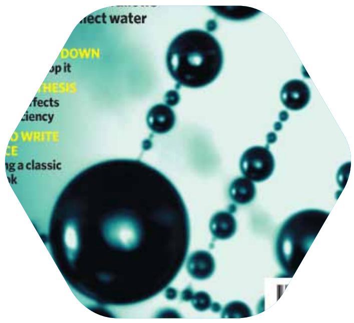
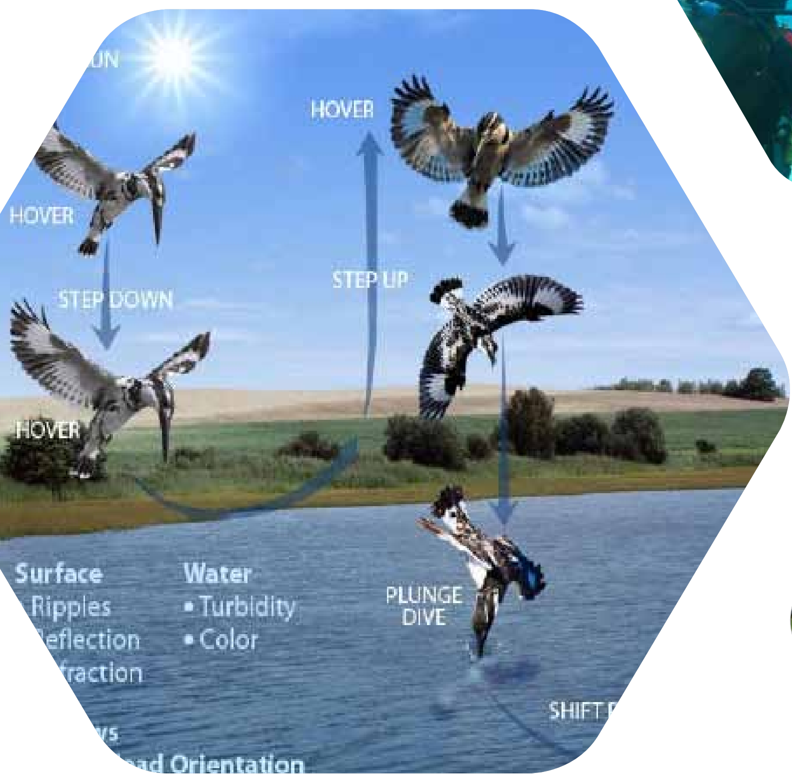
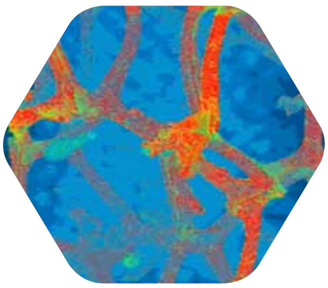
Newsletter

International Society of Bionic Engineering



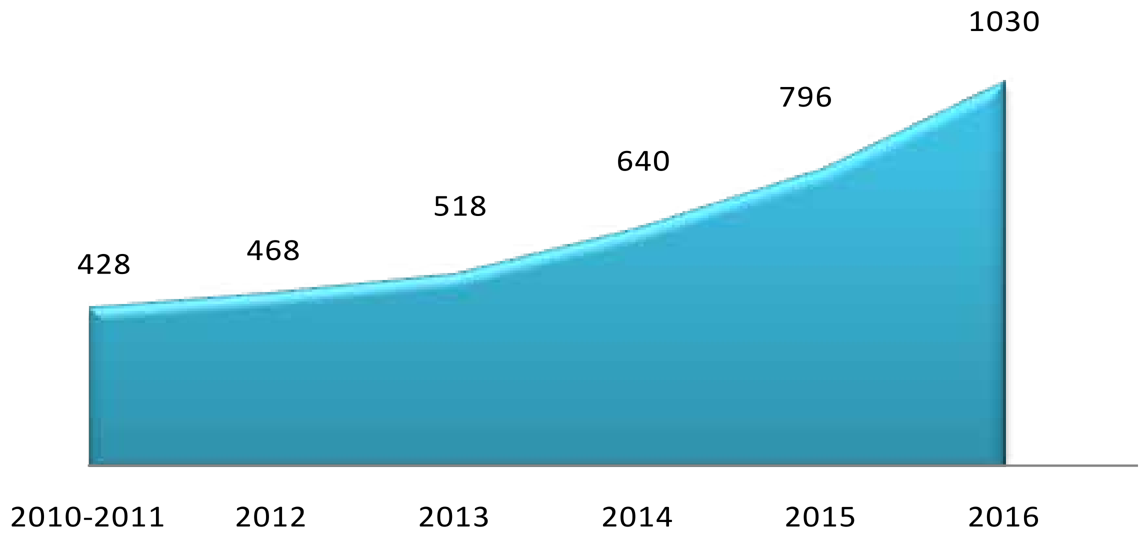




Contents

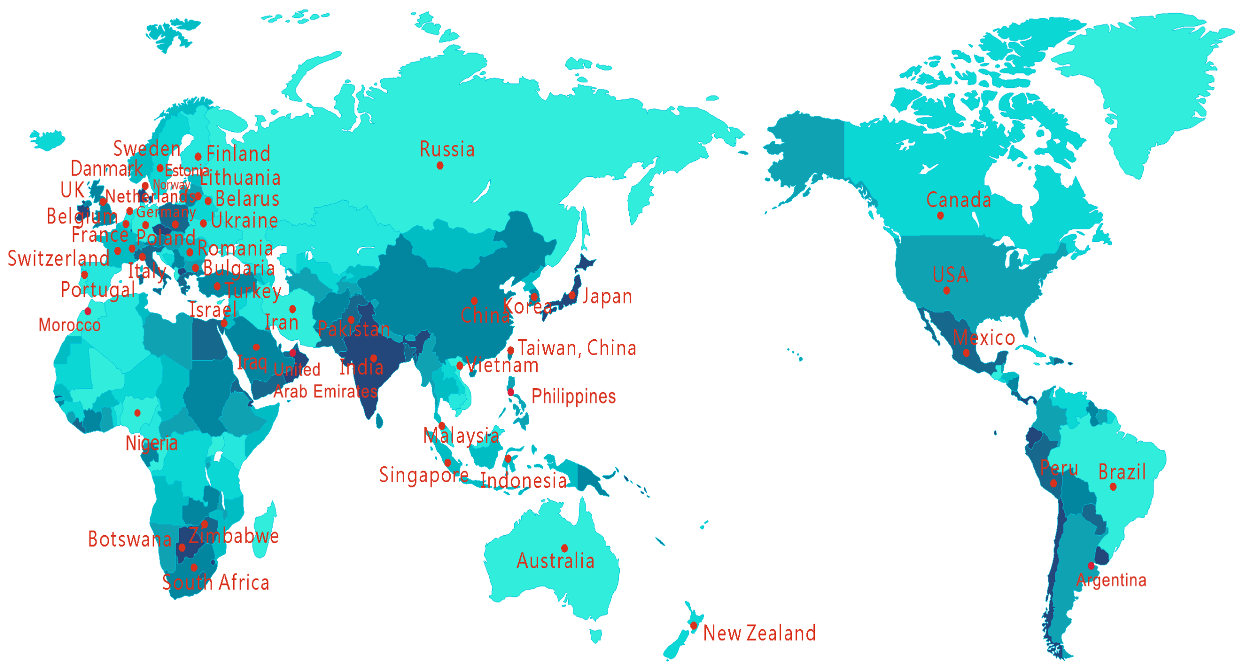
The International Society of Bionic Engineering (ISBE) is an educational, non-profit, non-political organization formed in 2010 to foster the exchange of information on bionic engineering research, development and application.

