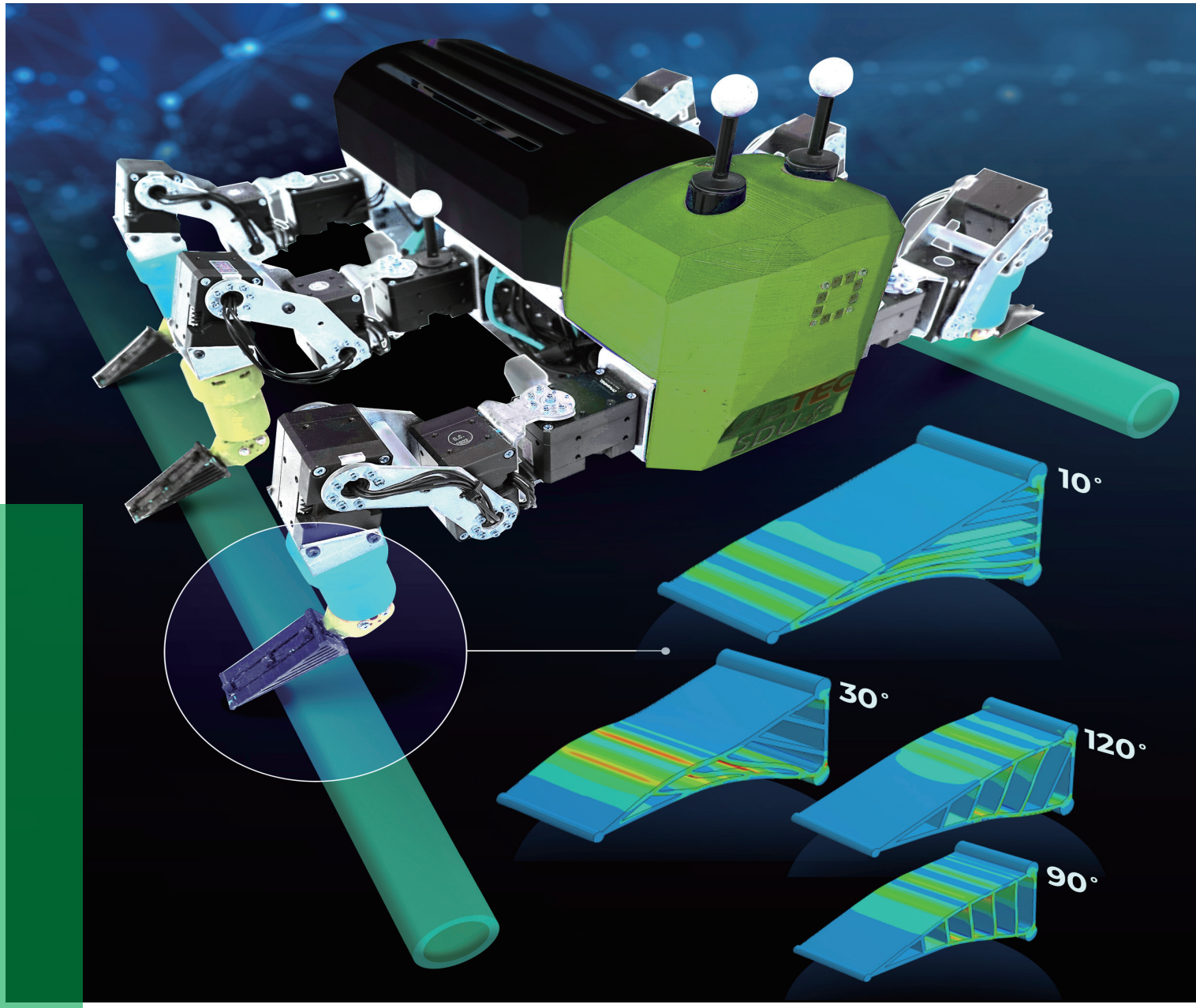
NEWSLETTER

International Society of Bionic Engineering

Volume 11, Issue 1, 2022



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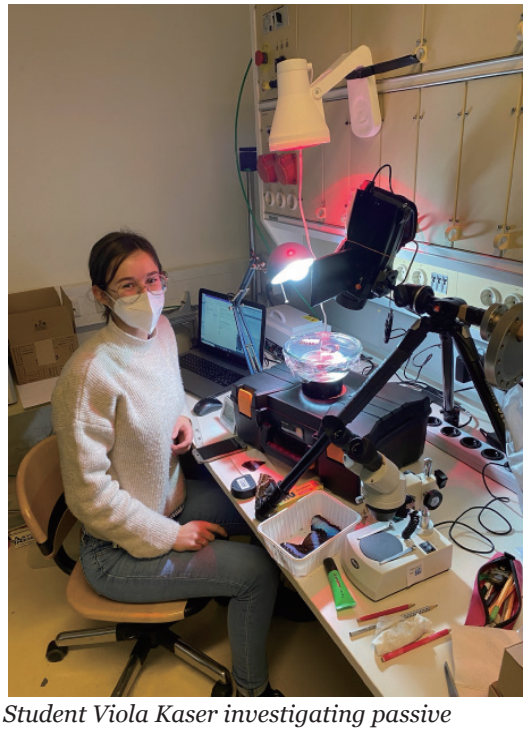
Cover Photo: Insect-inspired Robot Foot Design for Energy-Efficient Robot Locomotion, cover © Poramate Manoonpong.

Ille C. Gebeshuber

Institute of Applied Physics, Vienna University of Technology

Ille C. Gebeshuber is Associate Professor at the Institute of Applied Physics at the Vienna University of Technology, Austria, Europe, where she also graduated and completed her Ph.D. in the technical sciences. In 1999, she undertook postdoctoral training in scanning probe microscopy and biomimetics at the University of California, Santa Barbara, CA, USA, and soon after she returned to Austria to her home university, working on ion surface interactions, tribology and (bio-) nanotechnology. From 2009 to 2015, she joined the Institute of Microengineering and Nanoelectronics at the National University of Malaysia as Professor.



Student Viola Kaser investigating passive radiative cooling properties of tropical butterfly wings.

During her expeditions, together with students and scientific colleagues from culturally diverse backgrounds and expertise, she learned from the rainforest how one can identify well-adapted structures, materials and processes in living Nature. This inspired her to apply abstracted biological principles for solving technological problems for humans to face major challenges in a safe and sustainable way. In 2017, she was elected Austrian of the Year in the category “Research”. Her research focuses on nanotechnology and biomimetics, and takes a multidisciplinary approach, from biology and engineering to the fine arts and the social sciences. Science outreach and mentoring young talent in Europe and in Asia are important to her. Her public science books on solutions from the rainforest and their impact

Ready to explore the rainforest in Tanjung Tuan in Malaysia with pupils from various local schools.

development of a finite element model for the biomimetic optimization of stretch foils. The goal of the antibacterial structure research is to develop functional surfaces against multidrug-resistant bacteria, that can be used on door handles, wall coatings and surgical instruments. The butterfly research shall inspire façade paints as well as coatings for computer parts and spacecrafts that have passive radiative cooling as functional principle, replacing inadequate out-of-date current technologies. The research on the stretch foils is embedded in the "Production of the Future" research, technology and innovation initiative of the Austrian federal ministry for climate action, environment, energy, mobility, innovation and technology. The objective is to reduce the use of stretch wrap based on fossil raw materials for packaging and securing of load carriers by 30 % by 2025 compared to 2016.

