (BLMs) are major components of both cell membranes and endomembrane systems. In order to obtain ideal bionic systems of biomembranes, substrates with benign characteristics to BLMs should be developed. We have invented a facile self-assembly procedure to prepare conductive hybrid films of gold nanoparticles and cellulose. As shown in Figure 2, such conductive hybrid films have discrete networks of gold nanoparticles. They are very promising to be used as both supporting substrates and electrodes of BLMs.

Shell nacre is one of the most attractive biological materials for its superior mechanical properties. After the existence of mineral bridges in the organic matrix interface is confirmed, the microstructure of nacre is considered as “brick-bridge-mortar” arrangement. In the bionic growth process of calcium carbonate, structures of mineralbridges like those in nacre are obtained for the first time on the membrane of demineralized nacre, as is shown in Figure 3a. It provides a new proof for the mineral bridge theory of biomineralization.

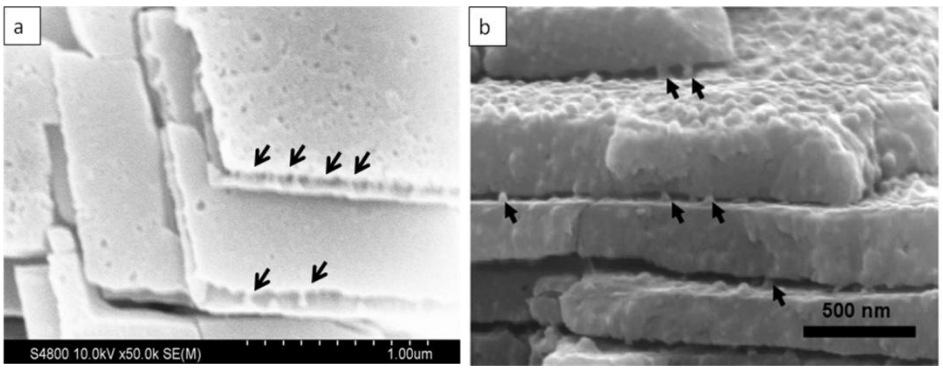


Fig. 3 SEM images of mineral bridges in bionic nacre (a) and natural nacre (b)

Biologically inspired robotics on a microscale: microbiorobots

by Kim Minjun, USA

Researchers at the Biological Actuation, Sensing, & Transport (BAST) Laboratory at Drexel University in the United States have been focused on engineering a variety of biologically inspired robots at the microscale These microbiorobots can be controlled at even the smallest scales by combining the merits of existing biological systems and the precision of engineered parts. Soon, they may be used for micromanipulation applications, such as drug efficacy testing, microtransport, and excision biopsies.

One of their many engineered microbiorobots includes the protozoan *Tetrahymena pyriformis* (*T. pyriformis*). This freshwater pear shaped organism is 25 microns in diameter, 4 times smaller than a human hair. It is also 50 microns long and can navigate in water up to 1000 microns/s, meaning that it is able to swim 20 times its body length in a second.

This organism makes an ideal candidate as a microbiorobot as it already has sensory organelles to detect temperature, light, and chemical gradients. In addition, it already possesses onboard power systems (taking in nutrients from its environment). Perhaps most importantly, the cells are able to be controlled; they are responsive to electric fields and also magnetic fields after the cells have ingested iron oxide particles.

The BAST team has turned *T. pyriformis* into their own microbiorobot by placing it in electric fields. In an applied field, the cells always turn to the anode. Based on this behavior, they could control this organism in a 2D plane. Also, they were able to manipulate this cell in a magnetic field be placing an artificial magnetic dipole inside of the cell. The result: they can steer the cell in three dimensions. Their recent work focuses on the control of a swarm of these cells.