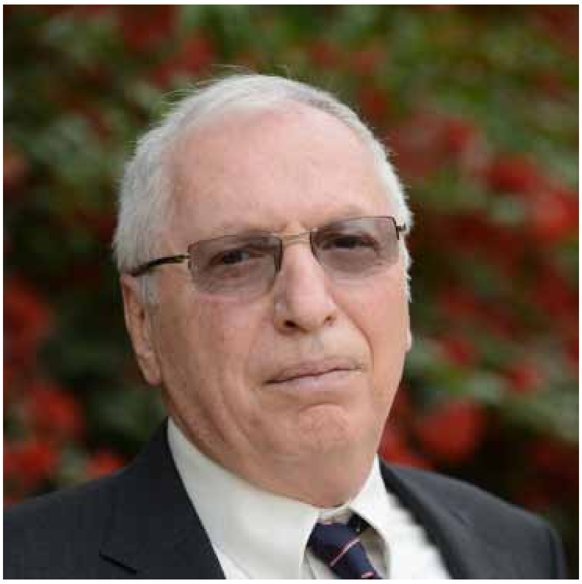
ISBE membership is open to those who have manifested a continuous interest in any discipline important to bionic engineering research as evidenced by work in the field, original contributions and attendance at meetings concerning bionic engineering research.



Growth of ISBE Membership

There are 1030 Individual Members coming from 55 different countries and regions and 6 continents of the world.





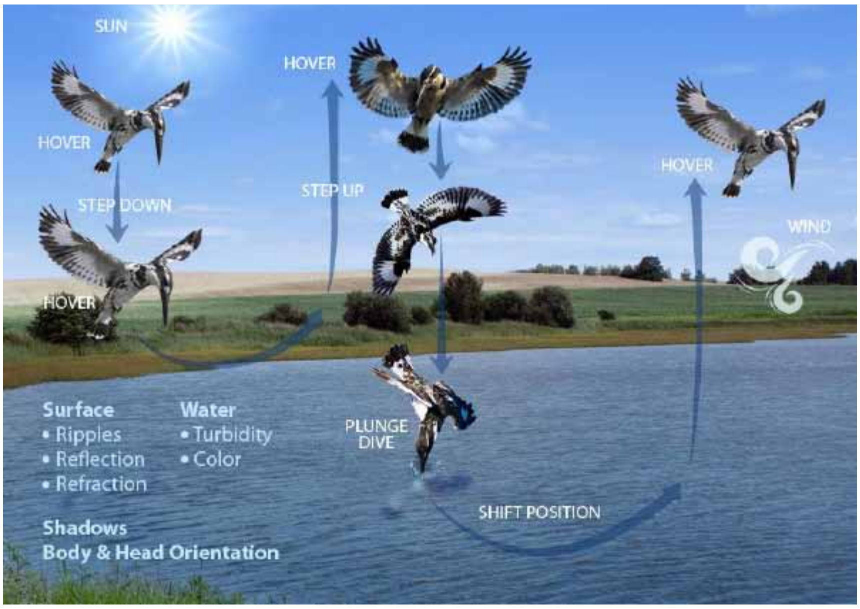
Daniel Weihs

Israel Institute of Technology

* Distinguished Professor and Head
* Autonomous Systems and Robotics Program
Technion, Israel Institute of Technology
* Haifa Member
* Member, Israel Academy of Science
* Foreign member US National Academy of Engineering

My area is Aerospace Engineering, with fluid dynamics as the specialty. My interest in bionics started when reading up on drag reduction for marine applications, as a part-time research assistant job in 1970 during my doctorate, which was in thermodynamics. I found studies that claimed that dolphin skin's flexibility reduced drag, and studies about Gray's paradox, which stated that the dolphin had hydrodynamic efficiency far beyond man-made vehicles. Sir James Lighthill published a review of Fish Swimming at that time, and I wrote to ask him about maneuver ability, which was not highlighted. His answer was No one has yet seriously looked at this -why don't you come over to study this?

During my Cambridge years (1971-1973) I worked on fish turning, starting, schooling and burst& coast swimming, all of which led to developments in related technical systems. Interestingly enough – Gray's paradox, which initially got me involved in bionics, turned out to be an artifact, and when we understood more about animal swimming. The area of bionics was not taken very seriously then, so a lot of perseverance was needed to work and get funded, and published.



Since then, further research led me to various bionic applications for marine systems, from fish like propulsion for shallow water motion, where props are in danger of dam age, to developing methods of rescuing dolphins from fishing nets. Later studies showed that boxfish have a self-stabilizing and drag reducing shape, later applied by Mercedes for it's Bio-Car, and similarities in other recent car designs.

My work on unmanned aerial vehicles led to studies of insect flight, especially the low-Reynolds numbers wings of Thrips, and the botanical dandelion seed equivalent. As a result, very small cm and mm sized floating flyers were designed. This project was commemorated by a postage stamp showing an early floater (see Figure).

Our most recent projects deal with flocking, control of insect flight and bionic inspired shallow water entry and motion.

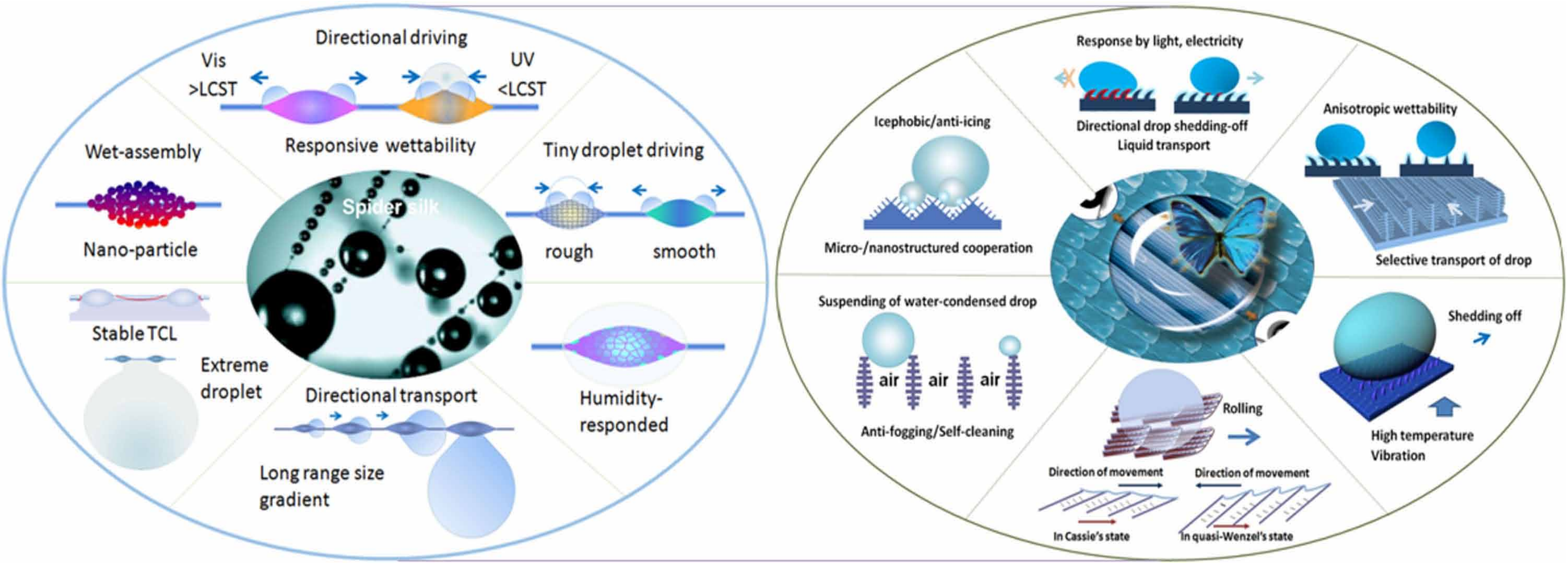
I would like to thank the many colleagues over 40+ years for fruitful collaboration and friendship, and the Society of Bionic Engineering for supportimg and encouraging this field, and especially, for giving me the Award in Ningbo.

