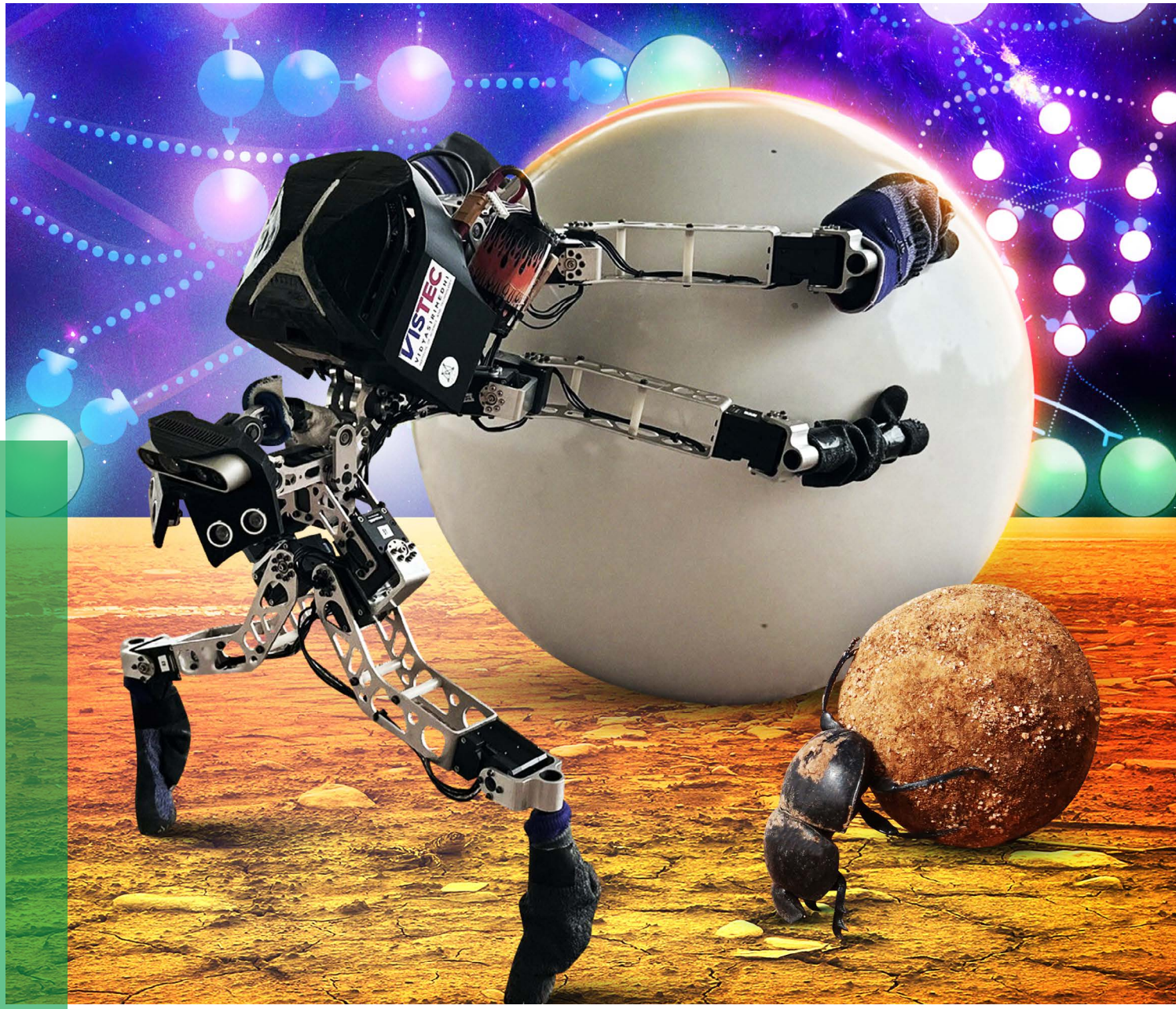
NEWSLETTER

International Society of Bionic Engineering

Volume 13, Issue 4, 2024



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Cover Photo: Learning from nature leads to groundbreaking robotics technology

Heike Beismann

Westphalian University of Applied Sciences, Germany

Heike Beismann is a professor at the Bocholt campus of the Westphalian University of Applied Sciences. From 2005 to 2011 she was a full-time member of the VDI (Association of German Engineers). Since 2012 she has been Professor of Biology and Biomimetics.

Her main research interests are plant biomechanics and how to decipher the structure-function relationships of plant models in order to translate abstract principles into engineering applications. Currently, a particular focus is on the opening mechanism of lignified fruits, mainly of invasive plant species, and how these internal structures can be deciphered at different hierarchical levels and what trigger mechanisms initiate the movement. Deformation analysis of surface models with DIC (Fig. 1) and µCT analyses to decipher the contribution of different tissues to the initiation of movement (Fig. 2) play a crucial role, as do mechanical tests and various microscopic analyses.

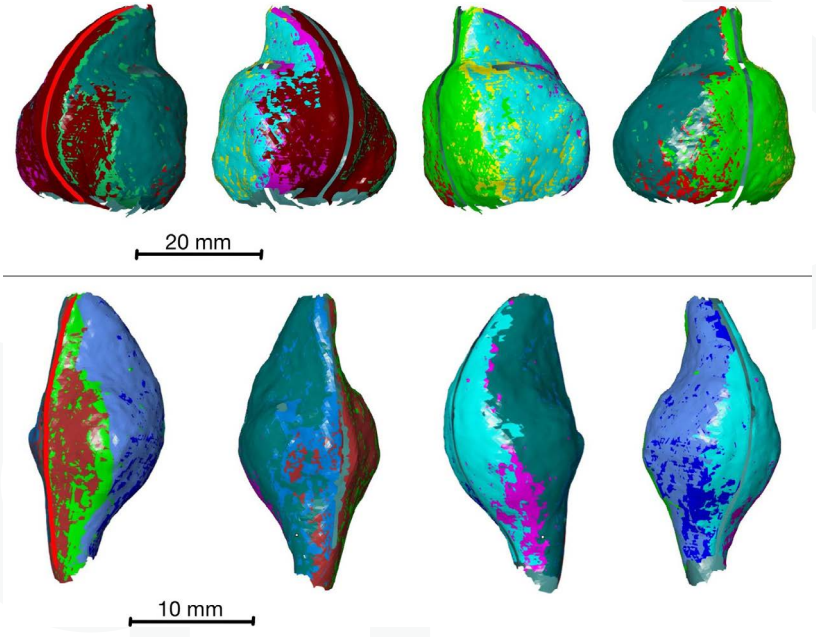


Figure 1: Surface models of lignified fruits of two Hakea species: See https://doi.org/10.3390/biomimetics9030191