Ille C. Gebeshuber is a founding member of the ISBE, and a global advocate of biomimetics. on the future of humankind are widely read.

Under her guidance students investigate diverse themes such as the development of antibacterial structures inspired by cicada wings, passive radiative cooling inspired by tropical butterflies, the experimental investigation of bio-based plastic films and the

Science outreach 2022 in the German Museum in Munich, the world's largest museum of science and technology.

Zhihui Zhang

***General Secretary of the ISBE**

***Chairman of Technical Committee Biomimetics at ISO (ISO/TC 266)**

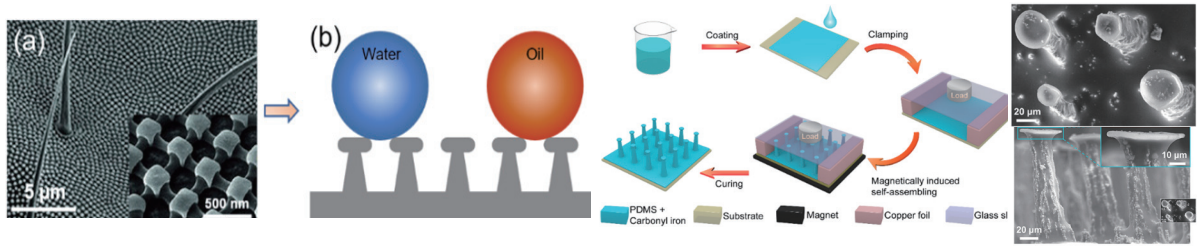
***Professor of Jilin University, China**

Zhihui Zhang is a professor at the Key Laboratory of Bionic Engineering of Ministry of Education, Jilin University. He is a winner of the National Science Fund for Distinguished Young Scholar. Prof. Zhang received his PhD degree in Materials Processing Engineering from Jilin University in 2007. Afterwards, he was selected as associate professor of Jilin University. As a visiting scholar, he had worked in the University of Manchester in 2014, and then was granted as a professor in the key lab.

Prof. Zhang's representative research including the following three aspects: design, preparation and tribology study of bionic functional surfaces; bionic additive manufacturing, and bionic prevention and repairing techniques of mechanical surfaces as shown in the following figures.

During the past years, he has successively presided over 15 national projects, including National Key R&D Program, Key Program of National Natural Science Foundation, National 863 Plan, etc. Prof. Zhang has been honored with various awards and prizes, e.g. the second prize of the “State Technological Invention Award” and the first prize of the “Science and Technology Award of Jilin Province”. He has published

Multistimuli-responsive microstructured superamphiphobic surfaces with large-range, reversible switchable wettability for oil inspired by the re-entrant structures of springtails.



Zhang ZH et al., ACS appl. Mater. Interfaces, 2019, (11): 28478.

Fabricated surface

Figure 1: Based on bionic prototypes, carrying out the researches concentrated on the theory and technol- ogy of bionic tribology, dedicated to excellent drag reduction, wear resistance, fatigue resistance and anti-erosion properties

nearly 120 papers in international academic journals, and authorized more than 30 national invention patents.

Prof. Zhang is currently the director of the national international science and technology cooperation base of bionic engineering and vice dean of the College of Biological and Agricultural Engineering in Jilin University, while serving as the Chairman of the Technical Committee Biomimetics at ISO (ISO/TC 266) and General Secretary of the International Society of Bionic Engineering (ISBE).

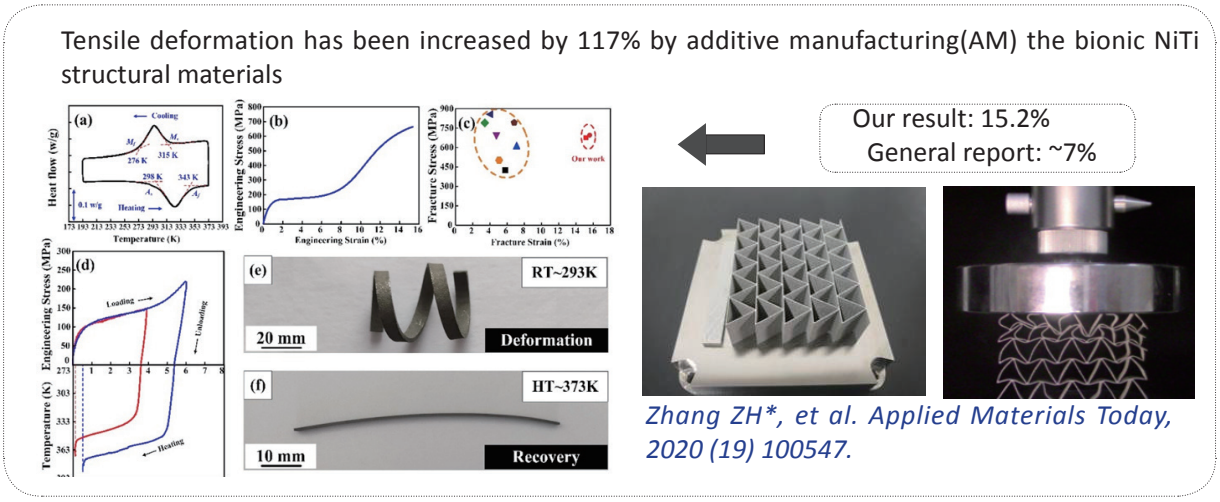
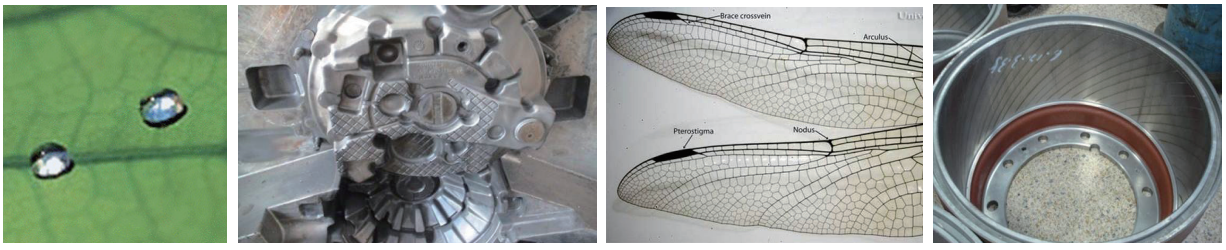


Figure 2. Based on bionic prototypes and bionic coupling theory, he engages in researches of bionic structure design and additive manufacturing for the metallic materials, intelligent materials, etc. to gain special functions and desired performances.



Self-cleaning ability of lotus leaf | Bionic anti-adhesion mold | Veins of dragonfly wings | Bionic anti-adhesion mold

Figure 3. To solve the problems of unsatisfied wear and fatigue resistance of metals, bionic anti-wear and anti-fatigue techniques were developed.