Yongmei ZHENG

Beihang University, China

Yongmei Zheng, PhD, is a professor at School of Chemistry and Environment, Key Laboratory of Bio-inspired Smart Interfacial Science and Technology of Ministry of Education, in Beihang University. Research interests are focused on biological/bioinspired gradient surfaces with dynamic wettability for applications of water collection/repellency. Publications are included in Nature, Adv. Mater., Angew. Chem. Int. Ed., ACS Nano, Adv. Funct. Mater., etc., 90 numbers among with 12 cover stories. The research works are highlighted by Nature news, etc., and also publications can be cited by Nature, Science, Nature Materials, etc. She has been honored with prestigious "IAAM Medal" of 2016 for notable and outstanding research in the Advanced Materials Science & Technology by the International Association of Advanced Materials (IAAM) of Sweden. She has been selected for the International Society of Bionic Engineering (ISBE) Outstanding Contribution Award in 2016.

There has been an exciting confluence of research areas, such as physics, chemistry, biology, materials science, and bio-inspired things in recent years. A kernel consists in organic materials with high/low surface energy, has various style micro- and nanostructures, such as regular/irregular, ordered/disordered, rough/smooth that can be endlessly arranged and combined, and is very adaptable for displaying the biological functions that developed during the thousands of years evolution in nature. She discovered that the capture silk of the cribellate spider, Uloborus walckenaerius, collects water from air (Nature, 2010, 463, 640, with cover story). Its unique micro- and nanostructure, which is characterised by periodic spindle-knots made of random nanofibrils that are separated by joints made of aligned nanofibrils, gives rise to a combination of gradients to achieve this cooperative effect that drives tiny water droplets (under 100 μm in diameter) toward the spindle-knots for highly efficient water collection. Her group is working to reveal the cooperative effect of multi-gradient micro- and nanostructured (MN) interfaces on the surface of wettable materials – for example, how to use chemical gradients, physical gradients, geometric gradients and responsive wettability gradients, to control droplet behavior. Inspired by the role that micro- and nanostructures (MNs) play in the water collecting ability of spider silk, they have designed and made a series of fibres (Nanoscale, 2014, 6, 7703, Materials Today: Proceedings 2016, 3, 696, Current Bionanotechnology, 2015, 1, 18) by integrat-



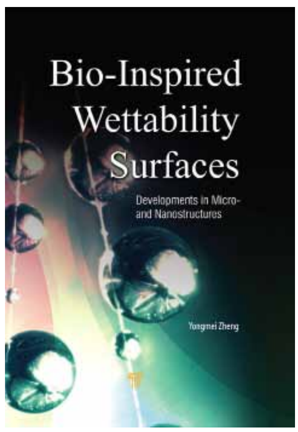
ing fabrication methods (Adv. Mater. 2012, 24, 2786) and technologies.

In addition, butterfly wings have multi-level oriented, anisotropic, or step-like micro- and nanostructures on their surface that repel water in a particular direction (ACS Nano, 2014, 8, 1321; Soft Matter, 2011, 7, 10569; Soft Matter, 2007, 3, 178). Condensed-droplets are repelled by wettability gradient on Lotus leaf with MNs (Appl. Phys. Lett. 2008, 92, 084106). They have modelled the micro- and nanostructures to obtain a bioinspired surface. The excellent water repellency of these bioinspired surfaces could have promising applications for controlling droplets in micro-fluidics as self-cleaning, anti-adhesion, anti-icing and anti-fogging surfaces (Adv. Mater. 2016, 28, 7729; Adv. Mater. 2012, 24, 2642; J. Mater. Chem. A 2014, 2, 3312).

Using inspiration from these biological observations, some integrative gradient surfaces can be designed for driving of droplets, such as anisotropic gradient (Adv. Mater. 2015, 27, 5057), high-temperature oriented hairs (Adv. Mater. 2014, 26, 6086), and gradient wettability of high adhesion (Angew. Chem. Int. Ed. 2014, 53, 6163). The integrative gradient surfaces from inspiration of beetle back and spider silk for high-effective water collection (Adv. Mater. 2014, 26, 5025). The structures on surfaces of materials can be tailored to demonstrate the mechanism of multiple gradients in driving tiny water droplets for applications of water collecting or micro-fluidic controlling systems.

Research in Zheng group looks also at ChemistryWorld in Royal Society of Chemistry (see http://www.rsc.org/chemistryworld/2014/08/interview-yongmei-zheng-spider-silk-water-droplet).

A monograph "Bioinspired wetta-bility surfaces: Development in micro- and nano-structures" has been published in June, 21, 2015 (see http://www.panstanford.com/books/9789814463607.html), which concluded the four effects of wettability surfaces with micro- and nanostructures: Lotus leaf effect cooperative with isotropic micro- and nanostructures; Butterfly Wing Effect cooperative with Anisotropically Oriented Micro- and Nanostructures; Spider Silk Effect cooperative with Gradient Micro- and Nanostructures and Beetle Back Effect: Heterogeneous Wetting Micro-and Nano-structures. Some inspired methods can be introduced to help the design of surfaces for micro-fluidic-controlling at micro- and nano-levels.



The Youth Commission of ISBE is now established

The Youth Commission of ISBE was established to unite young members of the Society, and promote academic communication, scientific research as well as talents and training in Bionic Engineering.

Nominations for the Youth Commission became open on October 9th 2016, and a total of 23 nominations from different countries and districts were received by the deadline October 31st 2016. According to the Youth Commission Proposal, the commission shall consist of 7 members including 1 Chairman, 2 Vice-Chairmen, 1 General Secretary, and 3 commission members. After rigorous evaluation by the Executive Board of Directors, the composition of the 1st Youth Commission of ISBE is as followed.

Chairman
Zhiguang GUO
Lanzhou Institute of Chemical Physics, CAS, China

Vice-Chairman
Giuseppe Carbone
Sheffield Hallam University, UK

Vice-Chairman
Poramate Manoonpong
University of Southern, Denmark

General Secretary
Limei TIAN
Jilin University, China

Commission Member
Zuankai WANG
City University of Hong Kong, China

Commission Member
Dingguo ZHANG
Shanghai Jiao Tong University, China

Commission Member
Daniel Tinello
Graz University of Technology, Austria

Workshop on Terrain Bionic Mechanisms Systems Innovation

2016 CSAM International Academic Annual Meeting was held in Wuhan on Oct 25. More than 700 representatives majoring in Agricultural Machinery attended the conference. Prof. Luquan REN, the Standing Vice President of ISBE and member of the Chinese Academic of Science, attended the conference and gave a presentation.

The Workshop on Terrain Bionic Mechanisms Systems Innovation was held during the Conference. The workshop was organized by the International Society of Bionic Engineering, the Education Committee of the Chinese Society for Agricultural Machinery (CSAM) and the Sub-branch of Terrain-machinery System of CSAM. More than 50 representatives attended the workshop, and had in-depth communication and discussion on the topics of Bionic Robot, Bionic Design, Bionic Mechanism, Bionic Materials etc. Dr. Lutz Richter, the General Secretary of the International Society for Terrain-Vehicle Systems (ISTVS) and the project manager of OHB was invited to make a presentation on "Planetary Mechanisms and Terra-mechanics".