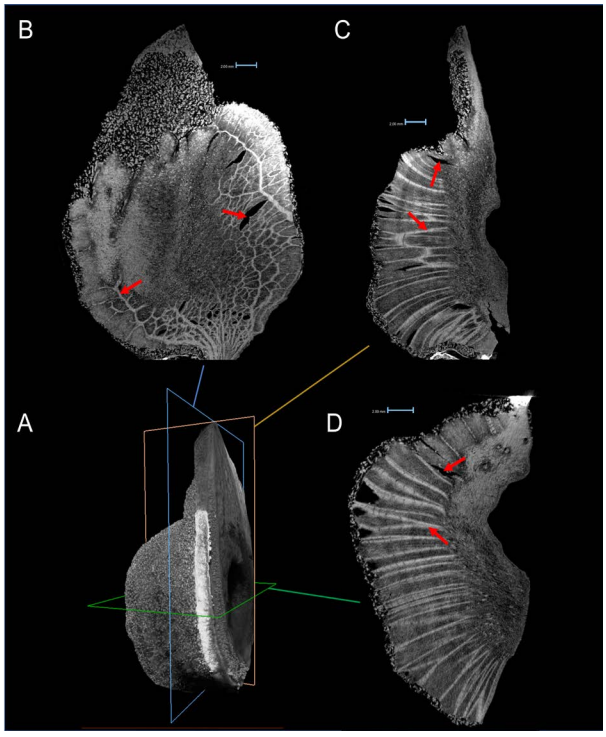


Figure 2: Greyscale 3D representation of a fruit of Hakea decurrens based on the reconstruction of an X-ray scan: See https://doi.org/10.1016/j.flora.2022.152035

She is also active in various national and international standardisation committees. She has had a significant influence on standardisation work at the national German level in the VDI and DIN (German Institute for Standardization). This standardisation work resulted in the parent ISO standard ISO 18458, which she chaired, and others such as ISO 18457 and ISO 18459, as well as a large number of VDI standards (VDI 6220 to VDI 6226),

Figure 3: Presentation of the VDI Badge of Honour for Services to Technology and the VDI in 2023

of which she chaired the framework guideline VDI 6220 Part 1 and Part 2. In 2023, she has been awarded the VDI Badge of Honour for Services to Technology and the VDI (Fig. 3).

The main objective of her research is to rethink technical challenges and develop new solutions through a biomimetic development process, using biological models. In addition, by working on the opening mechanisms of the fruits of invasive plants, she is able to address the issue of invasive plant control, thereby contributing to the protection of biodiversity and other SDGs (Sustainable Development Goals).

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.com Tel/ Fax: +86-431-85166507

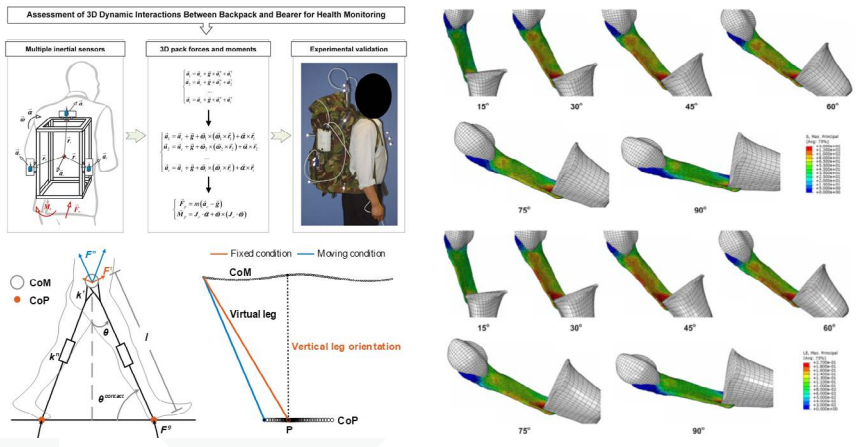
Address: Dingxin Building, Jilin University, 2699 Qianjin Street, Changchun P. R. China

Kunyang Wang

Jilin University, China

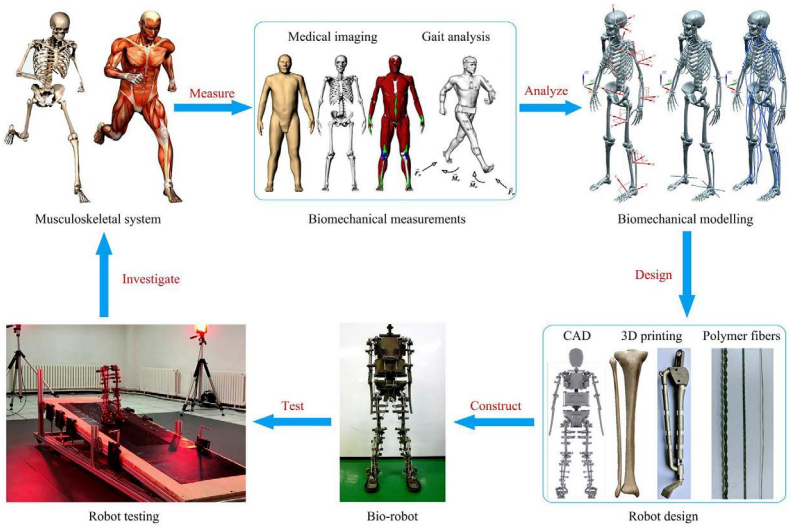
Kunyang Wang is a professor at the Key Laboratory of Bionic Engineering (Ministry of Education), Jilin University. He received the B.S. and M.S. degrees in mechanical engineering from Harbin Institute of Technology, Harbin, China, in 2012 and 2014, respectively, and the Ph.D. degree in mechanical engineering from the University of Manchester, Manchester, U.K., in 2019. He is currently Standing Member of the Youth Commission of International Society of Bionic Engineering (ISBE), Member of American Society of Mechanical Engineers (ASME), Associate Editors of Journal of Bionic Engineering and ICRA 2024, Youth Editorial Board member for of Advanced Bionics, and Session Chair at the 2021 International Workshop on Bionic Engineering.
He has been rewarded the National High-Level Overseas Talents, National Outstanding Postdoctoral Fellow in Innovation and Entrepreneurship, and First Innovation Prize in the CRME International Rehabilitation Medicine and Engineering.
His current research interests include human biomechanics, bioinspired robotics, mechatronics, prosthetics, and healthcare devices.