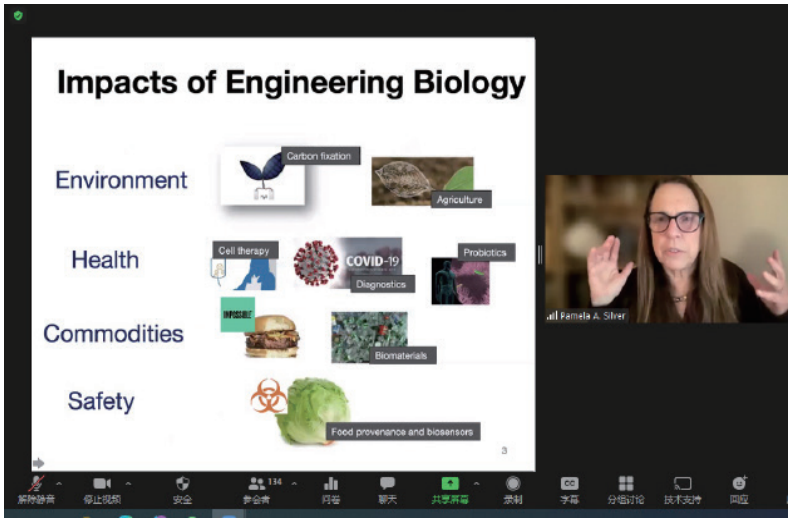
Call for Newsletter Submissions

ISBE Secretariat is always calling for news and ideas among our members, if there is any information you would like to include in a future edition of newsletter, please feel free to contact us.

Email: gyue@isbe-online.org Tel/ Fax: +86-431-85166507

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

The Fourth Online Academic Forum on "Frontiers in Bionic Engineering"

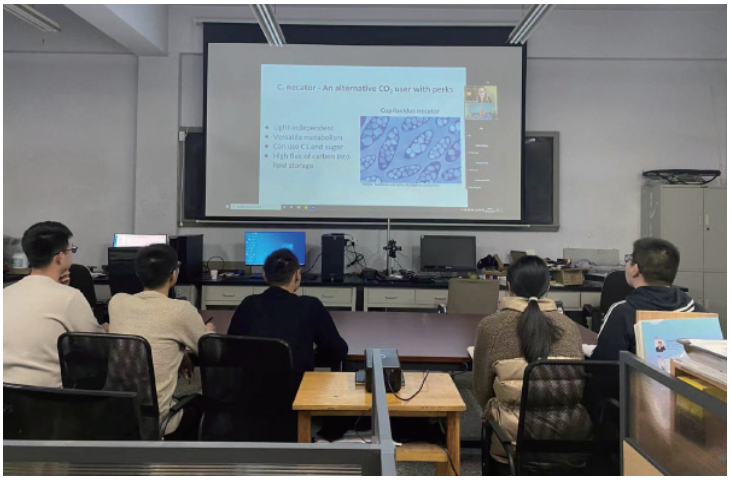


On 10th December, the Fourth Online Academic Forum on "Frontiers in Bionic Engineering" was successfully held via a Zoom conference, which was hosted by the International Society of Bionic Engineering (ISBE), the Bionic Science and Engineering Institute of Jilin University and the International Collaboration Center of Bionic Sci-Tech at Weihai Institute for Bionics-Jilin University. Prof. Pamela A. Silver from Harvard Medical School and the Wyss Institute for Biologically Inspired Engineering at Harvard University was invited to share the latest research progress of her group in the field of designing biology for health and sustainability. The forum was presided over by Prof. Zhenning Liu, Dean of the Bionic Sciences and Engineering Institute of Jilin University.

The engineering of biology presents infinite opportunities for therapeutic design, diagnosis, prevention of disease and solutions to environmental problems. Inspired by photosynthesis in nature, Prof. Pamela A. Silver and her team had developed an efficient artificial photosynthesis system based on a new Co-P catalyst for water splitting, which was cultured with the bacteria Ralstonia eutropha. The conversion efficiency of this artificial system is much higher than that of natural photosynthesis. This type of "bionic leaf" may start a new "green revolution", which is expected to solve the long-existing energy problem, so as to realize the sustainable development of human society.

Nearly 200 scholars and graduate students from over 50 universities and research institutes around the world attended the forum online.

"Frontiers in Bionic Engineering" online academic forum is a series of academic activities initiated by the Youth Commission of the ISBE. It aims to establish an academic exchange platform for scholars in bionics around the world to share their latest research ideas and achievement and further promote the innovation cooperation as well as the development of bionic science. The activity has gained great attention and support of specialists, scholars and graduate students, and received enthusiastic responses.



International Society of Bionic Engineering

2022 International Bionic Engineering Award

The ISBE offers International Bionic Engineering Award at each triennial conference to honour and encourage the society members for their prominent contributions and achievements in the field of bionic engineering.

The Award includes three categories:

1) Outstanding Contribution Award: Two winners, each one will be awarded 30,000 RMB;

2) Outstanding Youth Award: Two winners aged under 40 years old, and each one will be awarded 10,000 RMB.

3) Outstanding Student Award: Two winners aged under 30 years old, and each one will be awarded 5,000 RMB.

Qualifications

1) Outstanding Contribution Award and Outstanding Youth Award:

a. The winners shall have contributed remarkable research achievements in bionic engineering;

b. The winners shall have made great progress in scientific research, community service, technology transfer, etc in bionic engineering;

c. The winners shall have made a prominent contribution to the promotion of science and technology, international communication and collaboration, etc in bionic engineering.

2) Outstanding Student Award:

a. The winners shall be the students majored in a bionic academic discipline;

b. The winners shall show outstanding scientific and research qualities;

c. The winners shall have made remarkable research achievements in bionic engineering.

Now nominations are invited for this Award, and there are three methods of nominating candidates:

1) Self-recommendation;

2) Recommended by another member;

3) Recommended by a group of colleagues.

Common ways of submitting nominations are e-mail (xmtian@isbe-online.org or secretariat@isbe-online.org). **The deadline for submission of nominations is April 30, 2022**, unless otherwise indicated.

More Information: https://www.isbe-online.org/?ui=english&mod=info&act=view&id=4550

Call for Nominations for the Fellow Members of ISBE

The fellow members of ISBE refer to those who have made great achievements in the field of bionic engineering and made significant contributions to the development of the Society. The ISBE carried out the evaluation of fellow members respectively in 2014 & 2019, and 10 individual members in total have been selected as fellows.

Nominations for Fellow Members in 2022 are now being accepted!

Qualifications:

1) The candidate will have been a member of the ISBE for *at least three years.*
2) The candidate will have promoted the development of bionic engineering and shall have contributed significantly to the advancement or application of bionic engineering.
3) The candidate will have taken an active role in the activities of the ISBE and will have made significant contributions to the development of the ISBE.

Nomination methods:

a) Self-nomination:

Any Ordinary Member is eligible to nominate his/her self for Fellowship of the ISBE, and must have two (2) supporting nominators.

b) Nomination by others:

Three (3) Ordinary Members of the ISBE may recommend a candidate for Fellowship, and explanatory materials for recommendation also need to be provided.

The Members shall submit the Fellowship Application Form together with the recommendation letters to the ISBE Secretariat. The Executive Board of Directors is in charge of the evaluation, and the final result will be announced on the official website and Newsletter of the ISBE.

The ISBE will present the Certificate of Fellowship to the successful candidate at the opening ceremony of ICBE 2022 (September 15-18, 2022, Wuhan, P. R. China).

- ✓ The Application Form can be downloaded from the ISBE website: https://isbe-online.org/?ui=english&mod=info&act=view&id=4481
- ✓ Common way of submitting nominations is e-mail : xmtian@isbe-online.org
- ✓ The deadline for submission of nominations is **April 30, 2022**, unless otherwise indicated.

