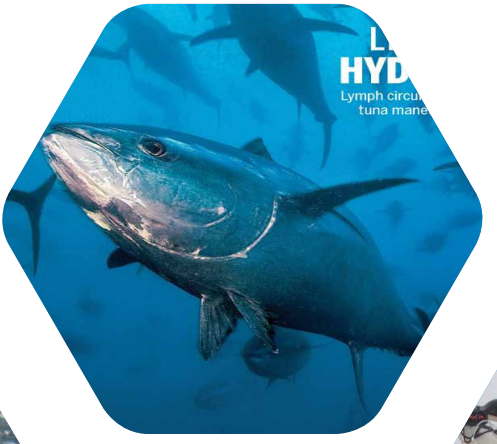
Newsletter

International Society of Bionic Engineering

Volume 6, Issue 3, 2017



Contents

Friedrich G. Barth

University of Vienna, Austria

* Professor Emeritus, Department of Neurobiology, University of Vienna, Austria
* Member: Academia Europaea, German National Academy of Sciences/Leopoldina, Bavarian Academy of Sciences, Austrian Academy of Sciences

Retirement does not seem to be an option for a scientist. Having been an Emeritus Professor at the University of Vienna for some 10 years now, I still find it highly rewarding to see and find out how nature works. I was born and raised in Munich/Germany and also went to University there, studying Biology and Human Physiology. As a young student I had the great opportunity to spend more than a year at the University of California at Los Angeles, California in Ted Bullock's laboratory, which considerably broadened my mind and the understanding of neurobiology, both of the human and the zoological side. Starting with my Ph.D. work in Munich, I have dedicated most of my research to sensors and sensory perception, always trying to see both the refinement in the details and its role in the larger contexts of behavior and ecology. Considering the evolutionary background of all the masterpieces we find in nature, a true understanding of their "design" (a product of specific evolutionary selection pressures) always needs an understanding of the biological relevance. As a logic consequence we combined fieldwork, behavioral studies, and laboratory work, applying state of the art technologies and learning a lot from engineering.

Multidisciplinary cooperation with engineers and physicists in search of the design principles

Having given the festive lecture in 2015 at the occasion of the 125 years anniversary of the German Zoological Society. Photo: DZG

of bio-sensors has always been part of our research. It allowed us to apply technologies not commonly used in biology and to develop models of what we wanted to understand. Both helped a lot in search of elementary "design" principles. Finite element analysis, particle image velocimetry, laser Doppler vibrometry, and techniques taken from fluid mechanics, material science, and other fields were part of our research efforts, apart from electrophysiology, behavioral experiments and electron microscopy. The arthropod senses studied, including related biomechanical and physical questions, were mainly mechanoreceptors serving the reception of strain, medium flow, vibration and touch. However, in my Department of Neurobiology at Vienna University (since 1987, after having held a chair at Frankfurt University for some 12 years), thermo- and hygroreception and vision were studied as well. Can a spider be the animal to study basics of all these senses? The spider senses have been a perfect choice, indeed, fascinating by their remarkable sophistication both in a biological AND a technical sense. More recently problems of communication in stingless bees (Meliponini) and the impressive material properties of selected cuticular structures caught our attention. Details can be found in more than 200 original full papers (for a list of publications see http://neuro.univie.ac.at/publications; https://www.oeaw.ac.at/m/bar).

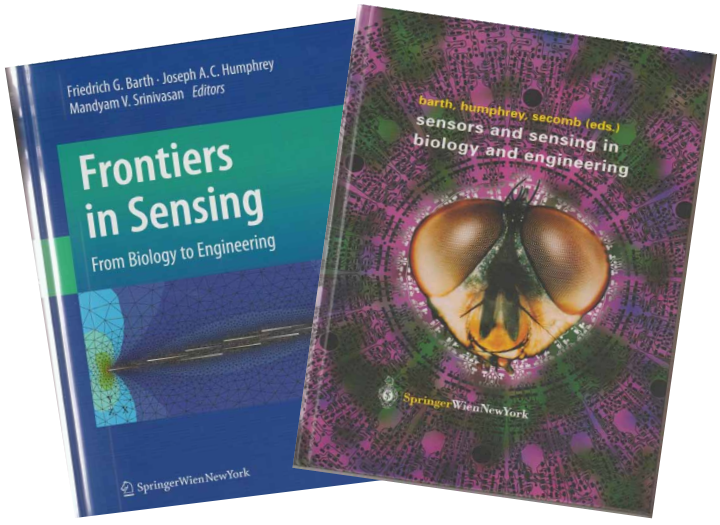


Fig.3, Fig.4: Covers of the two books mentioned

Research, lecturing, and guest professorships took me to many countries all around the globe, which I consider a particular privilege of being a scientist. In a long lasting effort to bring together biology and the physical sciences I organized a number of respective international conferences. Since 1996 I have been serving as Editor in Chief of the Journal of Comparative Physiology-A. Among the books I authored and edited two contain a lot of "engineering" and may be of particular interest to the members of ISBE: Barth et al. eds. (2003) Sensors and sensing in biology and engineering.399pp, Springer; and Barth et al. eds (2012) Frontiers in sensing: from biology to engineering. 438pp, Springer.