Prof. Wang has enriched the theory and technology of multidisciplinary integrated in-body precision analysis of human musculoskeletal system, developed the field of bionic bipedal robots based on human musculoskeletal intelligence, and put forward the principle and technology of bionic design and manufacturing of lower limb rehabilitation robots based on musculoskeletal mechanics. He developed the world's first humanoid walking robot reproducing the three-dimensional natural walking gait of human body which significantly reduced the energy consumption of movement, and developed bionic

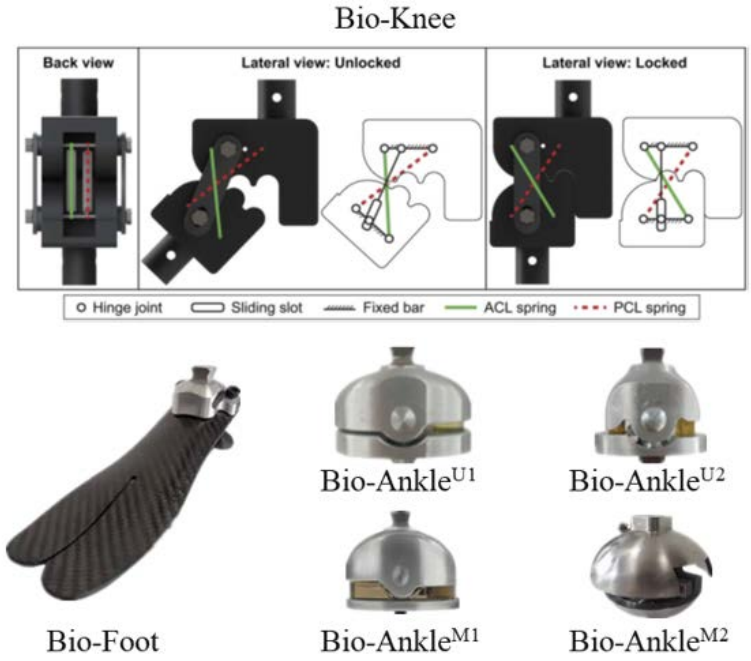


Three-dimensional modelling and analysis of human musculoskeletal system.

knee, ankle and foot prostheses with enhanced natural movement and road adaptability. The bionic lower limb prostheses have been transformed and applied in enterprises, and achieved good economic and social benefits. These results have promoted the key technological breakthroughs in advanced manufacturing fields such as robotics, rehabilitation equipment, as well as the level of innovation in the cooperation between academics, research, industry, and utilization.



A 3D Printed Bipedal Robot: Towards Humanoid Research Platform to Study Human Musculoskeletal Biomechanics.



Bionic knee, ankle and foot prostheses based on human musculoskeletal system.

Congratulations on the newly elected vice-presidents of the ISBE

According to the revised version of ISBE Statues passed at the ICBE 2023 (October 12-15, Wuhan), the number of vice-presidents of the Society was increased from 2 to 4. At the executive board meeting held on September 12, 2024 in Changchun, the board member Prof. Stanislav Gorb from Kiel University and Prof. Hyuneui Lim from Korea Institute of Machinery and Materials are recommended as the candidates of new vice-presidents. This proposal was finally approved by the board meeting via message in this October.

Congratulations on the newly elected vice-presidents of the ISBE!

Stanislav Gorb

Kiel University, Germany
Corresponding member of the Academy of Science and Literature Mainz, Germany
Member of the National Academy of Sciences Leopoldina, Germany

Stanislav Gorb is Professor and Director at the Zoological Institute of the Kiel University, Germany. His research focuses on morphology, structure, biomechanics, physiology, and evolution of surface-related functional systems in animals and plants, as well as biologically-inspired technological surfaces and systems. Gorb has authored several books, more than 500 papers in peer-reviewed journals. He receives the International Forum Design Gold Award in 2011, Materialica "Best of" Award in 2011, Karl-Ritter-von-Frisch Medal of German Zoological Society in 2018, Friendship Award of China in 2018 and Contribution Award of the ISBE in 2019. Currently he is severing as the chief editor of Biomimetics, and board editor of Applied Physics A.

Hyuneui Lim

Korea Institute of Machinery and Materials (KIMM), Korea
Associate member of the National Academy of Engineering of Korea (NAEK)

Hyuneui Lim is a director of Nature-inspired Research Center, KIMM and a Dean of Department of Mechanical Engineering, University of Science & Technology. Her research interests include surface engineering, nature-inspired functional surfaces, wearable sensor and actuator, eco-friendly nanofabrication, soft lithography and 3D printing. She is working as the representative of Korea of ISBE and a chair of Bioengineering Division of KSME. She has received many awards including the Korea Women's Engineering Grand Prize (2021), Award from chair of Science in National Assembly of Korea (2016), Prize from Prime Minister of KOREA Government (2014), etc. Now she is severing as an associate editor of Droplet, and editorial board member of Biomimetics and JMST.