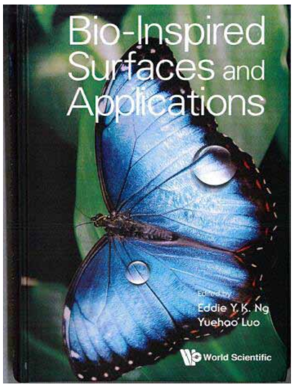
This workshop provided a good opportunity for the exchange of Terrain Mechanisms Systems research achievements, and offered a platform for representatives to communicate and cooperate with each other. It played a positive and pivotal role to promote the development of Terrain Bionic Mechanisms Systems research at an international and interdisciplinary level.

Dr. Lutz Richter and Mr. Runmao WANG, Director of the Office of Secretariat, ISBE also had in-depth discussions on the future cooperation between the two societies.

Welcome to visit Prof. Julian Vincent's Blog

Julian Vincent will soon come to the end of his period as President of our Society. To fill the gap that will be left, he has started a blog at **biomimetics.org.uk**. This will contain a variety of snippets of news, commentary on current advances in biomimetics, ideas which he is developing, requests for help, jokes and illustrations. There is room for comment, so he hopes that this will lead to a conversation around the world and a place for you to present your latest papers and ideas for discussion.

All welcome!



New Book: Bio-Inspired Surfaces and Applications

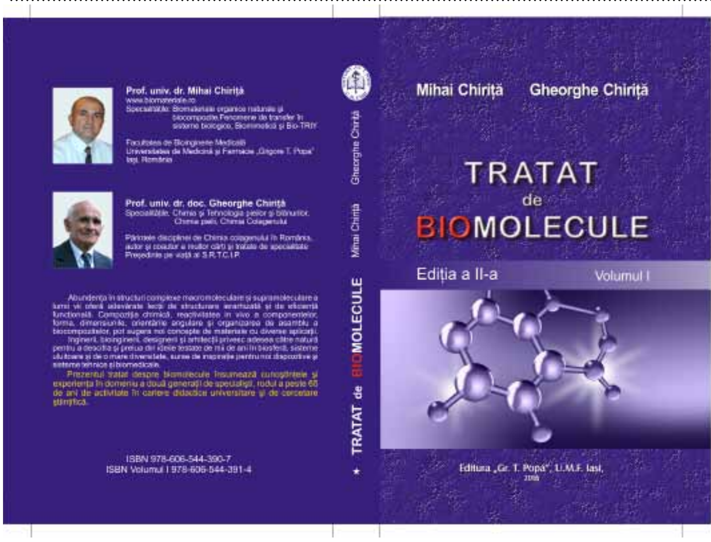
Edited by: Eddie Y K Ng
Yuehao LUO

Introduction

Through millions of years' natural selection, shark skin has developed into a kind of drag-reducing surface. This book shows how to investigate, model, fabricate and apply shark skin's unique surface properties, creating a flexible platform for surface and materials engineers and scientists to readily adopt or adapt for their own bio-inspired materials.

Nanyang Technological University, Singapore is a publishing a book on biomimetic drag-reducing surfaces and their application to fluid engineering. In particular, the book used the naturally occurring drag-reducing shark skin as a model. An accurate 3-D digital model of shark skin was built through scanning based on the real biological sharkskin. The book also covers other potential applications of bio-inspired drag-reducing technologies in natural gas pipelines. This involves the use of "hydraulic smooth pipe" adopting internal coating technology to reduce friction and increase transmission capacity of the pipe and efficiency of gas flow through bio-inspired pipe modification. In addition, this book covers other important areas such as "shape-imitation" to "spirit-imitation" in bio-inspired systems and insect-machine hybrid systems.

Two members of the International Society of Bionic Engineering Dr Rashid Qaisrani, Australian Government Department of Agriculture and Water Resources and Professor Li Jianqiao, Jilin University, China contributed actively to this book. Dr Qaisrani and Professor Li drafted a chapter on "Application of Bio-inspired Surfaces in Reducing Adhesion to the Surfaces of Soil Engaging Components of Agricultural and Earthmoving Machinery". The book is now in the process of publications.



New Book: TRATAT de BIOMOLECULE

Authors: Mihai Chirita
Gheorghe Chirita

Edited by: Gr.T.Popa

ISBN: 978-606-544-390-7
ISBN Volumul l 978-606-544-391-4

BIO-MIMETICS NEEDS MORE BIOLOGY

Friedrich G. Barth, University of Vienna, Austria

We all know that too often biologists are badly under-represented at ICBE-meetings. Sometimes they seem to be almost absent. Nevertheless, BIO-mimetics should start from "BIO", shouldn't it? There seems to be a problem which on the long run inevitably will affect both the quality and impact of biomimetic work. Admittedly, the design of novel synthetic devices is slowed down by a lack of "technical" analyses in biology, which often is more descriptive than "mechanistic". At the same time, however, data already available often are not truly appreciated by the engineering side and the complexity typical of biological phenomena is often ignored. In any case the fundamental role of evolution must be acknowledged, implying an effort to understand the biologically driven adaptive character of biological "design". Before even starting with BIO-mimetics it should be clear what a biological structure or process is adapted to and what its function is under biologically meaningful conditions. Obviously, ecological and behavioral aspects need to be considered here. Ideally, "technical biology" (explaining biological phenomena in terms of the physical sciences) mediates between biology and engineering. And in the best case biologists and engineers closely cooperate on a particular project on a long term basis.

Such cooperation would also help overcome problems resulting from profound differences regarding the approaches taken by the two disciplines. As Julian Vincent (2001) once put it a biologist looking at an organism and recognizing its overwhelming complexity looks at many answers to the problems of life and asks what the many original questions may have been. Contrary to such a top-down approach the engineer works bottom-up, usually with a clear goal, knowledge of the components and design principles. His or her interest in the existing biological literature is limited and often too superficial, missing the most interesting point or drawing wrong conclusions. As a result properties of organisms may be copied for dubious reasons and with an under-defined goal. Sometimes the biologist then wonders: Yes, bio-mimetics, but what for? Or: Yes, nice engineering, but where is the BIO-inspiration? The biologist may also miss more emphasis on environmental concerns like saving energy, producing little waste, avoiding harmful by-products etc., considering that our big concept globally now is (or should be) the survival of man and nature. It is in this context where BIO-mimetics and BIO-inspiration are needed in particular, based on the soft "technologies" found in nature that so well obey the needs of a healthy environment.

Problems of communication arising from basic differences between biology and engineering are manifold. The two disciplines speak two different languages. The wrong usage of well-defined biological terminology by engineers sometimes is a pain. Often concepts familiar to biologists, though relevant, are not abstract enough to be appreciated by the engineer who then tends to consider them as either too complex or too trivial to be taken as a starting point for bio-mimetics. And often, I am afraid, it is hard for the engineer to appreciate the biologist's rather positive attitude towards uncertainty and complexity, diversity and variation, the ever present hierarchy and multi-functionality in biology. Most biologists love the exceptions and the bizarre and learn from them. On the other hand, biologists commonly lack sufficient training in mathematical abstraction and modeling. This is a serious problem asking for help by engineers. Ideally then the process of long term cooperation is a win-win situation, where both sides learn from each other and step by step achieve a deeper understanding of the principles at work in nature and how they can be meaningfully applied in technology. BIO-mimetics needs both, the physics of biology and the biology of physics. To have more biologists at future ICBE meetings would be great, and more engineers not just touching but embracing biology.