Fig.2: In Guatemala pointing to one of our experimental spiders and its characteristic retreat on a banana plant. Photo: D.Schorkopf

Shutao WANG

The Technical Institute of Physics and Chemistry of the Chinese Academy of Sciences

Professor Shutao WANG received his PhD degree on the topic of bioinspired surfaces with controlled superwettability in 2007 from Institute of Chemistry Chinese Academy of Sciences (ICCAS) under the supervision of Prof. Lei JIANG. Then he worked in the Department of Molecular & Medical Pharmacology and California NanoSystem Institute at the University of California at Los Angeles as a postdoctoral researcher (2007–2010). He was appointed as a Professor of Chemistry in 2010–2014 at ICCAS. In 2015 he and Professor Lei JIANG founded the CAS Key Laboratory of Bio-inspired Materials and Interfacial Science in the Technical Institute of Physics and Chemistry, Chinese Academy of Sciences. He was elected as the Ministry of Education of Yangtze River Scholar Professor (2016), Youth Science and Technology Innovation Leader (2016), the Top-Notch Young Talents Program of China (2014), National Science Fund for Distinguished Young Scholars (2014). He also received Youth Distinguished Awards of Chinese Chemical Society (2013). He is associate editor of NPG Asia Materials and the editorial board's member of Current Chemical Biology and Science China Chemistry.

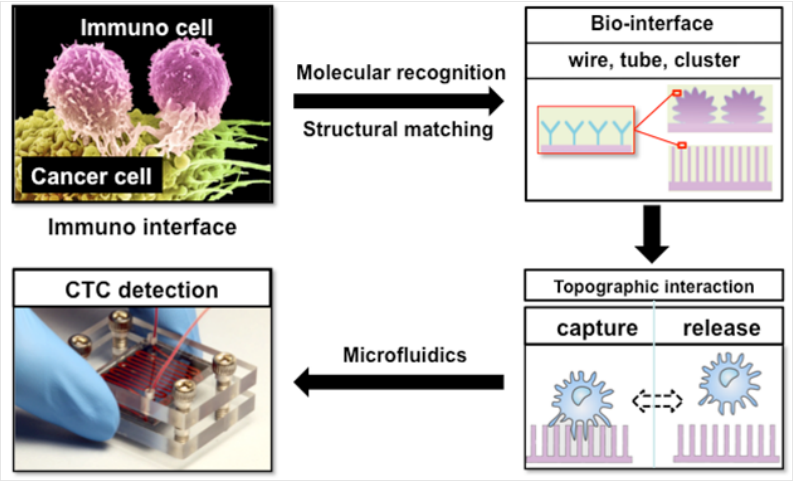


Figure 1. Design of our bioinspired surfaces with high specific recognition of cancer cell and their applicationin detection of rare number of circulating tumor cell (CTC). Inspiration from the immuno interface between cancer cells and immuno cells, they proposed the cooperative effect of molecular recognition and structural matching to design biointerfaces with high specific recognition of cancer cells. They prepared a series of surfaces with unique topographic features to successfully capture and release cancer cells in the assistance of stimuli-responsive smart molecules, and finally realized high effective detection of CTCs (one cell from billion) from the whole blood detection.

His research interests include the design and synthesis of bioinspired multiscaled interfacial materials with controlled adhesion and their applications. Inspired by multiscaled interactions between immune cells and cancer cells, they proposed the cooperative effect of molecular recognition

continues on page 6

1st International Youth Conference of Bionic Science and Engineering

The 1st International Youth Conference of Bionic Science and Engineering (ICBSE2017) was held in Lanzhou, China on July 28-31, 2017. The conference was organized by the International Society of Bionic Engineering (ISBE) and sponsored by Lanzhou Institute of Chemical Physics (LICP), Chinese Academy of Science. The honorary chair of the conference was Julian Vincent, the President of ISBE and professor of Heriot-Watt University (UK). The academic chairs of the conference were Academician Luquan REN from Jilin University and Academician Weimin LIU from LICP. The Conference got the support from the National Natural Science Foundation of China.

The Youth Commission of ISBE was established in December, 2016 to unite young members of the Society, and promote academic communication, scientific research as well as talents and training in Bionic Engineering. Nearly 200 representatives from more than 50 research institutes attended the conference. They showed

their latest academic achievements on biological interface and functionalization, biomimetic materials, biomimetic structures and mechanics, artificial intelligence and sensors, biomimetic engineering. During the opening ceremony, the General Secretary of Youth Commission, Prof. Limei TIAN from Jilin University introduced the work objective of the Youth Commission.

The ICBSE 2017 promoted the academic exchange and cooperation among young scholars. With creative and positive notes such as these, a push forward the development of bionic engineering will be seen worldwide.

and topographic matching in design of surfaces with high-specific cell recognition and adhesion for early cancer diagnostics and monitoring. This design breaks the traditional limit that merely depends on molecular recognition. Several multiscaled biointerfaces were designed to recognize and capture the CTCs from the whole blood. They also revealed the underwater low adhesive properties of the lower side of lotus leaf, the inner side of clam's shell and fish scales and they prepared a series of bioinspired coatings for anti-fouling and prevention of oil pollution.