2024 International Workshop on Bionic Engineering was held

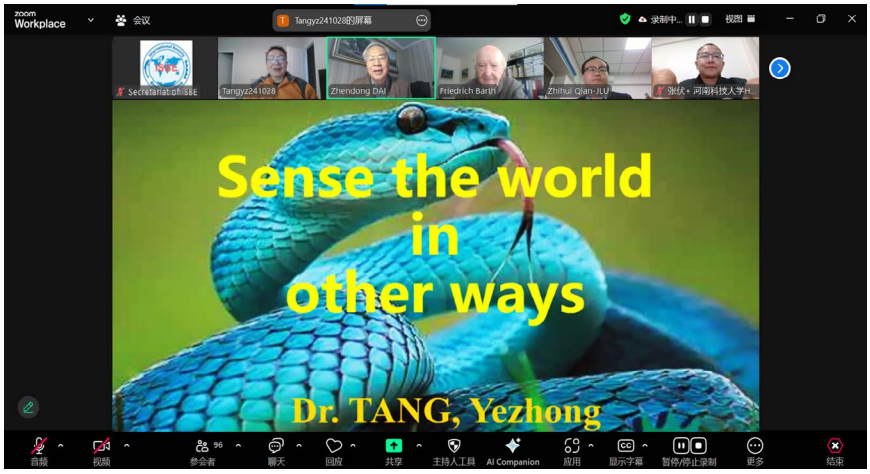
The 2024 International Workshop on Bionic Engineering (IWBE 2024) hosted by the ISBE and co-organized by the University of New South Wales (UNSW), Jilin University, and the Korea Institute of Machinery and Materials (KIMM), was successfully held from November 10 to 15 at UNSW in Australia. The workshop was jointly organized with the 2024 International Symposium on Nature-Inspired Technology (ISNIT 2024). The President of ISBE, Prof. Thomas Stegmaier from DITF Germany; the Vice-President of ISBE, Prof. Lei Ren from the University of Manchester/Jilin University; and the Chair of ISNIT, Prof. Eui-Sung Yoon from Korea Institute of Science and Technology (KIST) served as honorary chairs of the event.

At the opening, Prof. Thomas Stegmaier and Prof. Eui-Sung Yoon respectively delivered welcome speeches on behalf of ISBE and ISNIT. The General Secretary of ISBE, Prof. Zhihui Zhang from Jilin University and the former President of Korean Society of Mechanical Engineers (KSME), Prof. Wan Doo Kim from KIMM were also invited to attend the workshop. The opening ceremony was chaired by Prof. Yue Jiang from Jilin University.

The IWBE 2024 & ISNIT 2024 mainly focused on topics such as bionic surfaces and interfaces, bionic structures and materials, biomechanics and bionic healthcare engineering, motion bionics and bionic intelligence, as well as biofabrication and bionic manufacturing. It aimed to provide a platform for researchers, engineers, and entrepreneurs to exchange ideas and establish collaboration. Over 100 scholars and industry representatives from China, South Korea, Australia, Germany, Portugal, Japan, India, and Singapore participated in the event. The program featured 2 plenary talks, 20 keynote speeches, 16 invited reports, and 39 oral and poster presentations. The participants shared their cutting-edge research and insights, enriching the discussion on the latest advancements in bionics.

As the collaboration achievement of ISBE and KSME, the IWBE 2024 & ISNIT 2024 has presented the latest advancements in bionic engineering while fostering broader academic exchanges and collaborations. The event not only highlighted new academic growth points in the discipline but also promoted the integration of bionic research with industrial applications. Through this joint workshop, the ISBE has further extended its influence in the international bionics community.

International Lectures on Bionic Science and Engineering



International Lectures on Bionic Science and Engineering was successfully held via ZOOM platform On Dec. 3, 2024. The lecture invited Professor Yezhong Tang, a professor of evolutionary neural system at Chengdu Institute of Biology, Chinese Academy of Sciences to share his research experience with the topic of Sense the World in Other Ways.

The lecture was co-chaired by Professor Zhendong Dai from Nanjing University of Aeronautics and Astronautics and Professor Zhihui Qian from Jilin University. The lecture was organized by the Education Committee of ISBE.

Prof. Tang studies behavioral and neurophysiological characteristics of infrared in snakes, electroperception in electric fishes and magnetoperception in pigeons. He has published more than 100 papers and five books including an American textbook.

The lecture had attracted more than 100 scholars and graduates from multiple universities and research institutions around the world, including the University of Vienna in Austria, the University of Manchester in the UK, Jilin University, Nanjing University of Aeronautics and Astronautics, Beihang University, Beijing Institute of Technology, Dalian University of Technology, Wuhan University, Northwestern Polytechnical University, the Institute of Automation of the Chinese Academy of Sciences, the Institute of Physical and Chemical Technology of the Chinese Academy of Sciences, the Institute of Zoology of the Chinese Academy of Sciences, Sun Yat-sen University, Soochow University, Yangzhou University, Hohai University, Hangzhou Dianzi University, Henan University of Science and Technology, Northeast Forestry University, Shenyang Agricultural University, and Changchun University of Science and Technology.The participants had a wide discussion at the lecture.

The International Lectures on Bionic Science and Engineering, as a series of activities of the Society, is committed to promoting the dissemination of science and technology on bionics. It will keep building a good academic exchange platform for members, further facilitating exchanges among them and enhancing the level of bionic research and education.