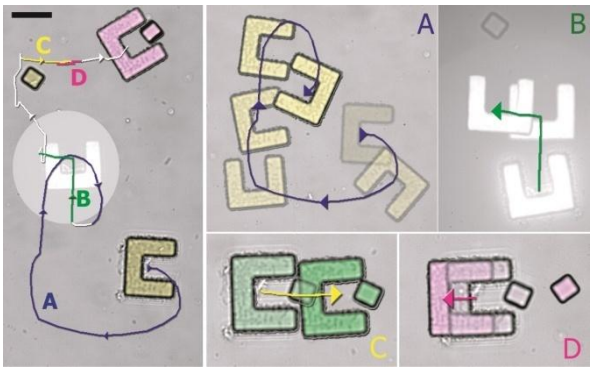


Figure 1

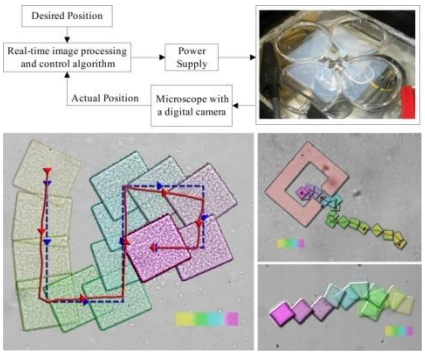


Figure 2

Another inspiration of BAST researchers is bacteria and bacterial flagella. Flagella are filaments which enable bacteria to swim, tumble, and navigate microfluidic environments. The helical motion of flagella bundling that is used for propulsion is what inspired their biomimetic magnetic microrobot.

This dumbbell-like microrobot consists of a three parts: (1) magnetic nano particle (MNP) connected to a (2) repolymerized flagella filament, which at the other end is connected to a (3) polystyrene bead, simulating any chemical or non-functional payload. The MNP would rotate under a rotating magnetic field, resulting in coiling of the flagella, and the helical motion of this flagellum would propel this micro-swimmer.

Bacteria themselves have also been integrated in one microbiorobot design. SU-8, a photoresist, can be designed to take on a variety of shapes. The BAST team has managed to blot these structures with the bacteria species *Serratia marcescens* to produce self-actuated microstructures as small as 10 by 10 microns which are controllable with electric fields. By controlling the shape of the structure, a robot can be designed to physically manipulate microscale

Objects such as cells or other microstructures with a high degree of precision.

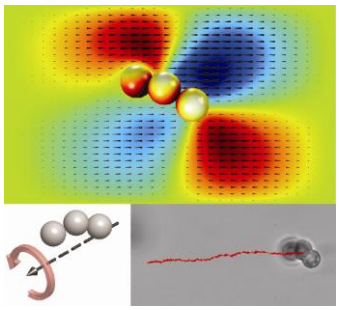


Figure 3

Recently, the team has created achiral swimmers consisting of several chemically conjugated magnetic micro particles. These swimmers utilize the same swimming methods employed by flagellated bacteria. Exposed in a rotating magnetic field, these microrobots rotate and in turn, result in a translational motion. They are inexpensive and engineered with a low degree of difficulty. Because they are made up of conjugated particles, they can also be modulated to be larger or conjugated with various objects to adapt to any functional role.

jlu_isbe@hotmail.com

International standardization of biomimetic methods and approaches | ISO/TC-266

by Arndt Pechstein, Germany

Bio-inspired materials and designs are becoming increasingly popular in many fields of applications. Yet, despite the vast potential of “biomimetics” (also: “biomimicry”, “bionics”) as an innovation system and a sustainability strategy, the strategic combination of knowledge on natural systems with modern techniques of simulation, organization, and production is still rare. The lack of transparency and communication between the various disciplines, most notably bio and material scientists/ engineers, might constitute the largest hurdle. Generating a common language in this area will be an important step towards disseminating biomimetic principles for sustainable technical and societal advancement.

The new ISO technical committee ISO/TC-266 "Biomimetics" attempts to raise the profile of biomimetics through globally accepted definitions as well as specifications of criteria to distinguish biomimetic products from others. The aim of the project is to describe and standardize the entire biomimetic process ranging from the development of ideas to the creation of biomimetic products and processes. Limits and potentials of biomimetics as innovation strategy are to be explored. Such standards shall serve as a bridge between research, development, and implementation and therefore ease the transfer of biomimetic concepts to commercial applications by establishing best practices.