Introduction to the *Journal of Bionic Engineering* (JBE)

The *Journal of Bionic Engineering* (JBE) is a single-blind peer-reviewed journal that publishes original research papers and reviews that apply the knowledge learned from nature and biological systems to solve real engineering problems. The topics that JBE covers include but are not limited to:

(1) Mechanisms, kinematical mechanics and control of animal locomotion, development of mobile robots with walking (running and crawling), swimming or flying abilities inspired by animal locomotion.

(2) Structures, morphologies, composition and physical properties of natural and biomaterials; fabrication of new materials mimicking the properties and functions of natural and biomaterials.

(3) Biomedical materials, artificial organs and tissue engineering for medical applications and rehabilitation equipment.

(4) Development of bioinspired computation methods and artificial intelligence for engineering applications.

JBE aims to provide a platform for the communication and dissemination of scientific knowledge and novel ideas in the field of bionic science and engineering.

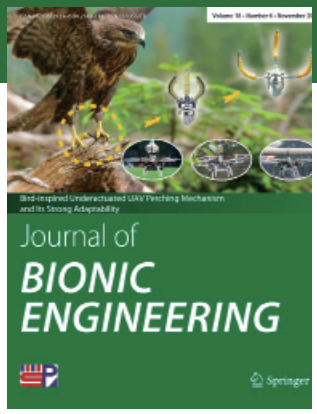
(1) Applies insight from nature and biological systems to solve bionic engineering challenges

(2) Offers research on kinematical mechanics and control of animal locomotion

(3) Explores bioinspired computation methods and artificial intelligence

Video Abstract of issue 6: https://mp.weixin.qq.com/s/Q07djzQkRXRJsR5uPpFWDw

Journal's website: https://www.springer.com/journal/42235/



Journal of Bionic Engineering

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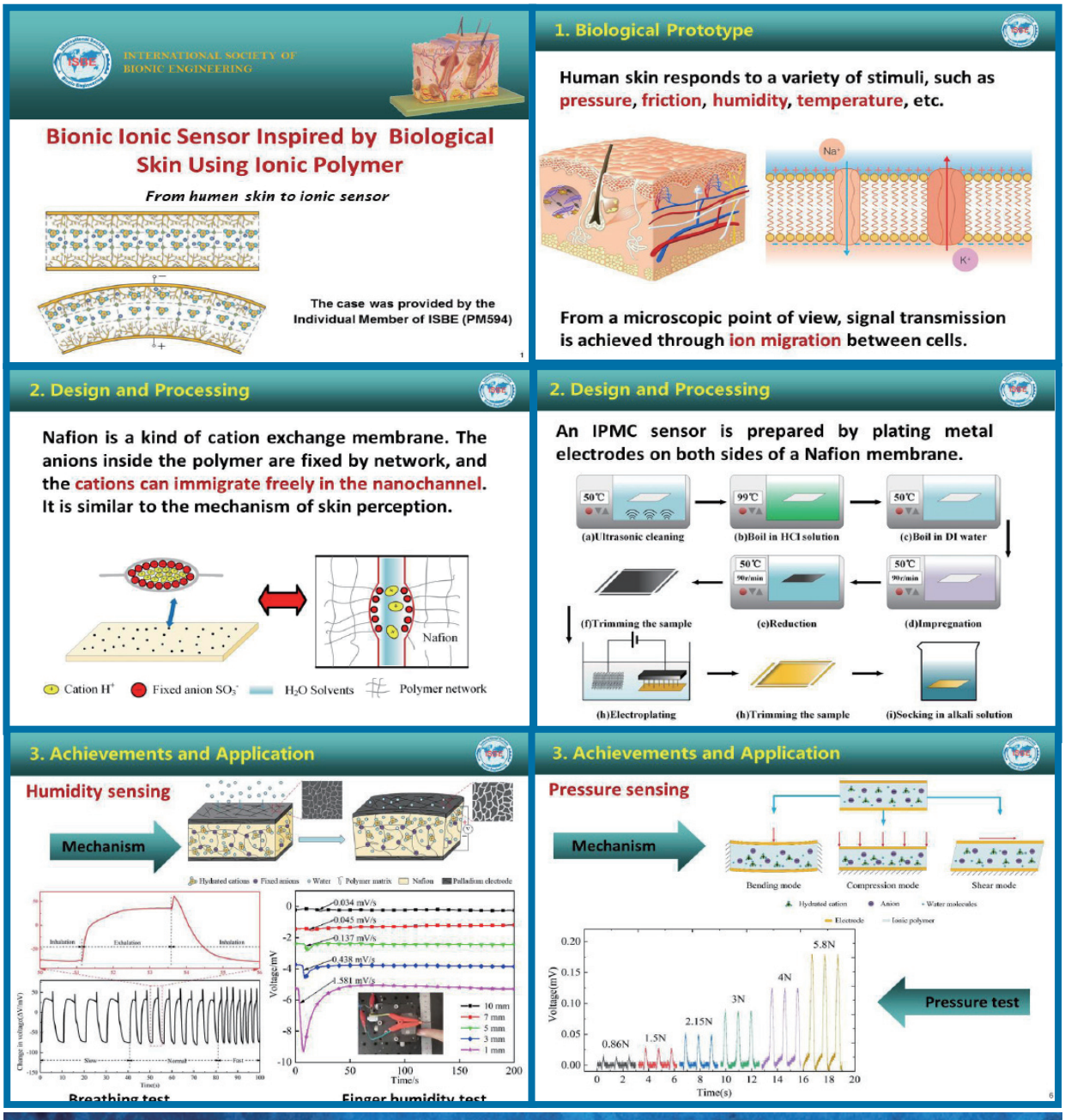
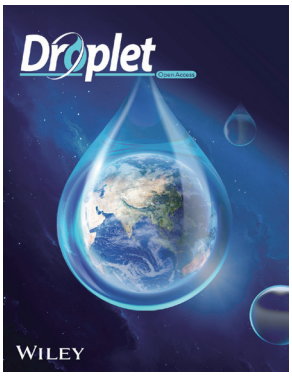
Case Study at ISBE Website



Call for Case Study Submissions

ISBE is calling for case study submissions now.
You can contact Ximei Tian for the template of case study. Your kindness and consideration will be appreciated.We look forward to receiving your submissions!
Email: xmtian@isbe-online.org
Tel: +86-431-85166507

Call for Papers – Droplet (Wiley)



Droplet is a peer-reviewed international and cross-disciplinary open access journal to publish reviews, research papers, and editorials that involve droplets, bubbles and related topics. The journal covers the design, synthesis, fabrication, characterization, manipulation, control, application and commercialization of structures, devices and systems that involve droplets and related objects from microscopic to macroscopic scales.

Droplet aims to provide an excellent platform for the dissemination of the cutting-edge research results in the general area of droplet & bubble. All manuscripts are subject to critical, anonymous peer review.

Why publish in Droplet?