A human-powered finned submarine

Iain A. Anderson, Auckland Bioengineering Institute, New Zealand

Boats, submarines, and underwater robots are driven by rotary screw propellers. In contrast, whales and fish; even jet-propelled squid and cuttlefish use fins that can provide propulsion, steering, braking and even support for perching onto rocks. And when not required fins can be folded out of the way. Why don't we use fins on our boats and subs too? Perhaps the single most important reason is that screw propellers can be coupled to a gearbox driven by a rotary engine or motor.

If we don't need to use a rotary drive then why use a propeller? We were faced with this question several years ago when we built our first human powered racing submarine: Taniwha. The vast majority of the human racing submarine community use rotary bicycle chain drives to turn propellers. We desired to use fins and our inspiration was the leatherjacket fish (Parikascaber), a relative of the triggerfish, found around the coast of New

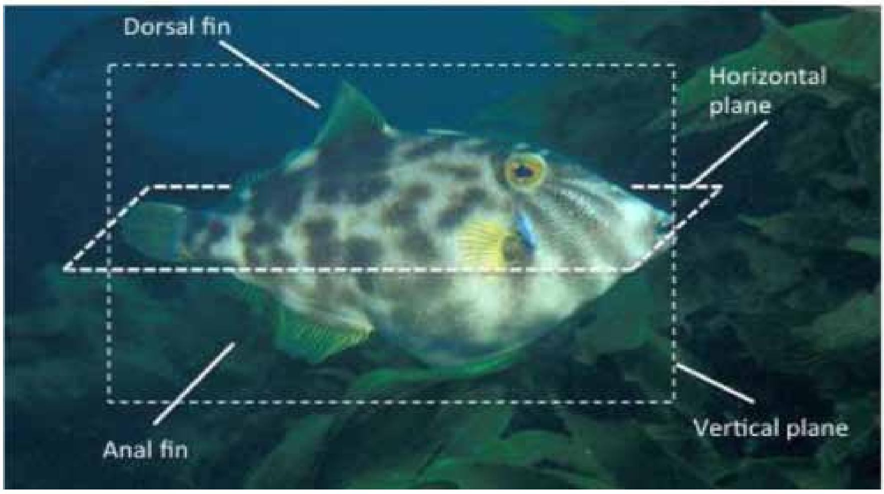


Figure 1: Our sub: the Taniwha was inspired by the leatherjacket (Parika scaber). Dorsal and anal fins in the vertical plane provide propulsion on a body that steers in the horizontal plane. Photo by Iain Anderson.

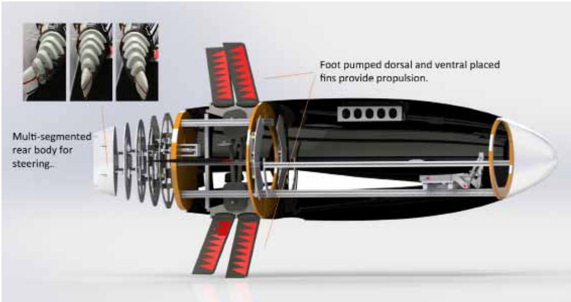


Figure 2:Taniwha's 2016 features

Zealand (figure 1). They rarely use their tail for propulsion unless frightened. Instead they wave intricateanal and dorsal fins for propulsion and use their rear body and tail for steering while browsing the reef for food.

Rather than trying to copy the complex multi-freedom fin set of the leatherjacket we used something much simpler: the Hobie Mirage drive (Hobie, Cal. USA), a foot-pedaled fin device used for propelling sit-on kayaks. Two fin sets were used: one on top and another underneath, mimicking the dorsal and anal fin placement of the leatherjacket. The Hobie mirage mechanism is simple: there is no rotary gearbox the fins are directly driven through a simple up and down pumping action by the legs. In 2016 we included body bending for steering; like the leatherjacket. For this we fabricated a multi-segmented rear body, geared using stiff cables and pulleys to bend around in a smooth curve, on the action of one hydraulic actuator (Figure 2). We covered the bendy-body segment with a neoprene skin that could be unzipped and removed for inspection of the drive.

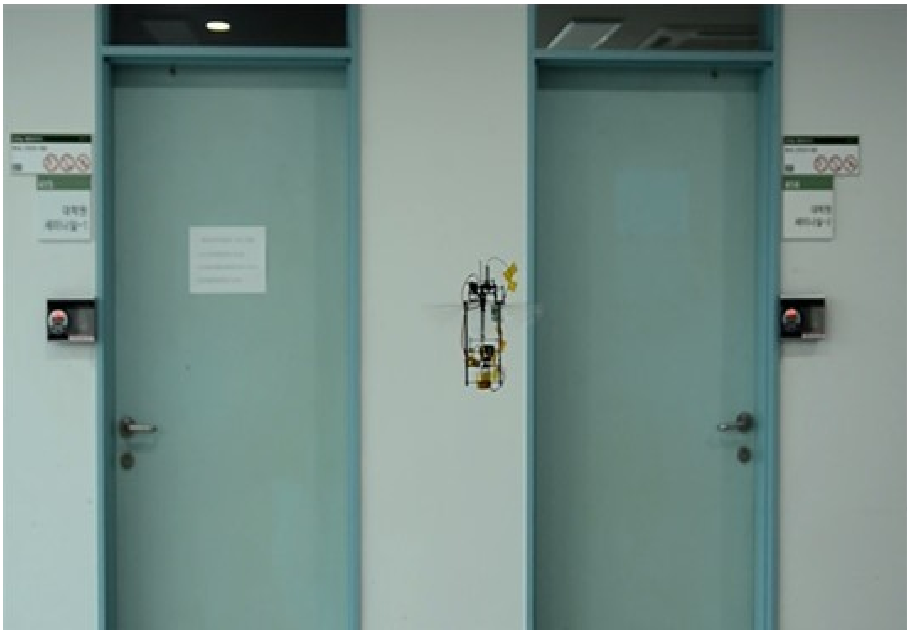
The sub has just competed at the 3rd European International Submarine Races; a University competition, that was held in a ship model testing tank (Qinetiq Ocean Basin) Gosport England in July of 2016 (http://www.subrace.eu/). We were the 2nd fastest sub in an international field of 11, with a top speed of 4.7 knots (2.42 m/s). Our superior reliability and overall performance won us the trophy.

There are many challenges to be overcome. For instance, our pilot experienced difficulty in establishing the angle of orientation of the sub. A fish would not suffer from this. With the help of sensors along its lateral line, a fish can detect the flow of water past its body and its position in the flow. Nerves in its fins can also feel the water and obstacles around it. Personalized submersible designers should take heed of this and provide a subpilot with a better haptic experience of their surroundings; we should design a submersible with feeling made possible through sensory bionic fins.It can be fast, maneuverable and won't get tangled in weed like propellers do!

Figure 3: Submarine Taniwhaon its way to completing another successful run around the QinetiQ Ocean Basin (July 2016). Photo byGerrit Becker.

Controlled flight of an insect-mimicking two-winged tailless flapping-wing micro robot

Hoon Cheol Park, Konkuk University, South Korea



At the end of June, 2016, Prof. Hoon Cheol Park of the Department of Advanced Technology Fusion at Konkuk University announced that his research lab successfully developed an insect-mimicking flying robot that weighs 20 grams. (Link: www.youtube.com/watch?v=KWzW69xfyso) This was the first time a tailless micro-robot weighing at that level was able to fly since the Hummingbird Nano Air Vehicle by AeroVironment took flight in 2011. In fact, it is more difficult to control flying robots resembling insects than those that are designed based on birds. Insects position themselves by solely relying on flapping its wings, whereas birds can also use their tails. In developing the flying robot, the research lab overcame technical difficulties with lightweight parts and finding the center of gravity for demonstrating controlled flight.