Currently, 9 countries are participating in the ISO/TC-266 with 15 others being oberserver nations. Four working groups (WGs) have been established.

WG1: "Terminology, concepts, and methodology" primarily deals with the differentiation between biomimetic and conventional processes.

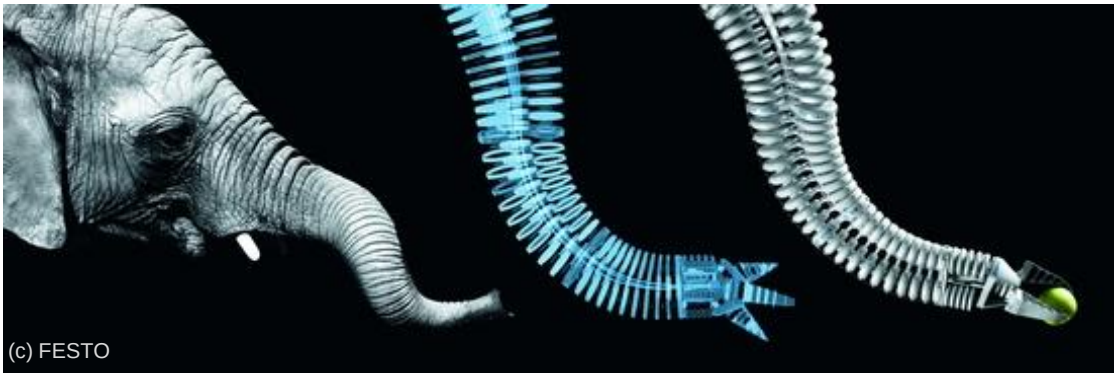
WG2: “Materials, structures, and components” shall provide a conceptual understanding of attributes and performance of biological materials, structures, surfaces, and components and manufacturing technologies.

WG3: "Biomimetic structural optimization" aims at familiarizing stakeholders with biomimetic optimization methods for the improvement of design and evaluation of load-bearing structures.

WG4: “Knowledge infrastructure for biomimetics” is directed at defining and explore the semantics of a biomimetic thesaurus for interdisciplinary information processing.

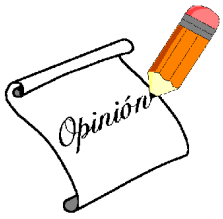
As Biomimicry specialist and founder & CEO of Biomimicry Germany, I am contributing as a guest member in the German committee since 2013 and have joined the German delegation to Prague as an observer for WG4. While I consider it very important to find a global consensus on what biomimetics is (and equally important, what it is not) I do see obstacles which need to be overcome in order to make this a success. First, clear sustainability aspects and metrics have to be included to distinguish mere bio-inspiration from true systemic biomimetic innovation. Detailed considerations of such kind are currently not part of the draft. Second, various nations being very active in the biomimetics field, namely the US and the Netherlands, are not active members of the project yet. Third, transparency and knowledge exchange between disciplines is key to a success of biomimetics. A semantically-driven ontology is needed to empower non-biologists to include natural systems into design, product and process innovation. While WG4 aims at addressing this point, the actual ontology and its rules do not even exist yet which makes a standardization of this aspect impossible.

The realization of biomimetic ideas relies on both the successful abstraction of biological principles and the transfer into the entire value chain. Importantly, sustainability aspects need to be addressed and integrated into the standards. Interdisciplinary exchange, international cooperation, and cross-sector


(c) FESTO

involvement are essential for both success and usefulness of an international standard.