• *First journal to fully devote to research on droplets/bubbles.*

• *Droplet will be an important platform for researchers in the 'Droplets/bubbles' related research fields including Physics, Chemistry, Engineering, Materials Science, Bionics, and Biology and others. It will provide a hub for high-level academic communications by connecting researchers all over the world.*

• *Benefit from a diverse and esteemed editorial board. All members are internationally active and renowned experts in this field.*

• *Open access means that your research will be available online to everyone, resulting in more shares, downloads, and citations.*

• *Publish your research at no direct cost to you. All APCs are waived until 2025.*

Editors-in-Chief

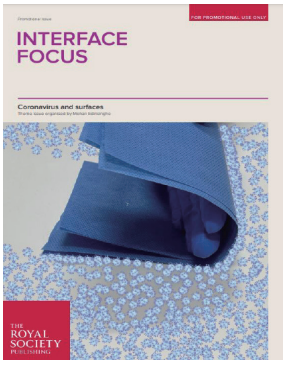
Luquan Ren, Jilin University, China

Chang-Jin "CJ" Kim, University of California, Los Angeles (UCLA), USA

Submission online: https://mc.manuscriptcentral.com/droplet

Journal website: https://onlinelibrary.wiley.com/journal/27314375

Welcome to visit the special issue of Interface Focus - Coronavirus and surfaces



Royal Society Publishing has recently published a special issue of Interface Focus entitled Coronavirus and surfaces organised by Mohan Edirisinghe. The articles can be accessed directly at https://royalsocietypublishing.org/toc/rsfs/2022/12/1 There is also a blog post at https://royalsociety.org/blog/2021/12/coronavirus-and-surfaces/

This issue highlights the role of different surfaces in the transmission of the SARS-CoV-2 virus. It has been discovered that the virus can linger on surfaces for a very long time, helping facilitate transfer between people when surfaces are touched. The papers in the special issue shed light on how long the virus can survive on different surfaces and whether we can we use this information to tailor surface properties. A Headline Review on "Surface interactions and viability of coronaviruses" in the Journal of The Royal Society Interface in January 2021 will go hand-in-hand with the content of this special issue in defining the materials and products that should be used.

Insect-inspired Robot Foot Design for Energy-Efficient Robot Locomotion

Poramate Manoonpong[1,2*], Hamed Rajabi[3,4], Jørgen C. Larsen[1], Seyed S. Raoufi[5], Naris Asawalertsak[2], Jettanan Homchanthanakul[2], Halvor T. Tramsen[3], Abolfazl Darvizeh[5], Stanislav N. Gorb[3]

[1]Embodied AI & Neurorobotics Lab, SDU Biorobotics, The Mærsk Mc-Kinney Møller Institute, University of Southern Denmark, Odense, Denmark

[2]Bio-inspired Robotics & Neural Engineering Lab, School of Information Science & Technology, Vidyasirimedhi Institute of Science and Technology, Rayong, Thailand

[3]Department of Functional Morphology and Biomechanics, Zoological Institute, Kiel University, Kiel, Germany

[4]Division of Mechanical Engineering and Design School of Engineering, London South Bank University, London, UK

[5]Department of Mechanical Engineering Islamic Azad University, Bandar-e-Anzali, Iran

The achievement, performed by an international research team from University of Southern Denmark, Christian-Albrechts-Universität zu Kiel, London South Bank University, Islamic Azad University, and Vidyasirimedhi Institute of Science and Technology, introduces insect-inspired robot technology that breaks with 25-year-old gripping technology - the result is creating international attention. They use an integrative approach, combining 3D printing with soft material, finite element modeling, and neural control, to 1) manufacture the insect-inspired robot foot/gripper structure with compliance; 2) investigate the effect of the structure under different inner crossbeam angles, different loads, and different cylindrical substrates; and 3) finally demonstrate the use of the novel insect-inspired structure as robot feet for energy-efficient on-pipe locomotion and as robot grippers for fragile object grasping (see, a video of the robot experiments at https://www.youtube.com/watch?v=QtEAR1LyBp4&t=5s)

The information of this study is also available at Advanced Science News, https://www.advancedsciencenews.com/insects-help-robots-gain-better-grip/

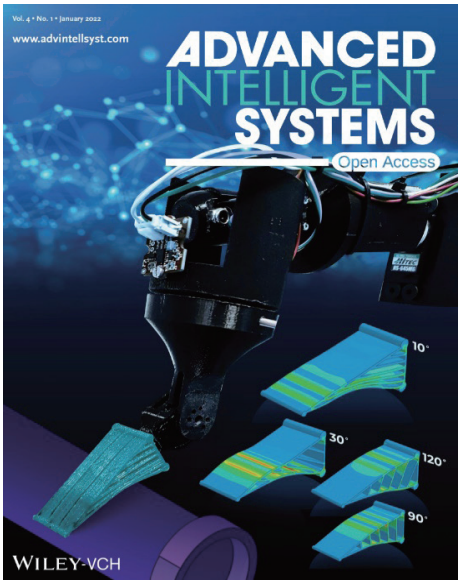


Figure 1: Among other crossbeam angles, the Fin Ray model with nonstandard 10°-inclined crossbeams has a greater contact area to a curved surface and better durability. It can enhance the efficiency of on-pipe robot locomotion. The work has been chosen for the front page of Advanced Intelligent Systems.

The detail content is referred to:

Manoonpong, P., Rajabi, H., Larsen, J.C., Raoufi, S.S., Asawalertsak, N., Homchanthanakul, J., Tramsen, H.T., Darvizeh, A. and Gorb, S.N., 2022. Fin Ray Crossbeam Angles for Efficient Foot Design for Energy - Efficient Robot Locomotion. Advanced Intelligent Systems, 4(1), p.2100133.

Sustainability Assessment of the Anthropogenic System in Panama City: Applying Biomimetic Strategies towards Regenerative Cities

A. Quintero1, M. Zarzavilla[1], N. Tejedor-Flores[1-4], D. Mora [1,3,4] and M. Chen Austin[1,3,4,*]

[1]Research Group Energy and Comfort in Bioclimatic Buildings, Faculty of Mechanical Engineering, Universidad Tecnológica de Panamá, Panama City 0819, Panama;

[2]Centro de Investigaciones Hidráulicas e Hidrotécnicas (CIHH)

[3]Centro de Estudios Multidisciplinarios en Ciencias, Ingeniería y Tecnología (CEMCIT-AIP)

[4]Sistema Nacional de Investigación (SNI)

*miguel.chen@utp.ac.pa

The urban metabolism of Panama's metropolitan area was investigated to understand the sustainability problem. Its current sustainability state was obtained by estimating the Green City Index, leading to identify key related problems. With the abstraction of the identified problems, the biomimetic strategy "problem-based approach" was carried out, where different pinnacles inspired by nature were selected for the design of regenerative solutions. A framework was proposed to take advantage of the regenerative potential in Panama City. Using ecosystem services, a set of indicators were developed to measure regeneration at the city scale. Consequently, a SWOT analysis was realized along with a questionnaire by local experts from different fields, showing that the feasible solutions were: arborization, green facades, solar roofs, e-mobility, green corridors, bicycle lanes, sidewalks, and biofilters. This research represents a step towards creating and developing regenerative cities. For more information see: https://doi.org/10.3390/biomimetics6040064