Professor Park's research lab was designated a "National Research Lab" by the Ministry of Science and Technology in 2007 and received $200,000 annually for five years. The lab also received support since 2013 as a research center specialized in biomimetics. Members of the lab also produced many academic papers in the process. According to a review paper entitled "A Review of Biomimetic Air Vehicle Research: 1984-2014" published in the International Journal of Micro Air Vehicle in 2015, Professor Park's research team from Konkuk University published the highest number of articles related to flying robots resembling birds and insects among universities in the world.

"Further research will improve the insect-mimicking robot so that it can fly autonomously," said Professor Park. "We will also continue to conduct research for practical applications and other robots resembling different types of animals."

Reversibly switchable wettability corresponding to different pH droplet and its corrosion resistance

Yan LIU, Jilin University, China

Nature has developed surfaces with particular wettability. The emerging field of biomimetics allows one to mimic the biological or natural surfaces to obtain desirable properties. Recently, functional smart surfaces that can realize the transition between different wettabilities under external stimuli have been intensively researched because of their potential application in the fields of microfluidics, bio-detection, smart on-off systems etc.

As shown in Fig.1, a facile approach to prepare pH-responsive surface is presented. Different pH water droplets were used to trigger the switching of the surface between superhydrophobicity and superhydrophilicity. What's more, based on the investigation of $HS(CH_2)_{10}COOH$ and $HS(CH_2)_{11}CH_3$ in this paper, the surface modified totally by $HS(CH_2)_{11}CH_3$ was proved to be superhydrophobic with low adhesion and its water repellency can improve the corrosion resistance of aluminum alloys effectively.

The micro-nano structure provides the optimized geometrical conditions for the formation of superhydrophobic and superhydrophilic surface (Fig.2). The combination of $HS(CH_2)_{10}COOH$ and $HS(CH_2)_{11}CH_3$ was essential to realize the transition between superhydrophobicity and super-hydrophilicity(Fig.1a). The super hydrophobic surface modified totally by $HS(CH_2)_{11}CH_3$ exhibited specular reflection phenomena(Fig.3a) and its water repellency endow the superhydrophobic surface with excellent corrosion resistance (Fig.3b).

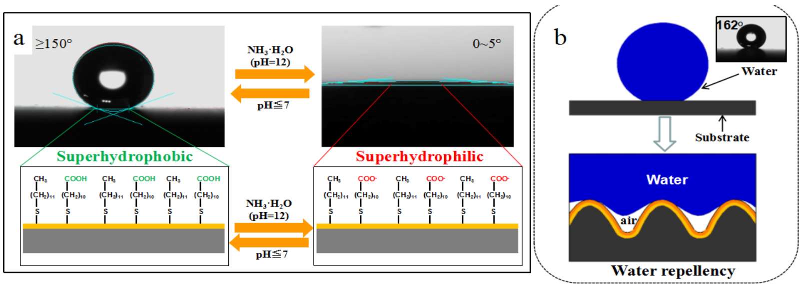


Fig.1

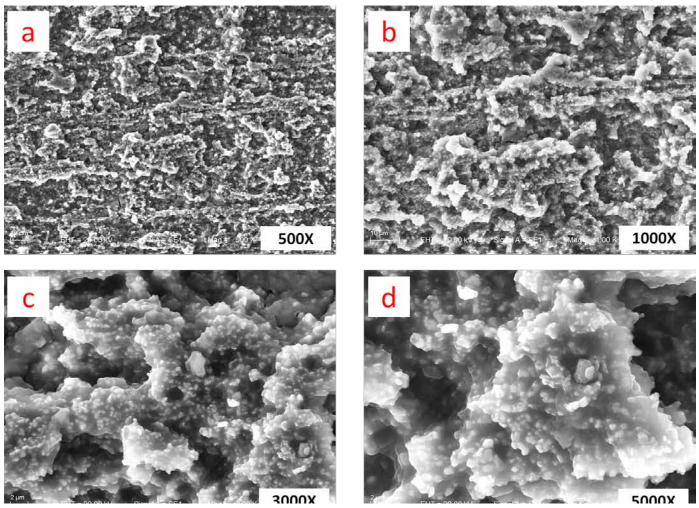


Fig.2

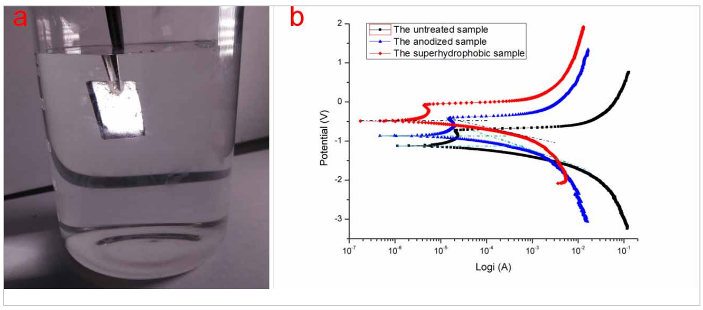


Fig.3

Learning from a dung beetle to advance robotic development: A bio-inspired approach

Poramate Manoonpong, Denmark and Stanislav Gorb, Germany

Recently, Artificial Life Robotics published a paper entitled “A robot leg with compliant tarsus and its neural control for efficient and adaptive locomotion on complex terrains”. This work, in collaboration between the robotic team in Denmark and the biomechanics team in Germany, presents a dung beetle-inspired robotic leg with compliant tarsus and its adaptive central pattern generator (CPG)-based neural system for locomotion control.

Dung beetles show impressive versatile locomotor abilities. They use their legs not only to walk but also to manipulate objects. They can enhance their locomotion efficiency on complex terrains by exploiting their compliant tarsi which can passively increase the contact area between the legs and surface. In addition to their biomechanical legs, their neural control allows them to move effectively and quickly adapt their movements to deal with environmental changes.

Realizing these complex achievements on artificial systems remains a grand challenge. As a step towards this direction, the paper presents here a first prototype of a novel artificial robotic leg with compliant tarsus (Fig. 2b) by analyzing real dung beetle legs through µCT scans (Fig. 2a). Compliant tarsus was designed according to the so-called fin ray effect. Real robot experiments show that the leg with compliant tarsus can passively adapt its shape to follow the contour of a substrate (Fig. 2c). This increases the contact area between the leg and surface; thereby enhancing locomotion efficiency. Applying a CPG-based neural control system with synaptic plasticity to the leg allows it to efficiently move on rocky and curved surfaces as well as autonomously adapt its movement online to deal with environmental changes, like different treadmill speeds, within a few steps (Fig. 2d).

Figure 1: The dung beetle Geotrupes stercorarius. The photo is from Chris Moody - www.microphoto.co.uk

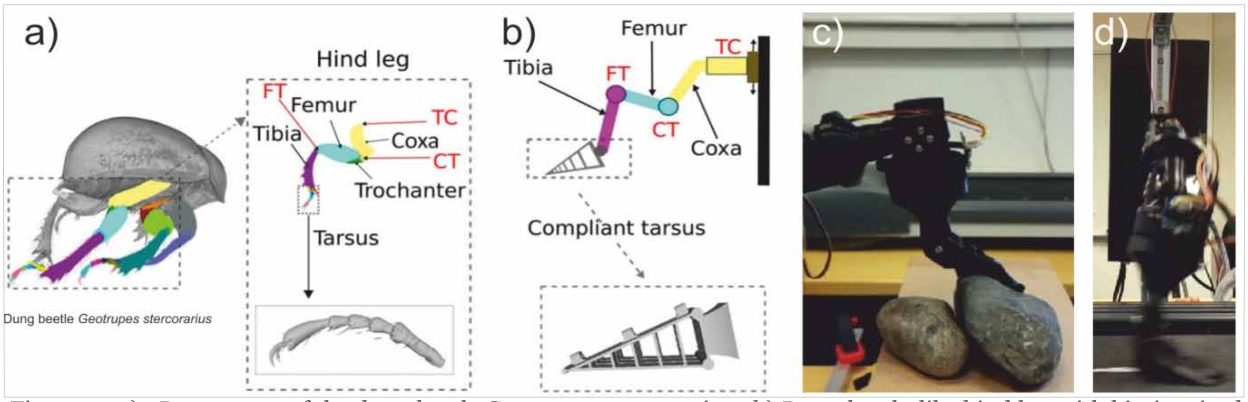


Figure 2: a) 3D structure of the dung beetle Geotrupes stercorarius. b) Dung beetle-like hind leg with bio-inspired tarsus. c) The passive adaptation of the tarsus on a rocky surface. d) The efficient and adaptive locomotion of the leg on a treadmill. All photos are adapted from Di Canio et al., Artificial Life, 2016.