Springer

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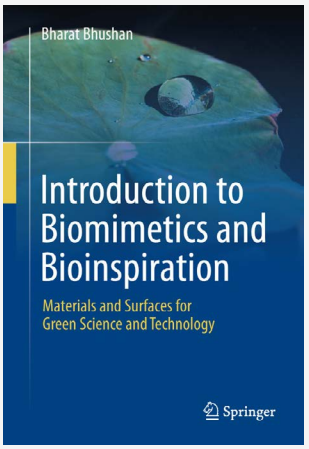

2024.
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106.99 € (D) | 109.99 € (A) |
CHF 118.00

B. Bhushan

Introduction to Biomimetics and Bioinspiration

Materials and Surfaces for Green Science and Technology

- Serves as an excellent textbook on biomimetics/bioinspiration for both graduate and undergraduate courses
- Useful to novices as well as experts in the field, practitioners, solution seekers, and the scientifically curious
- Catalyzes advancements the field, offering invaluable insights and tools for further exploration and innovation

This textbook provides a comprehensive overview of biomimetics and biologically inspired materials, capturing the essence of innovation that draws inspiration from nature. Featuring diverse examples of biomimetics, the book explores surfaces exhibiting characteristics such as roughness-induced super-phobicity/philicity, self-cleaning mechanisms, antifouling properties, low drag, reversible adhesion, high hardness, and mechanical toughness. It also covers phenomena like water harvesting, purification, insect locomotion, and piercing. The book emphasizes durable materials and surfaces with a strong focus on the Lotus Effect, superoleophobic/philic surfaces, anti-biofouling, water purification, oil-water separation, shark skin-inspired low-drag surfaces, gecko-inspired reversible adhesion, nanofabrication, water-harvesting, and mosquito-inspired painless piercing. This is the first textbook on biomimetics and bioinspired surfaces. It is tailored for undergraduate or graduate students of materials science, chemistry, physics, and biology, and serves as an excellent resource for a one-semester course in biomimetics/bioinspiration while also functioning as a valuable textbook for applied nanotechnology courses. Accessible to both novices and experts alike, as well as practitioners, solution seekers, and the intellectually curious, this book is poised to contribute to the advancement of biomimetics, fostering a deeper understanding of nature's design brilliance and its transformative potential in materials science.

ISBE member Professor Xu Hou proposed "Bioinspired Nanofluidic Iontronics", which was selected as one of the top ten emerging technologies by IUPAC in 2024

On October 22, during the opening ceremony of the 2024 World Forum on Science and Technology and Development, the "Top Ten Emerging Technologies in the Field of Chemistry by the world authoritative organization International Union of Pure and Applied Chemistry (IUPAC) in 2024" was officially released. It includes Frustrated Lewis pairs, Triboelectric nanogenerators, Aptamers, Mxenes, Hydration lubrication, Bioinspired nanofluidic iontronics, KRAS inhibitors, Neural network potentials, Active adsorption, and Electrochemical nitrogen cycle.

This release aims to showcase the transformative power in the field of chemistry and enhance the public's understanding of the crucial role of chemical science in improving social well-being and promoting sustainable development. This year's technology selection focuses on innovative achievements that are between technological discovery and full commercialization, showing great potential and is expected to open up new opportunities for chemistry and related fields. This year's selection not only promotes interdisciplinary cooperation in the field of chemistry but also will stimulate close collaboration between academia and industry. These technologies provide new solutions for global sustainable development and also help chemical manufacturers maintain their competitiveness in the industry. Although these technologies vary in maturity, they all show disruptive potential and are expected to reimagine our world and society.

IUPAC Wire

News and information on IUPAC, its fellows, and member organizations.
See also www.iupac.org/news

IUPAC Announces the 2024 Top Ten Emerging Technologies in Chemistry

IUPAC has released the 2024 Top Ten Emerging Technologies in Chemistry. The goal of this initiative is to showcase the transformative value of chemistry and to inform the general public about the potential of chemical sciences to foster the well-being of Society and the sustainability of our planet. The Jury*—an international panel of scientists with a varied and broad range of expertise- reviewed and discussed the diverse pool of nominations of emerging technologies submitted by researchers from around the globe and selected the final top ten, covering a range of fields from synthesis and polymer chemistry to health and machine learning. These technologies are defined as transformative innovations in between a discovery and a fully-commercialized technology, having outstanding potential to open new opportunities in chemistry, sustainability, and beyond.

The 2024 finalists are (in no specific order):

- Frustrated Lewis Pairs
- Triboelectric nanogenerators
- Aptamers
- MXenes
- Hydration Lubrication
- Bioinspired Nanofluidic Iontronics
- KRAS inhibitors
- Neural Network Potentials
- Active Adsorption
- Electrochemical Nitrogen cycle

This year again, the selection promotes cross-collaboration in chemistry to create exciting emerging technologies that bridge the gap between academia and industry, while continuing the current competitiveness of chemical manufacturers. The technology readiness level varies along the different solutions—nevertheless, all show a provocative promise to reimagine our world and our society. The new additions grow the list of emerging technologies to sixty.

The 2024 Top Ten Emerging Technologies in Chemistry are further detailed in a feature article published in the October issue of *Chemistry International (CI)* [see page 8]. Fernando Gomollón-Bel, the author of that feature, concludes by recognizing that "It is fascinating that, year after year, the "Top Ten" uncover chemical technologies with a true potential to transform our world." He added that "it reflects the real diversity of chemistry as the connecting science, a catalyst across disciplines that can and will accelerate sustainable solutions for our society."

The first selection of the Top Ten Emerging Technologies in Chemistry was released in 2019 as a special activity honoring IUPAC's 100th anniversary. The results were published in the April 2019 issue of *Chemistry International*, 41(2), pp. 12-17, 2019. The results of subsequent editions and the related articles in *CI* can be accessed at: https://iupac.org/what-we-do/top-ten/.

The search for the next Top Ten Emerging Technologies in Chemistry has already begun. For more information on the search for the Top Ten Emerging Technologies in Chemistry go to: https://iupac.org/what-we-do/top-ten/.