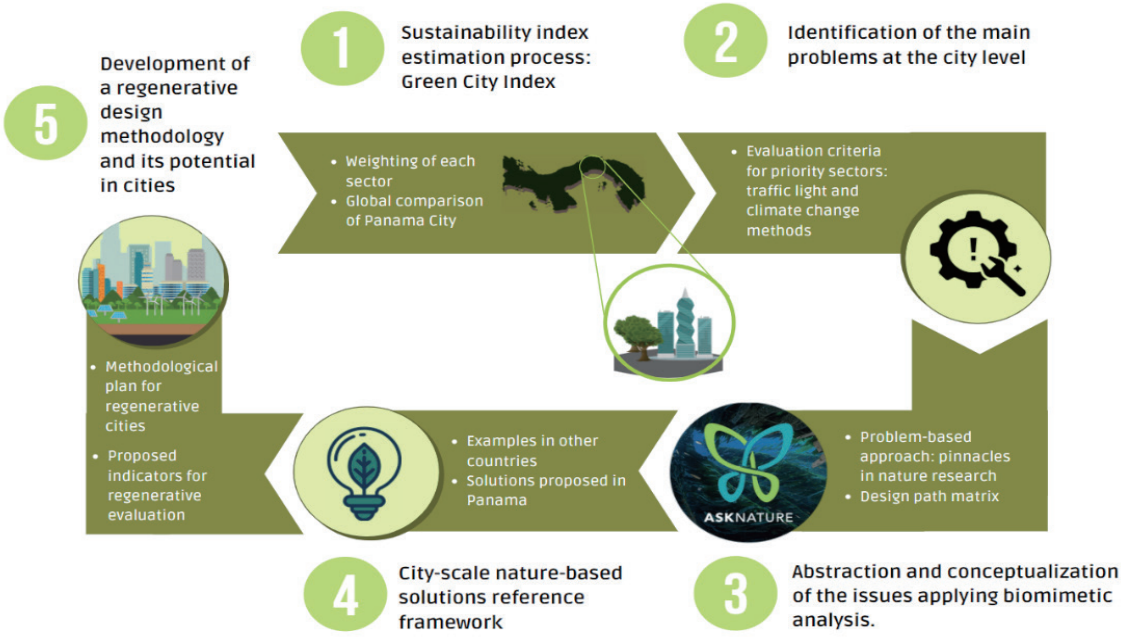


Figure: Overview of the methodology proposed

Enhancement of Dropwise Condensation by Engineering Nano/Micro/Macro Hierarchical Surfaces: Inspiration from Nature for Efficient Water Collection

Yaqi Cheng,[1,2,3] Xuehu Ma,[2] Zuankai Wang[3]

[1]Department of Materials Science and Engineering, National University of Singapore, 117580, Singapore

[2]Institute of Chemical Engineering, Dalian University of Technology, Dalian 116024, China

[3]Department of Mechanical Engineering, City University of Hong Kong, Hong Kong 999077, China

Worldwide water scarcity is becoming a severe threat to the development of human society in recent decades. Over thousands of years, natural species have evolved intriguing features to gather water from dew to cope with limited water supply, providing us some inspiration for high-performance water collection.

In our recent study, dropwise condensation on a micro-nano hierarchically engineered hydrophilic surface was attained by a liquid suction mechanism. The Rhacocarpus-inspired porous surface (RIPS) possesses three-level wettability, which facilitates a rapid, directional, and persistent condensate suction. Consequently, all aspects of advantages such as easy nucleation, frequent droplet removal, and well-defined droplet shedding size were achieved simultaneously.

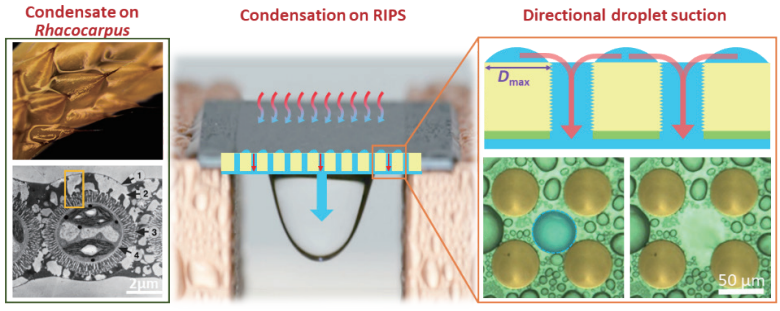


Figure 1: Moss Rhacocarpus and Rhacocarpus-inspired suction condensation on the micro-nano structured surface RIPS. (https://doi.org/10.1021/acs.nanolett.1c01928)

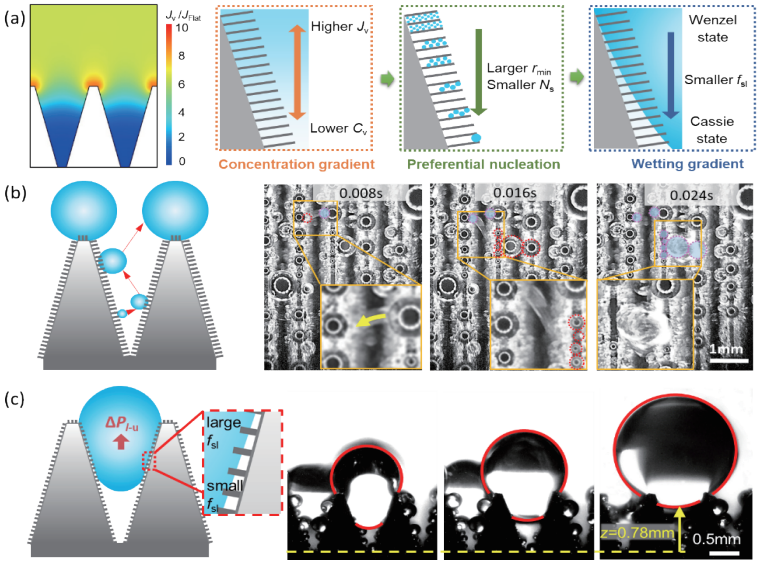


Figure 2: Desert beetle-inspired macro-nano engineered surface for enhancement of water vapor mass transfer, regulation of micro wetting state of condensate and thus droplet dynamic behaviors. (a) Schematic of the mechanism of condensation on macro-nano engineered surface. (b) Droplet jumping relay at small subcoolings. (c) Droplet self-propulsion at large subcoolings. (https://doi.org/10.1063/1.5082727; https://doi.org/10.1016/j.cej.2020.126901)

In addition, millimetric textures inspired by the desert beetles offer another strategy to enhance dropwise condensation. The macro-textured groove arrays promote water vapor mass transfer at the top and prohibit successive nucleation at the bottom. Endowed with such an induced-wetting gradient, small droplets can undergo the relay jumping departure and large droplets exhibit self-propulsion to rapidly detach from the surface.

These work not only to enrich the fundamental understanding of how the hierarchical structure and surface property regulate wetting behaviors, but also provide new design routes for the development of engineered materials towards energy-water nexus applications.

Interdisciplinary Trends: Artificial-Intelligence-Assisted Bio-Inspired Liquid Gating Membrane

Mengchuang Zhang[1,3,4], Yuan Jing[1], Jian Zhang[5], Zhizhi Sheng [6], Yaqi Hou[5], Jiadai Xu[5], Baiyi Chen[5], Jing Liu[5], Miao Wang[2] and Xu Hou [1,2,5,7*]

[1] Department of Physics, Research Institute for Biomimetics and Soft Matter, Fujian Provincial Key Laboratory for Soft Functional Materials Research, Jiujiang Research Institute, College of Physical Science and Technology, Xiamen University, Xiamen 361005, China

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[3] School of Civil Aviation, Northwestern Polytechnical University, Xi'an, 710072, China

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[5] State Key Laboratory of Physical Chemistry of Solid Surfaces, College of Chemistry and Chemical Engineering, Xiamen University, Xiamen 361005, China

[6] Suzhou Institute of Nano-Tech and Nano-Bionics, CAS, Suzhou 215123, China

[7] Innovation Laboratory for Sciences and Technologies of Energy Materials of Fujian Province (IKKEM), Xiamen 361005, China

As a new kind of structural material, liquid gating membrane (LGM) is undergoing continuous development and optimization for different applicable scenarios. To address the long-term high consumption caused by traditional "trial and error", artificial intelligence technology is employed for design and test of LGM, by effectively integrating material structure, composition and performance.