Specialist Short Courses 2017

Specialist Short Courses 2017 organized by the International Society of Bionic Engineering (ISBE) were successfully held in Lanzhou Institute of Chemical Physics, Chinese Academy of Science, Lanzhou, China on July 27-28, 2017. The courses were presented by Prof. Julian Vincent from Heriot-Watt University and Prof. Jianqiao LI from Jilin University. A total of 34 scholars and postgraduates attended the courses.

During the two days' workshop, the innovative teaching methods including specialist tutelage, classroom interaction, practical experience, and group presentation were adopted. Prof. Vincent and Prof. LI showed a method for identifying and solving trade-offs in biology and engineering, and attendees were able to design novel products based on biological systems using such a method. After the courses, Prof. Vincent issued the certificates to all the attendees.

This workshop provided good opportunities for attendees to learn the basic methods and skills of biomimetics. It was a memorable event to popularize bionic science and technology, spreading its ideas, methods and spirits, and accelerating the pace of academic research and development.

Call for Solutions from RIPED

During the process of oil development, sensors are needed to measure the moisture content of crude oil. Presently, stainless steel is used to make the electrodes of the sensors. However, in practical application, such electrodes often suffer from fouling and erosion because of the harsh environment downhole. Researchers in RIPED are now considering bionic surface treatment a promising way to solve the problem and calling for ideas. According to our tentative plan, the treated surface should be conductive, anti-erosion, and anti-fouling. Moreover, we would also like to try a different material other than stainless steel to make the electrodes if an appropriate one is suggested.

In addition to the moisture content sensor, a vibration energy harvester is also needed for surface treatment. This treated surface should be anti-erosion, impact-resistant, and insulated to meet its application requirements.

If there are any possible solutions, please contact:

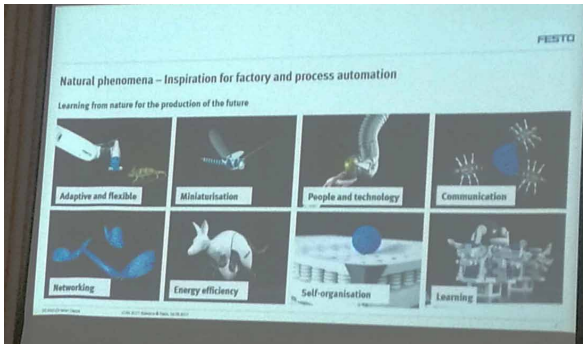
qinghai.yang@petrochina.com.cn

futao0205@petrochina.com.cn

International Workshop on Biorobotics and Biomechanics

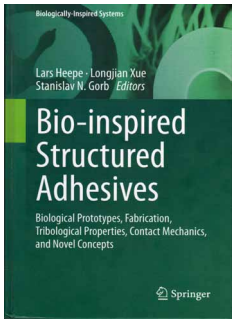
The International Workshop on Biorobotics and Biomechanics, organized by the International Society of Bionic Engineering, University of Manchester (UK), and Jilin University (China) was held in Jilin University on August 15, 2017. The honorary chair of the workshop was Academician Luquan REN, the standing vice-president of ISBE and professor at Jilin University. The chairs of the workshop were Prof. Jianqiao LI who is the General Secretary of ISBE, Prof. Lei REN from University of Manchester (UK), Prof. Zhiwu HAN and Prof. Qian CONG from Jilin University (China). Prof. Jianqiao LI delivered the welcome speech and gave a general introduction of ISBE at the workshop.

During the workshop, Prof. Lei REN from the University of Manchester (UK), Dr. Christian Deppe from Festo Company (Germany), Dr. Lei JIANG from China North Vehicle Research Institute, Dr. Tao GENG from University of Middlesex (UK), Prof. Rui ZHANG from Jilin University and Dr. Guowu WEI from University of Salford (UK) were invited to deliver the keynote speeches. There were more than 100 scholars and students who attended the workshop. Topics on the research progress of bionic walking, bionic robots, and biomechanics were presented. Dr. Christian Deppe made a systematic introduction of Festo bionic learning network, including bionic ants, bionic butterfly, and bionic motion robots etc. which had attracted wide interests.



The workshop was a success and allowed for a display in research progess within bio-robotics and biomechanics, as well as cross communication between representatives.

New Book on Bio-inspired Structured Adhesives



New book "Bio-inspired Structured Adhesives" edited by Lars Heepe, Longjian XUE, Stanislav N. Gorb in the book series of "Biologically-Inspired Systems" has been recently published by Springer. The book deals with the adhesion, friction and contact mechanics of living organisms. Further, it presents the remarkable adhesive abilities of the living organisms which inspired the design of novel micro- and nanostructured adhesives that can be used in various applications, such as climbing robots, reusable tapes, and biomedical bandages. The technologies for both the synthesis and construction of bio-inspired adhesive miciro- and nanostructures, as well as their performance, are discussed in detail.