*The following comprised the panel of judges for the 2024 Top Ten Emerging Technologies in Chemistry: Chair, Michael Droescher, (German Association for the Advancement of Science and Medicine), Jorge Alegre-Cebollada (Centro Nacional de Investigaciones Cardiovasculares, Spain), Mamia El-Rhazi, (Université Hassan II de Casablanca, Mohammedia, Morocco), Ehud Keinan (Technion, Israel), Javier Garcia Martinez (Universidad de Alicante, Spain), Rai Kookana (CSIRO Land & Water, Australia), Juliane Sempionatto (Caltech, USA), Molly Shoichet (University of Toronto, Canada), Zhigang Shuai (Tsinghua University, China), Natalia P. Tarasova (D. I. Mendeleev University of Chemical Technology, Russia), Kira Welter (Wiley-VCH, Germany), and Bernard West (Life Sciences Ontario, Canada)

https://iupac.org/what-we-do/top-ten/

Winners of the 2024 IUPAC-Solvay International Award for Young Chemists

The International Union of Pure and Applied Chemistry and Solvay announce the winners of the 2024 IUPAC-Solvay International Award for Young Chemists, presented for the best Ph.D. theses in the chemical sciences, as described in 1000-word essays.

The five winners are:

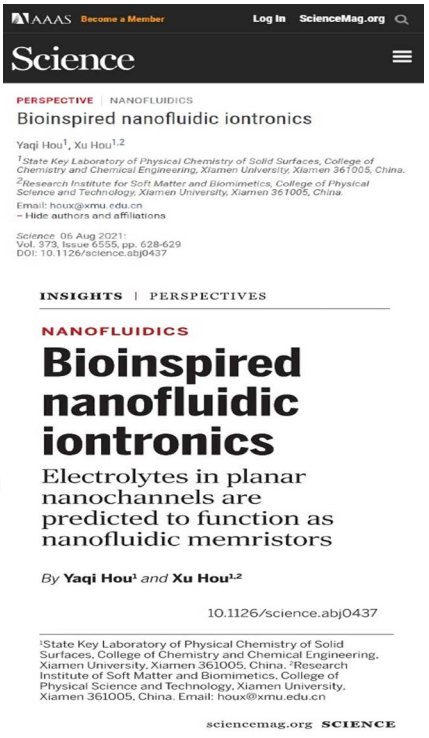
- **Subhajit Bhattacharjee** (India), Ph.D., University of Cambridge, UK
  https://orcid.org/0000-0003-0596-1073
- **Robert Thomas O'Neill** (United Kingdom), Ph.D., University of Liverpool, UK
  https://orcid.org/0000-0002-4348-7635
- **Gabrielle Mandl** (Canada), Ph.D., Concordia University, Canada

18 Chemistry International October-December 2024

Among the technologies selected this year, such as "Bioinspired Nanofluidic Iontronics" and "Electrochemical Nitrogen Cycle", there are contributions from Chinese scientific research teams. Among them, "Bioinspired nanofluidic iontronics" was first proposed by Professor Xu Hou of our ISBE member in 2021 (Science, 2021, 373, 628-629) and has promoted its global development. He also organized an international academic special issue on "Bioinspired Nanofluidic Iontronics" in International Journal of Smart and Nano Materials. Bioinspired nanofluidic iontronics, that is, inspired by the signal transmission and storage mechanism of the biological nervous system and taking the controllable ion transmission function of ion channels as a template, through the design of nanomaterials, constructs an artificial ion controllable transmission nanofluidic device

platform with similar functions. The content includes the preparation of nanoconfined pores and channels, the research on the material transmission mechanism in confined spaces, and the development of nanofluidic devices for intelligent applications, etc., and takes building an intelligent computing system with ions as signal carriers as the ultimate goal.

Since 2019, taking the opportunity of its 100th anniversary, IUPAC, in conjunction with chemical academic organizations from various countries and regions around the world, has jointly launched the global activity of "Top Ten Emerging Technologies in the Field of Chemistry of the Year". It is hoped that innovative technologies with great potential can be selected on a global scale to change the current global chemical and industrial landscape and promote the realization of the United Nations Sustainable Development Goals (SDGs).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Science

PERSPECTIVE | NANOFLUIDICS

Bioinspired nanofluidic iontronics

Yaqi Hou[1], Xu Hou[1,2]

[1]State Key Laboratory of Physical Chemistry of Solid Surfaces, College of Chemistry and Chemical Engineering, Xiamen University, Xiamen 361005, China. [2]Research Institute for Soft Matter and Biomimetics, College of Physical Science and Technology, Xiamen University, Xiamen 361005, China.

Email: houx@xmu.edu.cn

– Hide authors and affiliations

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INSIGHTS | PERSPECTIVES

NANOFLUIDICS

Bioinspired nanofluidic iontronics

Electrolytes in planar nanochannels are predicted to function as nanofluidic memristors

By **Yaqi Hou**[1] *and* **Xu Hou**[1,2]

10.1126/science.abj0437

[1]State Key Laboratory of Physical Chemistry of Solid Surfaces, College of Chemistry and Chemical Engineering, Xiamen University, Xiamen 361005, China. [2]Research Institute of Soft Matter and Biomimetics, College of Physical Science and Technology, Xiamen University, Xiamen 361005, China. Email: houx@xmu.edu.cn

sciencemag.org SCIENCE

Announcement of Changing Website Domain Name

Due to the transition to our new domain name, from 3 December 2024, the website address of ISBE will be changed as follows.

(Previous): https://isbe-online.org (New): https://isbe-online.com

If you are saving the current address in your bookmarks (favorites), please update it to the new one.

For the foreseeable future, all incoming emails will still reach us if they are sent to our old address: our.name@isbe-online.org. However, the old address will eventually be phased out so please do update your contacts to our.name@isbe-online.com.

We appreciate all your cooperation and apologize for any inconveniences these changes may cause.

Journal of Bionic Engineering

Journal of Bionic Engineering (JBE) applies insight from nature and biological systems to solve bionic engineering challenges; offers research on kinematical mechanics and control of animal locomotion; explores bioinspired computation methods and artificial intelligence.

The topics of Journal of Bionic Engineering (JBE) include but are not limited to:

• 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.

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

• Biomedical materials, artificial organs and tissue engineering for medical applications; rehabilitation equipment and devices. Development of bioinspired computation methods and artificial intelligence for engineering applications.