Most recently, Hou group proposed an Active Kriging Machine Learning Method to predict the mechanical and rheological performance of liquid gating system, thus guiding and accelerating the development of LGM. Compared to classical sequential model, which is still restricted by poor selection strategy of training samples, this adaptive approach is focused on local accuracy near the most sensitive search region, minimizing the size of experimental tasks.

Other branches will be also developed to suit for the novel artificial intelligence assisted system, including regression method, neutral networks, support vector machine and clustering algorithm, thus opening up a new platform to design and study bio-inspired liquid gating technology. The result has been published in Interdisciplinary Materials as a cover article of the inaugural issue. For more information, please see https://xuhougroup.xmu.edu.cn/.

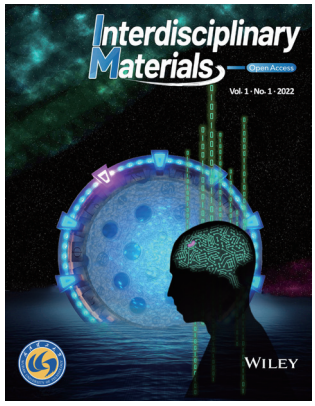

Figure. The cover article of the inaugural issue of Interdisciplinary Materials, which embodies the interdisciplinary concept of artificial-intelligence-assisted bio-inspired liquid gating membrane.

Reference:

M. Zhang, Y. Jing, J. Zhang, et al. Performance Prediction of Magnetorheological Fluid-Based Liquid Gating Membrane by Kriging Machine Learning Method. Interdisciplinary Materials 2022,1,1-13. doi:10.1002/idm2.12005

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X. Hou. Liquid Gating Membrane. National Science Review 2020, 7,14-16.

A novel bio-inspired mechanism to elucidate the movement flexibility of the honeybee abdomen driven by muscles

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Honeybee abdomens exhibit amazing movement flexibility according to different environments after billions of years of evolution. Natural movement flexibility, such as the waggling movement to gather information from food sources, rotating movement to control flight stability, and the swinging movement to dissipate the residual flying energy, is contributed to by cooperation from the abdominal muscle group. Therefore, this intriguing biological advantage has attracted attention and led to research into the movement flexibility mechanism of the honeybee abdomen.

In our study, we revealed the morphological characteristics and the muscle distribution of honeybee abdomen by 3D reconstruction as shown in Fig.1. Considering the similarity of the muscle distribution between two adjacent segments, we obtained the muscle distribution of the muscular driving unit of honeybee abdomen (Fig.2) and we proposed a novel equivalent unit mechanism inspired by it (Fig.3). The extension ratio, bending angle, and swing angle of the equivalent unit mechanism reached 9.36%, 1.22°, and 4.43°, respectively. The deformation ability of the EUM was consistent with the movement of the abdomen (Fig.4), confirming the movement flexibility. This work may provide a new perspective for distributed bionic mechanism design.

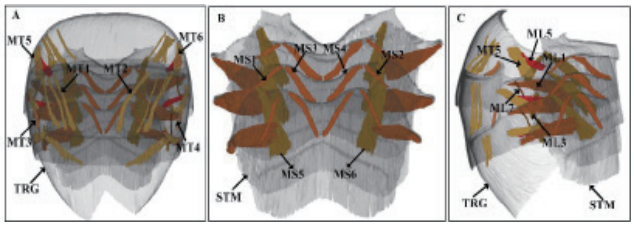

Fig. 1: The morphological characteristics and the muscle distribution of honeybee abdomen by 3D reconstruction. (A)~(C) The muscles distributed on the terga, the sterna and the lateral structures.

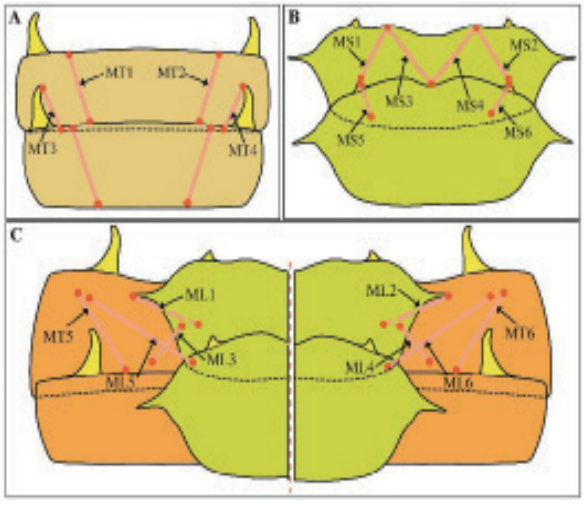

Fig.2: The muscle distribution of the muscular driving unit. (A) The muscle distribution between two adjacent terga; (B) The muscle distribution between two adjacent sterna ; (C) The muscle distribution between the adjacent tergum and sternum.