Lars Heepe Longjian XUE Stanislav N. Gorb

Book information

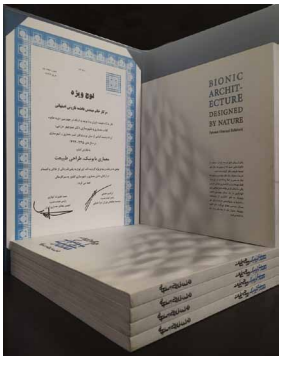
Bio-inspired Structured Adhesives: Biological Prototypes, Fabrication, Tribological Properties, Contact Mechanics, and Novel Concepts

by Lars Heepe, Longjian XUE, Stanislav N. Gorb
ISBN 978-3-319-59113-1
Weblink: http://www.springer.com/series/8430?detailsPage=titles

"Bionic Architecture, Designed by Nature" award winning book

The ceremony of the fourth biennial of architecture and urban planning for the awarding of the Dr. Manouchehr Mozayeni award was held on Wednesday, July 21st, at the Museum of Religious Arts of Imam Ali in Tehran, Iran. The book "Bionic Architecture, Designed by Nature", by Fatemeh Gharuni, won the Special Award of Architecture and Urbanism in this event. The book, which is the result of eight years of author's research, is the first to study the science of bionics as a paradigm in architecture and urbanization in Persian.

The author first explains the relationship between architecture and nature and the role of geometry in nature, and then explains the basics of bionic formation and bionic design techniques in five chapters that cover different levels of imitation and inspiration from nature.



The description on the back cover of this book states: "One of the methods of sustainable development is applying techniques that have been used by nature for millions of years. Bionic is an interdisciplinary topic inspired by how problems are solved in nature."

Although Janine Benyus defined the Biomimicry, but from the beginning of human life on Earth, architecture has been inspired from the nature.

Hydraulic Control of Tuna Fins

Vadim Pavlov, Ukraine

The lymphatic system in teleost fish has genetic and developmental origins similar to those of the mammalian lymphatic system, which is involved in immune response and fluid homeostasis. In our recent article published in Science magazine http://science.sciencemag.org/content/357/6348/310, we show that the lymphatic system of tunas functions in swimming hydrodynamics. Specifically, a musculo-vascular complex, consisting of fin muscles, bones, and lymphatic vessels, is involved in the hydraulic control of median fins. This specialization of the lymphatic system is associated with fish in the family Scombridae and may have evolved in response to the demand for swimming and maneuvering control in these high-performance species. The advantages of hydraulic force generation and transmission as well as the ability to sustain the force over long periods of time, make this strategy a solution for the range of biomimetic applications. The ability to change dynamically the stability properties during transient motion by altering fin sweep angle with a

lymphatic hydraulic system appears promising for a aquatic robotics. Application of this system to underwater robotic vehicles requires an investigation of how dynamic fin change impacts maneuvering qualities. Future studies should also address the implementation of robust and simple actuation mechanisms observed in tuna in aquatic robotic vehicles.

Call for submissions

Have you new ideas or related subjects in the fields of Bionics, that you would like to see?

We'd like to include it in our upcoming newsletter.

Feel free to contact us and share your ideas.

Email: gyue@isbe-online.org

Tel/ Fax: +86-431-85166507

Address: C508 Dingxin Building, Jilin University, 2699 Qianjin Street, Changchun P. R. China

Bionic modifications of disc seeders to improve soil scouring, stubble handling and herbicide incorporation

Rashid Qaisrani, Australia

Australian farmers interest in disc seeders increased recently due to their ability to operate at higher speeds (up to 20 km/h) and sow at narrower row spacing under high crop residue environment (Ashworth et al., 2010). This allows for improved timeliness, leading to more uniform crop maturity and increased crop competition against weeds. However, successful operation is greatly dependant on the disc design, operating environment and soil conditions at the critical time of sowing. For example, wet soil conditions coupled with inappropriate design such as low clearance between various components and inefficient scraper designs have caused many disc systems to fail in wet heavy clay soils. Moreover over, due to low soil disturbance, the disc seeders have poor herbicide incorporation ability. However, their ability to cut through heavy stubbles is significantly improved. Therefore, Australian grain growers are divided over the use of disc or tine sowing technologies under various soil types, sowing conditions, farming systems, crop rotations and stubble retention and management. Grain Research and Development Corporation (GRDC) held a number of farmers meeting in 2007 and raised these issues with farmers. As an outcome of these meetings, the GRDC funded a range of research projects aimed at assessing the pros and cons of disc seeding technology in Australian context.

Bionic modification to improve soil scouring, stubble handing and herbicide incorporation of disc seeders

Mole Rat (Scaptochirusmoschatus) has the ability to dig soil using its fore claws. The profile curves of its claw toe provide an excellent structure for digging. The researchers have designed a biomimetic stubble-cutting disc based on the geometrical characteristics of the mole rat claw toes. This will further enhance the stubble handling capability of disc seeders under wet conditions.