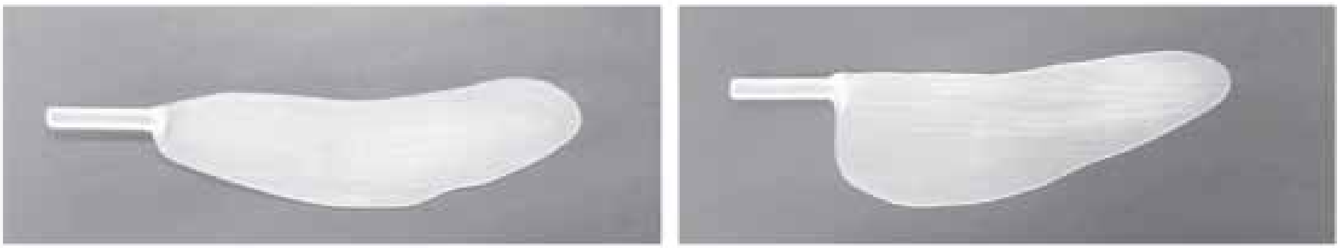


Figure 1. Dragonfly-like wing models used in the present study. (a) Fore-wing model, (b) Hind-wing Model.

Experimental studies of tandem flexible flapping wings inspired by dragonflies

Wu, Yanhua, Nanyang Technological University, Singapore

Zheng Y. and her co-workers at Nanyang Technologcial University, Singapore and Hong Kong Polytechnic University have recently performed a series of experimental studies on the aerodynamics of tandem flexible flapping wings inspired by dragonflies. Three pairs of flexible wings were fabricated using 3D printing and their flexibility was controlled by thickness of the wings. Their aerodynamic performances such as the force, power consumption and efficiency were compared with the tandem rigid wings in both hovering and forward flights. They observed that, when the tandem wings processed a little flexibility, the average aerodynamics forces and efficiencies could improve, but too much flexibility would hurt the wings' performance. The dynamic force traces revealed that the different peak values, phase lag and secondary peaks were the main reason to cause different mean aerodynamic forces between the tandem wings studied. Both phase-locked and time-resolved PIV had been used to measure the velocity fields to explain how the flow was affected by the tandem flexible wings. Details of these studies can be found in the following publications:

Y. Zheng, Y.Wu and H.Tang. 2016. A time-resolved PIV study of the force dynamics of the flexible tandem wings. Journal of Fluids and Structures, 62, 65-85.

Y.Zheng, Y.Wu, and H.Tang. 2016. An experimental study on the forewing-hindwing interactions in hovering and forward flights. International Journal of Heat and Fluid Flow, 59, 62-73.

Y.Zheng, H.Tang and Y.Wu. 2015. Force measurements of flexible tandem wings in hovering and forward flight. Bioinspiration & Biomimetics, 10, 016021.

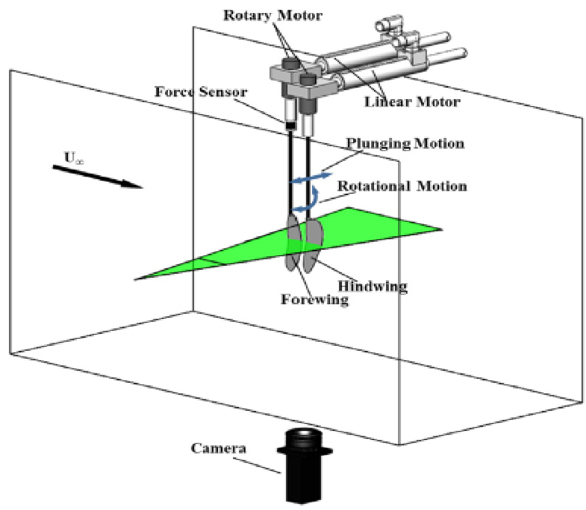


Fig. 1. Experiment setup for force and PIV measurements. Measurements of the hovering flight were carried out in the water tank while those of the forward flight were done in the water tunnel.

Current status and development prospect of petroleum engineering bionics

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Petroleum engineering bionics takes the technical requirements in oil/gas exploration and development as a fundamental starting point, with the purpose of improving the current technical system or creating a new one, provides innovative solutions for the key technologies in functional materials, surface performance, information acquisition and processing, engineering realization, etc. The technical system of petroleum engineering bionics covers oil/gas exploration, development and petroleum engineering, and the development of the system goes through three stages including knowledge accumulation, achievement transformation and industrial application.

PetroChina Research institute of Petroleum Exploration and Development (RIPED) began the study of petroleum bionic technologies in 2008. Some bionic technologies have been applied in production, and more bionic technologies are in the stage of laboratory study. Three typical petroleum bionic technologies are listed as the following:

Bionic Expansion Cone

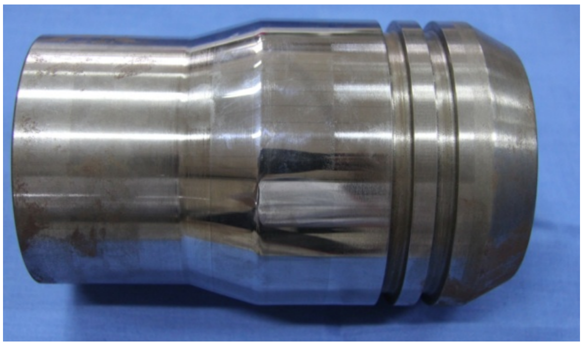


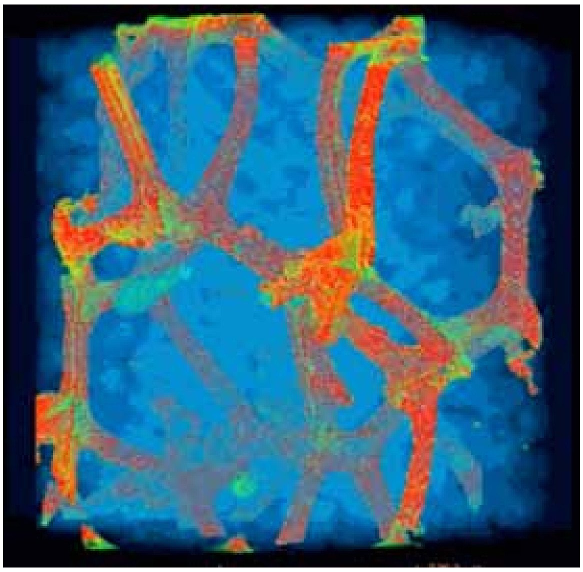
Fig.1 Bionic expansion cone

The solid expansion tubular (SET) technology is usually used to repair damaged casing, extend old well strings for developing deeper oil layers, perform sidetracking, construct various types of oil wells, and even for complex formation problems. As the key tool of SET technology, the expansion cone deforms the expansion tube plastically using hydraulic pressure, so the expansion cone must have sufficient strength, impact resistance, wear resistance and corrosion resistance because it suffers high interface stress during the operation. Pangolins have hard scales like armor to protect the inner body. Take pangolin as bionic object, the bionic expansion cone was designed and fabricated. A hard layer like hard scale was made on the cone surface, the wear resistance of the cone was evidently improved and the friction was reduced by above 50%. The bionic expansion cones have been used in dozens of wells in Daqing oil fields.