Journal Homepage: *http://www.springer.com/journal/42235*

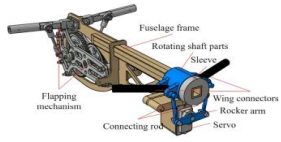
Research Article

Design and Experimental Verification of a Roll Control Strategy for Large Wingspan Flapping-Wing Aerial Vehicle

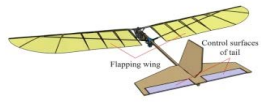
Rui Meng, Bifeng Song, Jianlin Xuan, Xiaojun Yang & Dong Xue

Abstract

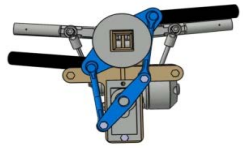
Most flapping-wing aircraft wings use a single degree of freedom to generate lift and thrust by flapping up and down, while relying on the tail control surfaces to manage attitude. However, these aircraft have certain limitations, such as poor accuracy in attitude control and inadequate roll control capabilities. This paper presents a design for an active torsional mechanism at the wing's trailing edge, which enables differential variations in the pitch angle of the left and right wings during flapping. This simple mechanical form significantly enhances the aircraft's roll control capacity. The experimental verification of this mechanism was conducted in a wind tunnel using the RoboEagle flapping-wing aerial vehicle that we developed. The study investigated the effects of the control strategy on lift, thrust, and roll moment during flapping flight. Additionally, the impact of roll control on roll moment was examined under various wind speeds, flapping frequencies, angles of attack, and wing flexibility. Furthermore, several rolling maneuver flight tests were performed to evaluate the agility of RoboEagle, utilizing both the elevon control strategy and the new roll control strategy. The results demonstrated that the new roll control strategy effectively enhances the roll control capability, thereby improving the attitude control capabilities of the flapping-wing aircraft in complex wind field environments. This conclusion is supported by a comparison of the control time, maximum roll angle, average roll angular velocity, and other relevant parameters between the two control strategies under identical roll control input.



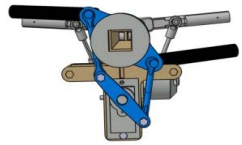
(a)Schematic of roll control mechanism



(b)Aircraft control surface status when no control is performed



(c)Variations in the roll control mechanism when roll right



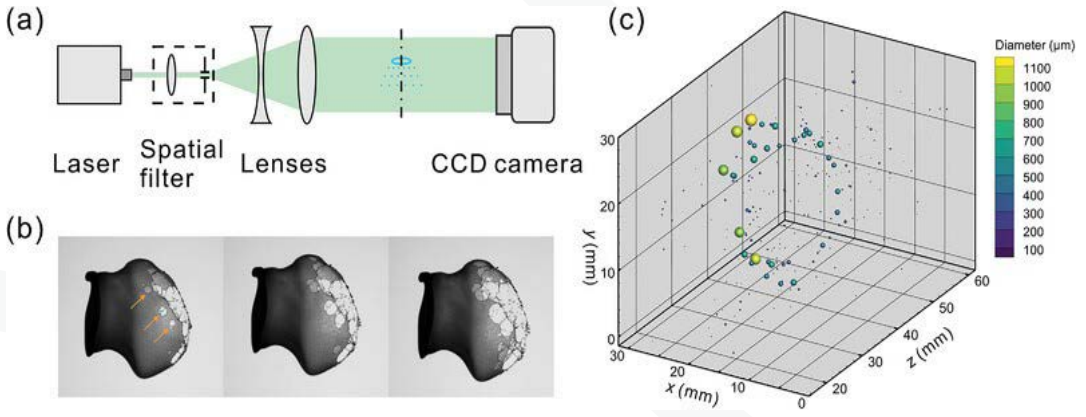
(d) Variations in the roll control mechanism when roll left

Aerodynamic Breakup of Emulsion Droplets in Airflow

Recently, the team of Prof. Zhizhao Che from the State Key Laboratory of Engines at Tianjin University has published a study on "Aerodynamic Breakup of Emulsion Droplets in Airflow" in Droplet (https://doi.org/10.1002/dro2.146).

This study experimentally investigated the aerodynamic breakup of water-in-oil emulsions in airflow, utilizing high-speed photography to observe the breakup process and digital in-line holography to measure fragment sizes. Comparative analyses between emulsion droplets and single-component droplets are conducted to examine the breakup morphology, breakup regime, deformation characteristics, and fragment size distributions. The emulsion droplets exhibit higher apparent viscosity and shorter stretching lengths of the bag film and peripheral rim due to the presence of a dispersed phase. The breakup regime transitions of emulsions are modeled by integrating the viscosity model of emulsions and the transition model of the pure fluid. The fragment sizes of emulsion droplets are larger due to the shorter lengths of the bag film and peripheral rim.

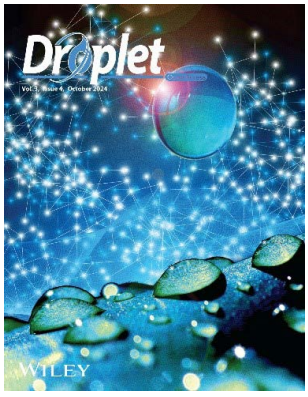
These findings contribute to a deeper understanding of the breakup dynamics of emulsion droplets, with implications for various applications in fluid atomization, spray combustion, aerosol science, and environmental engineering.



Publication Details:

Zhikun Xu, Jinzhao Liu, Houpeng Zhang, Tianyou Wang, Zhizhao Che. Aerodynamic breakup of emulsion droplets in airflow. Droplet, 2024, 3, e146.

Scan the QR code to read the full article at Droplet



Droplet 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.