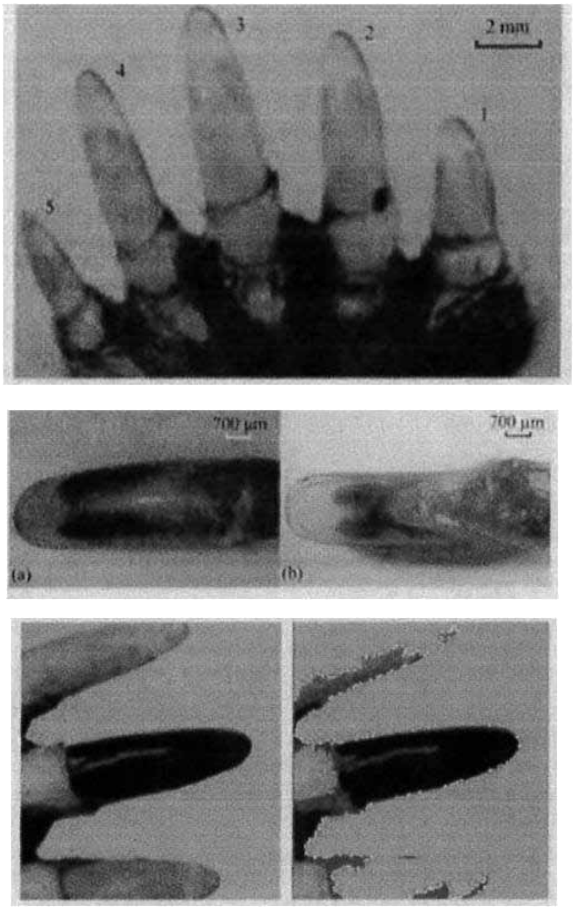


Figure 1: Morphology of fore paw (top); Morphology of toe (middle) and soil extraction process

Bionic addresses the two key issues of the use of disc seeders in wet stick soil conditions.

• The surfaces of the discs may be bionically modified to improve their performance in moist sticky soil conditions without delaying seeding

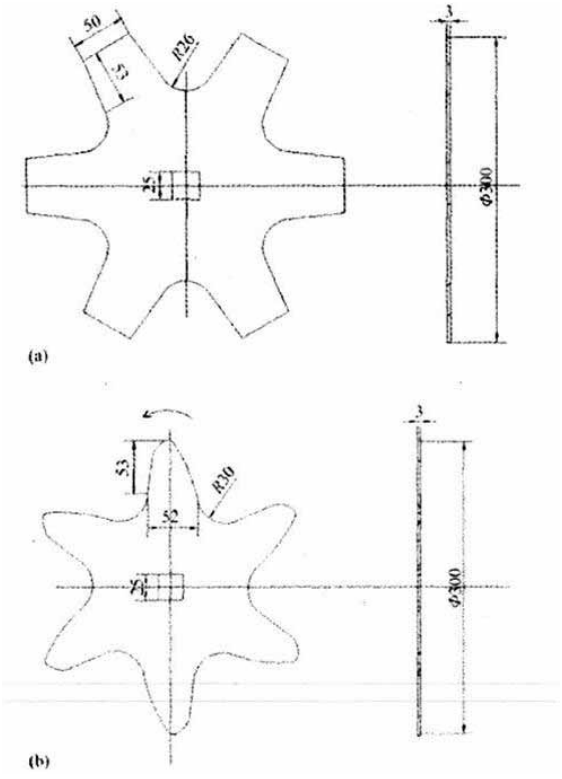
operations, stubble handing and herbicide incorporation

• The simulation of mole rat toe and paw on the surfaces of coulters will improve their stubble cutting and stubble handling abilities of seeders.

Application of bionic modification on the surface of disc improves their cutting, herbicide incorporation and soil scoring ability

The performance of soil cutting tools such as coulters depends on the geometry of cutting blade, soil mechanical properties, soil textures and operation conditions such as forward speed, cutting depth, stubble structure and properties. Disc coulters are used for cutting stubble during sowing. Biomimetic engineering may be used to improve the effectiveness of rotary coulters. This will address one of the major issues of stubble retention and management in conservation farming system.

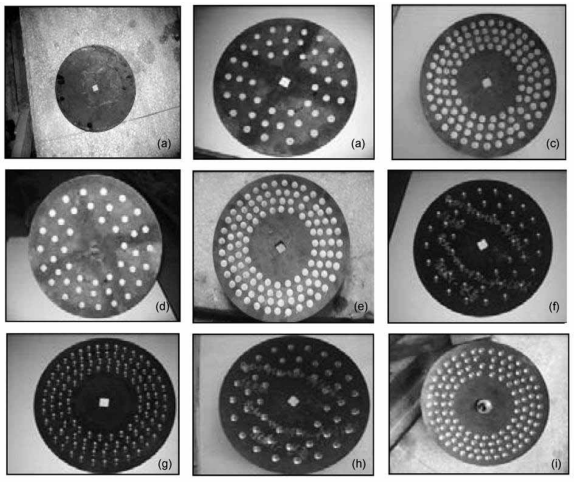
Bionic modification also addresses some of the key issues associated with the use of disc seeders such as handling wet sticky soil,