Bionic Sand Control Pipe

Fig.2 (a) porous metal

Sand control technologies are widely used in oil wells to prevent or reduce the sands flowing into the well bore. Traditionally, two dimensional or plane sand control pipes are very common, but the effect of sand control is limited. Based on the micro-structures of a bone, three dimensional sand control structures were designed by using porous metal to made sand control pipe. The sand could flow into the pore of the three dimensional structures, but couldn't seal off the whole flow channel. This kind of bionic sand control pipe has been applied in 5 oil wells, the results indicated that the effect of sand control was remarkable and effectively prolonged the pump detection period.



(b) Micro XCT of porous metal

Self-dissolved Brid ge Plug

A new material called dissolvable material has been prepared in recent years. The material has low density and high strength, which is suitable to fabricate downhole tools in petroleum industry. The self-dissolvable bridge plugs, which are used for staged fracturing operation, have been made by using dissolvable material. After fracturing, the plug could be self-dissolved without artificial intervention. The self-dissolved plugs have been used more than 100 times in many oil/gas fields, like Daqing, Jilin, Sichuan and so forth. The self-dissolve plug could be more economic, reliable and safer than traditional plugs.

Fig.3 Field application of self-dissolved bridge plug

Except the technologies mentioned above, other petroleum bionic technologies like bionic vibration wave communication, biomimetic surface for antiscale are still under researching in the laboratory, maybe which could be finally making their way out of the lab and into the oil/gas fields. The results indicate that bionics could provide more reliable, flexible, high efficiency, and economic technological system for the petroleum industry, and could further promote the technological advance of petroleum industry.

2017 International Workshop on Bionic Engineering (IWBE2017)

June 13-14, 2017, Denkendorf, Germany

Organizers: International Society of Bionic Engineering (ISBE)
German Institute for Textile and Fibre Research Denkendorf (ITV Denkendorf)

Topics: The lectures and attendees in the workshop will present and discuss new knowledge in biological science and bionic transfer regarding energy.

One focus lies on energy harvesting, based on solar radiation and energy storage.

Another focus will be on saving energy in friction and by adapting the shape of a body in moving systems. Highly astonishing surface structures and interactions of insects, animals and plants show fantastic low friction coefficients, low abrasion and low drag from bodies to soil, to water and to air. We are only at the beginning of understanding these first class performances in order to adapt it to marine technology, piping, aircraft, mobility, ...

Other energetical optimized processes are liquid transport mechanisms in analogy to the capillary effect and cohesion theory of trees and leaves.

Heat deviation in order to not over heat plays a crucial role in most living organisms and also in industrial processes. Living organisms show properties, which can highly adapt to harsh environment, such as keeping the temperature in a comfortable range. Examples are adaptive thermal insulation in arctic regions, light and heat management in very hot and sun intensive desert regions. This gives us the necessary knowledge we need in construction.

The workshop also deals with energy conversion, energy transport and heat recovery processes according to the role model of nature. For example little knowledge is available in details for transforming chemical energy into mechanical energy with high efficiency at low temperature.

In terms of energy, further elements are welcome in order to create a link between biology, knowledge and technology transfer.

Submission: We invite you to submit proposals for lectures to the chair of the conference:

Dr. Thomas Stegmaier
thomas.stegmaier@itv-denkendorf.de
Please indicate title of the lecture, author(s) and short summary of the contents of the lecture (half page or less).
The lectures in the workshop will last about 20 to 30 minutes.

Location: Institute of Textile Technology and Process Engineering (ITV Denkendorf), German Institute for Textile and Fibre Research Denkendorf (DITF Denkendorf), Koerschtalstrasse 26, 73770 Denkendorf, Germany

Travel Options: Airport Stuttgart: is close to the institute (20 min by taxi)

Denkendorf is a municipality in the district of Esslingen in Baden-Württemberg in southern Germany. It is located 5 km south of Esslingen, and 14 km southeast of Stuttgart.

Registration:

Registration type	Registration fees	Fees including
Paid Member	€180 (early bird) € 200	workshop materials catering during the workshop transfer from the hotels to the workshop welcome dinner attendance to the workshop
Standard Delegate	€220 (early bird) €240	

* Early Registration Deadline: 30 April 2017.
The On-line Registration System will open in the near future!

If you have questions:
Secretary of ISBE, Jilin University, China
secretariat@isbe-online.org
Secretary of ITV Denkendorf, Germany
Casey Metcalf: e-mail: casey.metcalf@itv-denkendorf.de;phone: 0049 711 9340 510

SSBSS 2017

4th International Synthetic & Systems Biology Summer School

Biology meets Engineering & Computer Science

July 17-21, 2017 Robinson College,

University of Cambridge, UK

Summary

SSBSS 2017 DEADLINES:

Application: March 31, 2017

Notification Acceptance: April 10, 2017

Oral Presentation/Poster Submission: March 31, 2017

Notification of Decision for Oral/Poster Presentation: April 10, 2017

Topics

Computational Synthetic Biology
Genetic Engineering
Metabolic Engineering
Reading and Writing Genomes
Synthetic Genomes
Synthetic Circuits and Cells
Artificial Tissues and Organs
Genomically Recoded Organisms
Genome Design
Pathway Design
Biological Design Automation and Biological CAD
Computational Systems Biology
Genome Engineering
Cellular Systems Biology
Experimental Synthetic Biology
Computational Synthetic Biology
Stochastic Gene Regulation
Gene Signaling
Quantitative Molecular Biology
High-throughput Techniques
Biological Engineering
Industrial Synthetic and Systems Biology

More information, please visit http://www.taosciences.it/ssbss/

ICABBB 2017 : 19th International Conference on Applied Bionics, Biophysics and Biomechanics

Bangkok, Thailand
December 17 - 18, 2017

Conference Aims and Objectives

The ICABBB 2017: 19th 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 on all aspects of Applied Bionics, Biophysics and Biomechanics. It also provides a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Applied Bionics, Biophysics and Biomechanics.

Call for Contributions

All honorable authors are kindly encouraged to contribute to and help shape the conference through submissions of their research abstracts, papers and e-posters. Also, high quality research contributions describing original and unpublished results of conceptual, constructive, empirical, experimental, or theoretical work in all areas of Applied Bionics, Biophysics and Biomechanics are cordially invited for presentation at the conference. The conference solicits contributions of abstracts, papers and e-posters that address themes and topics of the conference, including figures, tables and references of novel research materials.WASET

Conference Proceedings

All submitted conference papers will be blind peer reviewed by three competent reviewers. The post conference proceedings will be abstracted and indexed in the International Science Index , and submitted to be indexed in the Google Scholar, Scopus and Thomson Reuters. The conference abstracts and proceedings book, CD and certificate of presentation will be distributed to participants at the conference registration desk.

Important Dates

Abstracts/Full-Text Paper Submission Deadline	Dec. 31, 2016
Notification of Acceptance/Rejection	Jan. 30, 2017
Final Paper (Camera Ready) Submission & Early Bird Registration Deadline	Aug. 17, 2017
Conference Dates	Dec. 17 - 18, 2017

Newsletter

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ISBE NEWSLETTER

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