Author: Dr. Arndt Pechstein | Biomimicry Specialist, Consultant & Design Thinking Coach; Founder & CEO of Biomimicry Germany - a Berlin-based NPO for Education and sustainable Innovation; Owner of phi360 - a Berlin-based innovation consultancy; Design Thinking Coach at Hasso-Plattner Institute (D.School)



Does Bionics have any principles?

by Julian Vincent, President, ISBE

Science and engineering are human activities that have been shown to be enormously successful in terms of increasing the ease with which we exist on this planet. Too successful, in that we are currently faced with a variety of imminent catastrophes, whether or not you believe that our climate is changing as a result of these activities. We are using natural resources at an increasing rate at the same time as we destroy the natural world that not only gave birth to mankind but supports and feeds us. It is partly in response to these warnings of doom that we study how biology solves problems and try to incorporate the results into our technology.

Success is limited, however, I suspect that many engineers regard our efforts as playing around the edges, with no real impact. But if we believe in what we, as researchers in bionics, can achieve, we should be aiming for higher and harder targets. How?

Science and engineering are based on principles and maths. At present bionics has no general principles to guide it and its maths has been stolen from other sciences. Even some of our best ideas are simply reworkings of known, and often quite old, principles of physics. What's more, bionics lacks the general test of engineering that quality resides in doing the same job for half the price. We need more basic thoughts about what we do, or we are little more than boys-with-toys.

Any principles must come from data, supported by experiment. This immediately rules out design spirals and circles. They basically only say “Try this – or this – or this – or go back to the thing you first thought of”. A second generation of such systems tries to place ideas and techniques in some sort of order that may (e.g. Quality Function Deployment) or may not (e.g. TRIZ) be backed by calculation. But still no general principles. Still no proof of usefulness. Still no testable concepts.

I’d like to suggest that a big contribution could be made by our International Society. We should initiate a project to establish guiding principles. Such principles should be testable, general, based on data, and capable of guiding bionic thinking and design in generally fruitful directions. They should therefore be able not only to suggest good practise, but to measure the advantages obtained. Above all they should be expansive rather than restrictive.

Furthermore I’d like to suggest two ideas that are based on data from experiments that I have done or been involved in:

1. In biology, materials are expensive and design is cheap; in technology materials are cheap and design is expensive.

2. In biology, information and structure (which require relatively little resource) replace energy and raw materials of engineering (both of which are finite resources).

Some of the data backing these assertions are in my papers “Survival of the Cheapest” (*Materials Today* 5(12), 28-41) and “Biomimetics - its practise and theory” (*Roy. Soc. J. Interface*, 3, 471-482).

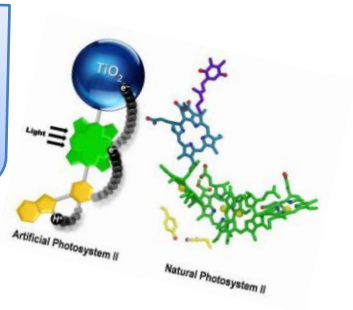
But I’m sure you can do better!

News, Academics & updates in short

Why do birds fly in a V? Endangered ibis reveals its amazing secret
Geckos inspire engineering research
- Knovel

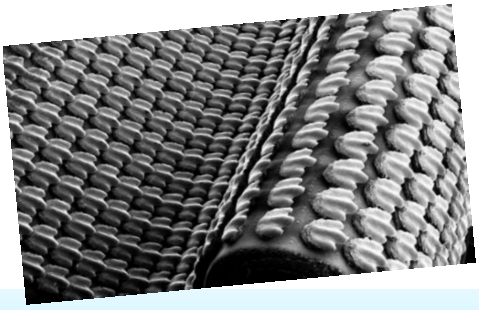
Geckos inspire engineering research
- Knovel

Artificial Leaf Jumps Developmental Hurdle
- Lab Manager

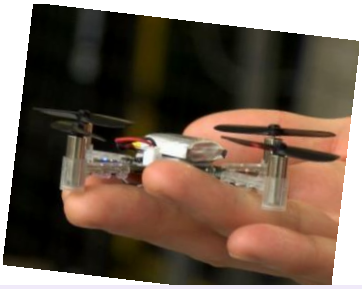


Bionic Kangaroo Is a Hopping Good Time
- Discovery News

MIT Scientists Create New Field Of Science Called 'Plant Nanobionics'
- redOrbit.com



3D-printed shark skin demonstrates how denticles boost swimming speed
- Tech Times



Researchers Design Bio-Inspired Drones and Flying Robots
- News Tonight Africa

For more, please visit:
http://www.isbe-online.org/news.asp

Note: the above stories are all abstracted from ISBE websites, You may visit the official website of ISBE for more details. But for further information, please contact the source cited above.