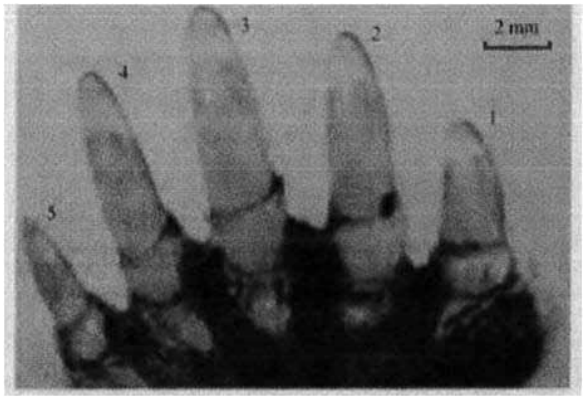


better incorporation of herbicides and handling comparative heavy loads of stubble. Therefore, bionic modifications of the surfaces of the discs proved to be very beneficial for improving their performance in moist sticky soil conditions without delaying seeding operations.

Figure 2: Conventional and bionic discs

• The simulation of mole rat toe and paw on the surfaces of coulters will improve their stubble cutting and stubble handling abilities of seeders.



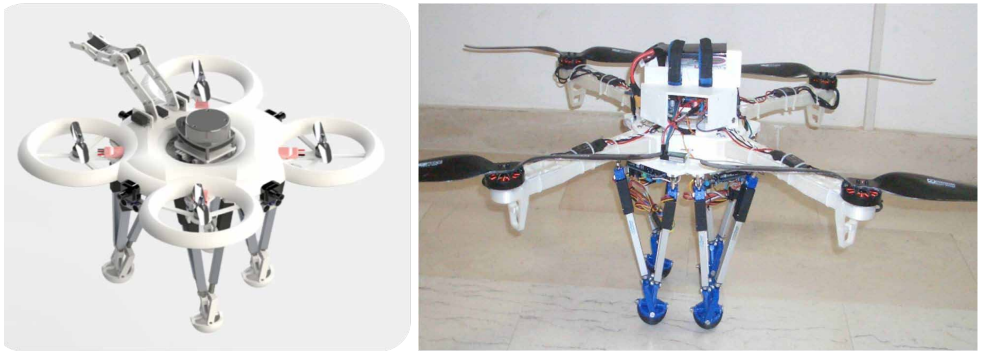


Combination of unsmoothed and stubble star design will address both issues of improving herbicide incorporation and soil scouring properties of disc seeders.

Heritagebot Platform for applications in Cultural Heritage frames

Marco Ceccarelli, LARM: lab of Robotics and Mechatronics, Cassino University, Cassino, Italy

In Cassino, Italy, a region funded project has led to the design and construction of a robot as a platform for servicing in Cultural Heritage frames such as inspection, monitoring, survey, restauration and tec. The Heritagebot Platform is the result of a two-year project (http://heritagebot.unicas.it/) with multi-disciplinary collaboration from the areas of Cultural Heritage studies (DART), Robotics (LARM), Economy and Entrepreneurship (IMPRENDILAB) and Finance exploitation (FINLAB). The prototype in Fig.1 is the final version of the design that has been developed by LARM team mainly in collaboration with DART team. The structure is based on a full integration of a locomotor module with four legs with a drone module with four helices that give the possibility of walking in any environment with careful ground interaction and small flight to overpass obstacles and increase the payload in floating mode. The platform is designed in a modular architecture not only to adjust the motion modules to the application task and its frames but also to host any equipment necessary for the desired target. The design is inspired by natural architectures of insects with legs and wings giving them high performance in mobility and load transportation.



a) b)

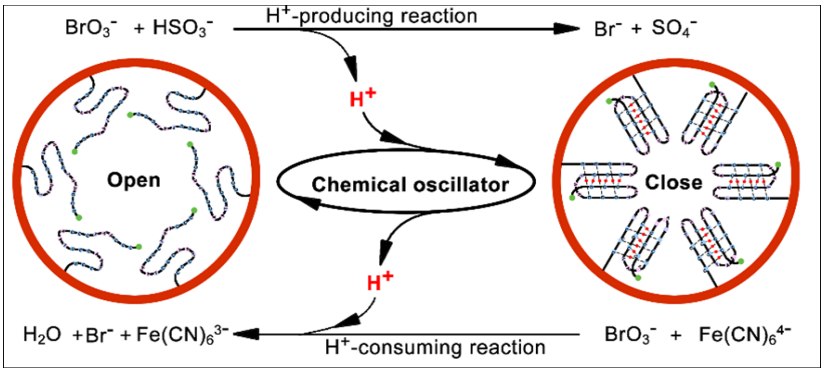
Fig.1 The Heritagebot Platform for applications in Cultural Heritage frames: a) a CAD design; b) a prototype

The article entitled “Oscillatory Reaction Induced Periodic C-Quadruplex DNA Gating of Artificial IonChannels” was published in ACS Nano

Jian WANG, Technical Institute of Physics and Chemistry, Chinese Academy of Sciences

Recently, inspired by functional biological ion channel systems, Prof. Lei Jiang’s team in Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, reported a novel approach that integrates a chemical oscillator into a synthetic proton-sensitive nanochannel modified with C-quadruplex (C4) DNA motors.