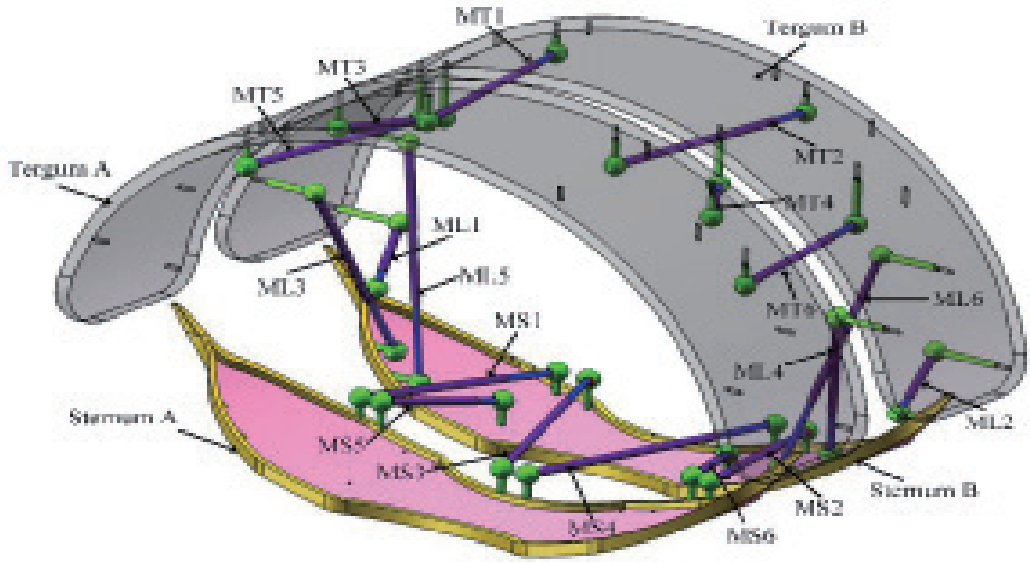

Fig. 3: The equivalent unit mechanism inspired by the muscular driving unit

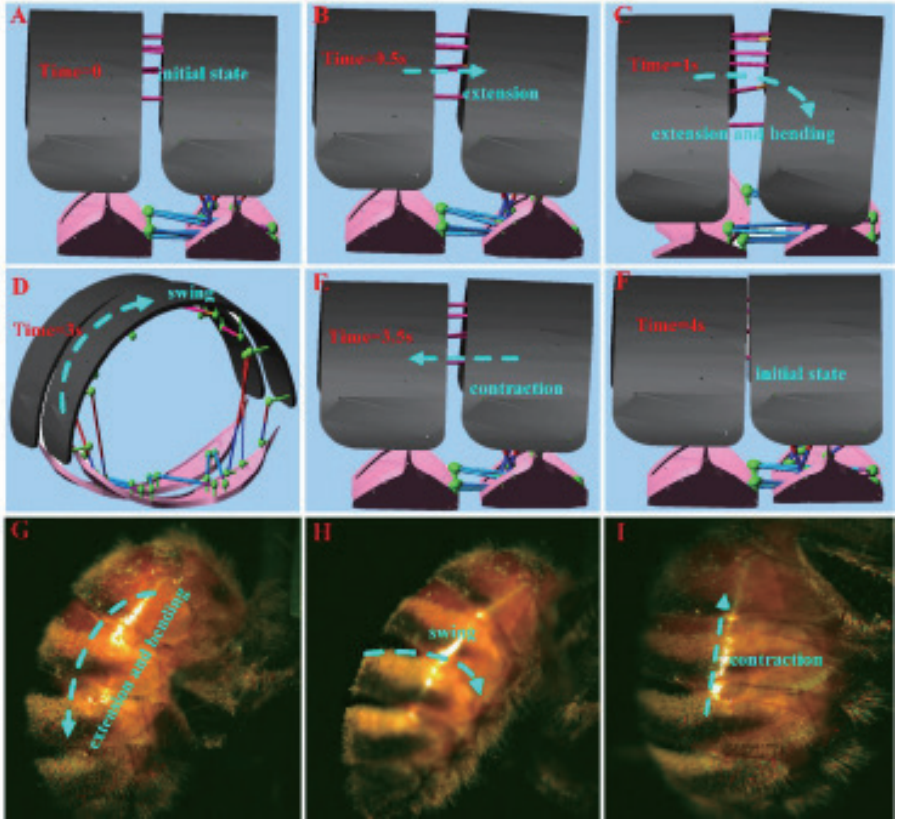

Fig.4: The deformation movement comparison of EUM and honeybee abdomen. (A)~(F) The deformation process of EUM. (G)~(I) The deformation movement of honeybee abdomen.

A Bionic Stratospheric Airship Inspired by *Physalia physalis*

Yueneng Yang, National University of Defense Technology, China

The research work "a bionic stratospheric airship" completed by Associate Professor Yueneng Yang of College of Aerospace Science and Engineering, National University of Defense Technology has been authorized by international invention patent (U.S. patent). In order to solve the key problems of aerodynamic optimization and thermal control of stratospheric airships, an invention is proposed, which provides a bionic stratospheric airship inspired by *Physalia physalis*. Its hull and gasbags are designed via imitation in shape and resemblance in function, respectively. The hull shape is designed by lofting according to the shape of Physalia Physalis. The gasbags include a helium gasbag, two ballonets and a heat regulating gasbag. The helium gasbag provides static lift, the ballonets are used to ascend and descend by exhaust and inflation respectively, and the heat adjusting gasbag is filled with a working medium reversibly regulated between a gas state and a liquid state, which is used to adjust the pressure and temperature of the hull in large range. The invention is applied to design a technical test airship, and the experimental results show that it exhibits good flight performance and effective control capability in terms of buoyancy and pressure.

Fig.2 Flight experiments of the bionic airship

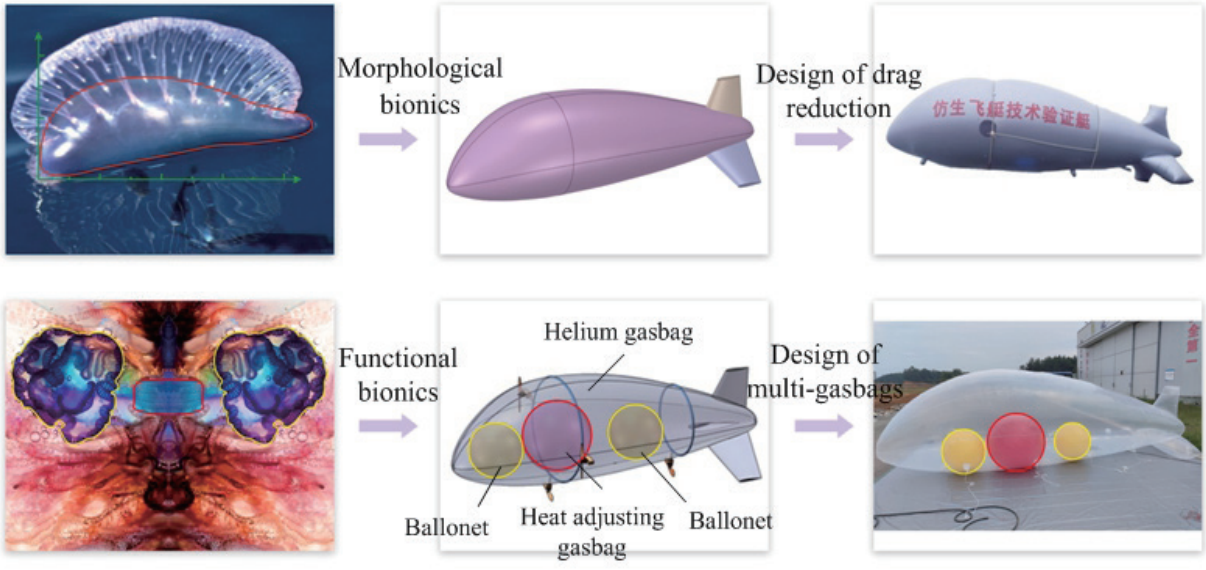

Fig.1 Bionic design process of the airship

The 7th International Conference of Bionic Engineering-ICBE 2022

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Deadline for early-bird registration： July 31, 2022

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- Bionic machinery
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- Biosensors and signal processing
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- Other fields related with bionics

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The submitted papers will be subject to a peer review process in the standard of ARM conference and Robotica Journal. All final accepted papers from submissions to the Robotica Journal will be published in the December Issue of Robotica in 2022.

It is, however, possible that a submitted paper to Robotica is rejected but accepted with the ARM conference option. It will be published in the Conference Proceedings and will be included in the IEEE explore. It should be noted that all accepted papers for both choices must be presented in the 2022 IEEE International Conference on ARM (ARM 2022, www.ieee-arm.org).

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- Intelligent mechatronics, automation, control systems
- Bionic robotics, autonomous and evolutionary robotics
- Modelling of human sensory and motor systems
- Bionic robot navigation, task and motion planning
- Locomotion and manipulation in biological and robot systems
- Teleoperation, tele-robotics, haptics, and semi-autonomous systems
- Robotic systems modeling, optimization, simulation and experiments
- Control system modeling and simulation techniques and methodologies
- AI, intelligent control, neuro-control, fuzzy control and their applications
- Industrial automation, process control, manufacturing process
- Rehabilitation robot system, neuro-robotics, wearable robots

Important Dates

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31 March 2022: **Proposal for tutorials and workshops**
30 April 2022: **Notification of paper and session acceptance**
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