UPCOMING ACTIVITIES

The **Symposium on Agricultural Bionic Engineering & Technology** co-sponsored by the International Society of Bionic Engineering and International Commission of Agricultural and Biosystems Engineering will be held in mid-September of 2014 in Beijing,

THEME: Agricultural Bionic Mechanism Design and Manufacturing

DATE: September 16-19, 2014

VENUE: China National Convention Center (CNCC), Beijing, China

IMPORTANT DATES:

Abstract submission deadline: April 30, 2014

Full paper submission: July1, 2014

Hotel reservation deadline: July 1, 2014

Online submission close: Aug. 1st, 2014

SUMMISSION GUIDELINES:

A person intending to make an oral presentation (30 minutes for the keynotes and 15+5 minutes for the normal reports) or a poster at the Symposium should submit a one page Abstract (A4 paper approximately 500 words) no later than March 1,

2014 via online submission system. The Abstract should include the paper Title and Keywords related to the theme of Agricultural Bionic Mechanism Design and Manufacturing and following the template provided at the website. Abstracts will be reviewed by specialists appointed by the seven sections of CIGR and others selected by the Symposium Organizers. Notification of acceptance or rejection will be given by April 15, 2014. The full paper submission deadline is June 1, 2014. The papers that meet the expected levels of quality and technical content will be accepted for publication on International Agricultural Engineering Journal (IAEJ) and Transaction of CSAM, submitted to EI Compendex for consideration for indexing.

Detailed registration information please refer to the following websites:

http://www.cigr2014.org/registration/index.shtml

ACCOMMODATION:

CNCC Grand Hotel (four-star hotel)

Inter Continental Hotel (five-star hotel)

Yuanchenxin International Hotel (four-star hotel)

Best Western OL Stadium Hotel (four-star hotel)

7 Days Inn (express inn)

CONTACT: TIAN Ximei

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Email: office-isbe@263.net; jlu_isbe@hotmail.com

Web: http://www.cigr2014.org/

Workshop on Review and Future Perspective of Bionic Engineering

To further promote the development of bionic engineering, the Workshop on Review and Future Perspective Bionic Engineering-2014 organized by the International Society of Bionic Engineering (ISBE), will be held in mid-September in Beijing, P. R. China. Detailed information is as followed:

DATE: September 18, 2014

VENUE: China National Convention Center (CNCC), Beijing, China

ACCOMMODATION: All the participants will be accommodated at one's own expense.

CONTACT: Tian Ximei

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EMAIL: office-isbe@263.net; jlu_isbe@hotmail.com

WEBSITE: http://www.isbe-online.org/

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Conference Objectives

The **ICABBB 2014: International Conference on Applied Bionics, Biophysics and Biomechanics** aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of Applied Bionics, Biophysics and Biomechanics. It also provides the premier interdisciplinary forum for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns, practical challenges encountered and the solutions adopted in the field of Applied Bionics, Biophysics and Biomechanics.

Important Dates

Paper submissions: June 30, 2014

Notification of acceptance: July 30, 2014

Final paper submission and authors' registration: August 26, 2014

Conference Dates: September 26 - 27, 2014

More Information, please visit:

http://www.waset.org/conference/2014/09/london/ICABBB

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The International Conference of Bionic Engineering (ICBE) and International Workshop of Bionic Engineering (IWBE) are premier meetings for those working on bionic engineering. They bring together researchers and developers, both academic and industrial, from around the world to share their research achievements and explore research collaborations in the fields of bionic engineering.

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