The artificial self-oscillating nanochannel system that can autonomously and periodically control its gating process under constant conditions. The chemical oscillator, containing H+-producing and H+-consuming reactions, can cyclically drive conformational changes of the



C4 DNA motors on the channel wall between random coil and folded i-motif structures, thus leading to autonomous gating of the nanochannel between open and closed states. The autonomous gating processes are confirmed by periodic high-low ionic current oscillations of the channel monitored under constant reaction conditions. The utilization of a chemical oscillator integrated with DNA molecules represents a method to directly convert chemical energy of oscillating reactions to kinetic energy of conformational changes of the artificial nanochannels and even to achieve diverse autonomous gating functions in artificial nanofluidic devices.

Paper: http://pubs.acs.org/doi/abs/10.1021/acsnano.6b08727

Analysis of kinematic parameters of goats walking on different slopes

Fu ZHANG, Yafei WANG, HAUST, China

Small agricultural machinery is easy to dump Biomimetic walking mechanisms is of great strategic significance in accelerating the development of farm machinery and equipment that is suitable for hilly and mountainous areas and in promoting the development of agricultural equipment. The walking mechanism is a type of robot that can imitate the movement of animals. To study the motion parameters of goat at different slopes within the walking mechanics, a comparative analysis of the motion parameters of a goat on different slopes was conducted in this research.

In order to get the goat's walking sequence on different slopes, a high-speed camera system is used in this test (see Fig.1). Considering the horizontal displacement of 0.8–0.9m as an example, the centroid change curve of the goat walking on different slopes is presented (see Fig.2). The speed and acceleration of the goat on different slopes are presented (see Fig.3). When the goat walks on different slopes, the fluctuation range of the centroid with a displacement range of 0.079–0.59 and the rate range of 0.4–2.2 m/s. the goat walking on the slope with a rate of change ranging from 0.4–2.2 m/s as the slope increases and the absolute value of goat acceleration decreases.

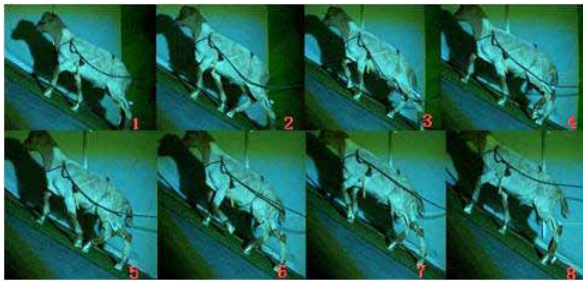
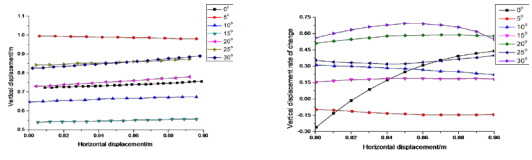


Fig.1 The goat's walking sequenceon a 30°slope



a b

Fig.2 Change curve of goat on different slopes

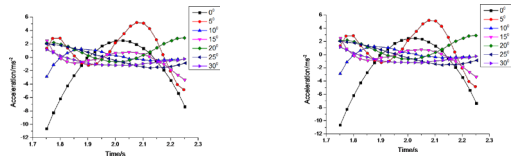


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Fig.3 Change curve of velocity and acceleration of goat on different slopes

THEME: Inspiring Bionic Innovations

SPONSOR: International Society of Bionic Engineering (ISBE)

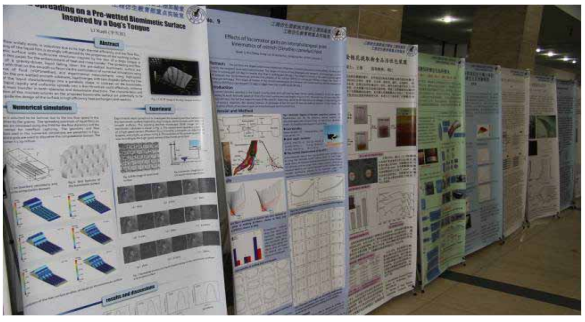
ORGANIZERS:

Youth Commission of ISBE

Journal of Bionic Engineering

Key Laboratory of Bionic Engineering, Jilin University

National-Local Joint Engineering Laboratory of Bionic Engineering, Jilin University



WINNING PRIZE:

Grand Prizes:

Premier Prizes: 3 persons, RMB 5,000 and a Certificate.

Secondary Prizes: 10 persons, RMB 3,000 and a Certificate.

Tertiary Prizes: 20 persons, RMB 1,000 and a Certificate.

Special Awards:

The Best Design Awards: 5 persons, RMB 500 for each and a Certificate.

The Best Creativity Awards: 5 persons, RMB 500 for each and a Certificate.

The Best Popularity Awards: 5 persons, RMB 500 for each and a Certificate.

CONTACT: Dr. Jie ZHAO office@isbe-online.org

Welcome to join us to submit your innovative works *http://tgxt.isbe-online.org*

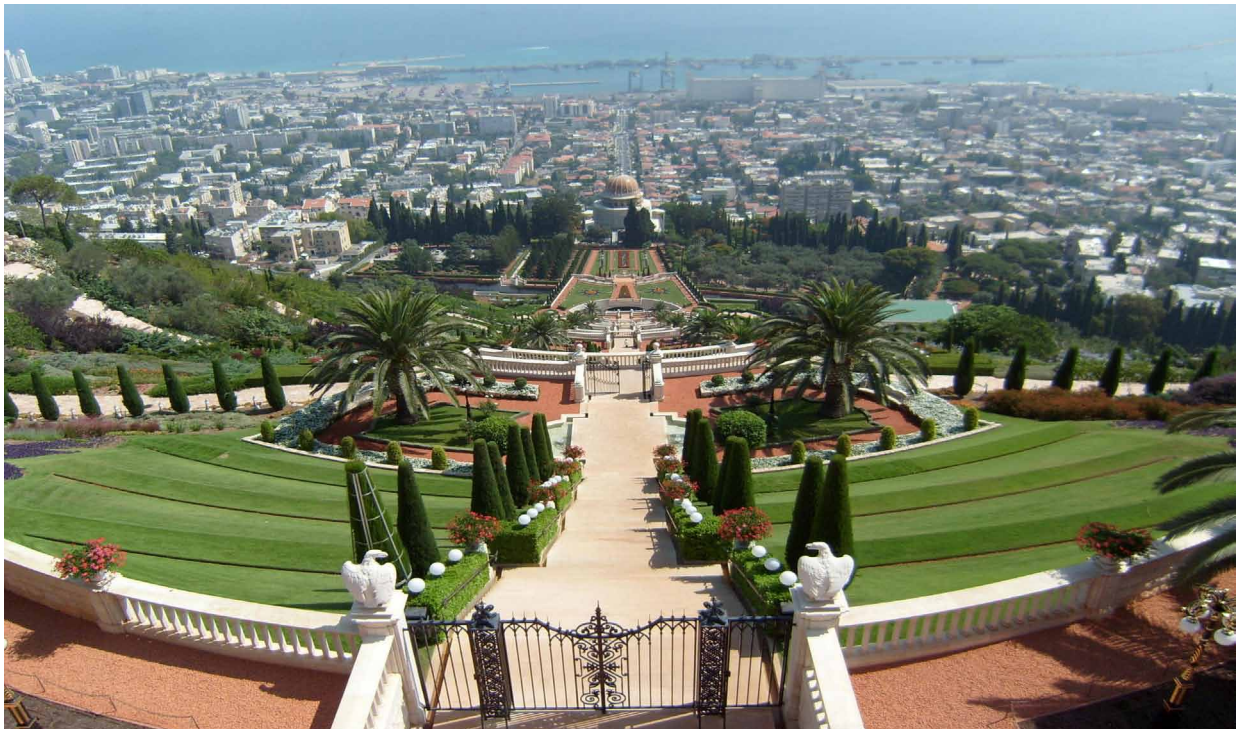
ISTVS 10th Asia-Pacific Regional Conference

The conference is organized by the International Society for Terrain-Vehicle Sytems(ISTVS), ISBE will organize a Bionics Session at the Conference. For more Information, please visit http://www.istvs.org/conferences-2016-2017/

2018 International Workshop on Bionic Engineering (IWBE2018)

2018, Haifa, Israel

Organizers: International Society of Bionic Engineering
Technion-Israel Institute of Technology



2018 ASABE Annual International Meeting

Date: Jul 29 - Aug 1 2018

Location: Cobo Center, Detroit, Michigan USA

Welcome to the Session: Machinery Systems-Bionics Engineering for Agricultural Automated Systems

Description: Bionics is the collection of biological methods and systems used in engineering and new technology. This session aims to share the bionics ideas in the wide fields of energy conversion and agricultural engineering dedicating to energy saving and rural development.

For more information, please visit http://www.asabemeetings.org/

Conference Aims and Objectives

The ICBMST 2018: 20th International Conference on Biomimetic Materials Sciences and Technologies aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Biomimetic Materials Sciences and Technologies. 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 Biomimetic Materials Sciences and Technologies

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 Biomimetic Materials Sciences and Technologies 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.

Important Dates

Abstracts/Full-Text Paper Submission Deadline	February 3, 2018
Notification of Acceptance/Rejection	July 3, 2018
Final Paper (Camera Ready) Submission & Early Bird Registration Deadline	August 3, 2018
Conference Dates	December 6 - 7, 2018

More information please visit https://waset.org/conference/2018/12/new-york/ICBMST

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