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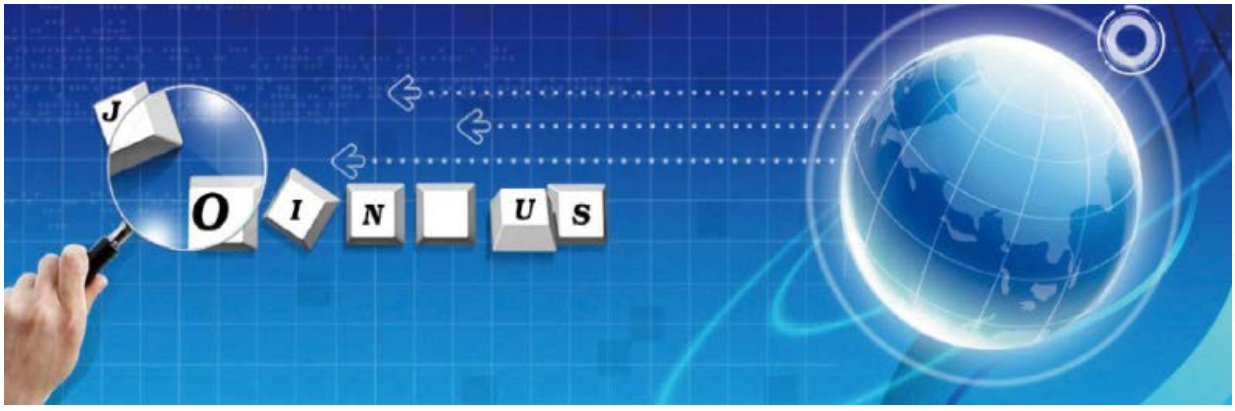

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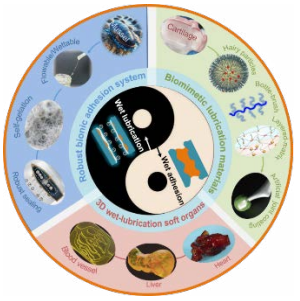
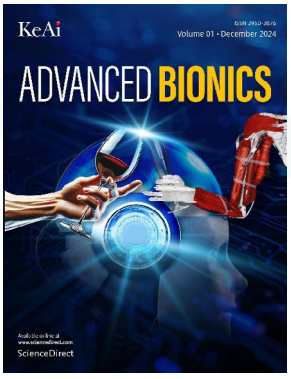
Welcome to the ISBE!

Bio-inspired wet/lubricious/adhesive soft matter and performance control in-between

Shuanhong Ma, Desheng Liu, Wenbo Sheng, Yanfei Ma, Bin Li, Xiaoduo Zhao, Xiaolong Wang, Feng Zhou, Weimin Liu, Lanzhou Institute of Chemical Physics (LICP) , CAS



Nature evolves soft but structural architectures with typical wet/lubricous/adhesive behavior and functionalities. In order to simulate these features, novel polymers materials, advanced modification methods and manufacture techniques are developed for engineering diverse bioinspired wet/lubricous/adhesive soft matter systems. This review focuses on two typical interface functionalities of soft architectures in nature: wet lubrication and wet adhesion. Correspondingly, systematic summaries of recent progress for constructing bioinspired wet/lubricious/adhesive soft matter systems are proposed, including the surface grafting methods to construct hydrophilic wet lubrication surfaces, the bionic design of mechanically robust and structured soft matter lubrication materials, the novel preparation of high-performance biomimetic wet adhesion materials, and the advanced manufacture of 3D soft matter-based wet/lubricious devices. Subsequently, the current strategies relying on diverse regulation factors including surface hydration/roughness, surface intrinsic states, bulk mechanics, as well as multi-factors synergy, are introduced for achieving dynamic friction or adhesion control of bioinspired soft matter lubrication/adhesion systems. Finally, the existing problems, challenges and future development directions of bioinspired wet/lubricious/adhesive soft matter materials and devices are discussed. This review provides a clear guidance for designing bioinspired soft matter-based lubrication, adhesion, or adhesion-lubrication switchable systems. (https://www.sciencedirect.com/science/article/pii/S2950387624000023)



Advanced Bionics (ABS) is an international peer-reviewed, open access journal that publishes original research papers, reviews, letters, editorials, highlights, perspectives, comments and news.

ABS focuses on the study of novel principles and functions observed in biological systems, as well as the application of this knowledge to address real-world scientific challenges.

ABS aims to lead advancements in fundamental bionic research, pushing the boundaries of novel bionic investigations and fostering disruptive technologies within the field. Submissions to the journal are expected to provide fresh insights, possess scientific impact and a high level of quality, as well as contribute to shaping the future of bionic research.

As an interdisciplinary journal, ABS covers a wide array of topics, including but not limited to:

(1) Bionic Robotics, Electronics, and Intelligent Devices
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(8) Bio-inspired structures and design

Journal Homepage

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Engineered Materials: Bioinspired 'Good Enough' vs. Maximized Performance

Ille C. Gebeshuber, TU Wien

In the publication, "Engineered Materials: Bioinspired 'Good Enough' vs. Maximized Performance," published in Advanced Functional Materials, the authors challenge the traditional engineering focus on maximizing individual material properties. Authored by PhD student Richard van Nieuwenhoven (TU Wien), theoretical biologist Markus Drack (Tübingen University) and physics professor Ille C. Gebeshuber (TU Wien), the research explores a more sustainable design philosophy rooted in Nature's approach to materials: "good enough" performance, which balances resource efficiency, durability and repairability over extreme optimization.

In contrast to technology's frequent quest for ever-stronger or more elastic materials, Nature evolves materials that fulfill multiple roles—strength paired with adaptability, resilience with the ability to self-repair. Engineered Living Materials (ELMs), a new frontier in material science, exemplify this approach: they incorporate natural processes into technical applications, such as self-healing concrete with embedded bacteria or living footbridges grown from plant networks. These Nature-inspired solutions demonstrate potential for lower maintenance, environmental compatibility and adaptability to changing conditions.

By prioritizing materials that meet functional needs without demanding perfection, the work underscores how bioinspired approaches could transform material science, aligning it with ecological principles and future sustainability goals. This study emphasizes that learning from Nature could yield materials that are not only innovative but also respectful of our planet's resources.

Van Nieuwenhoven R.W., Drack M. and Gebeshuber I.C. (2024) "Engineered Materials: Bioinspired 'Good Enough' vs. Maximized Performance", (invited article), Advanced Functional Materials 34(35), 2307127. (https://doi.org/10.1002/adfm.202307127).

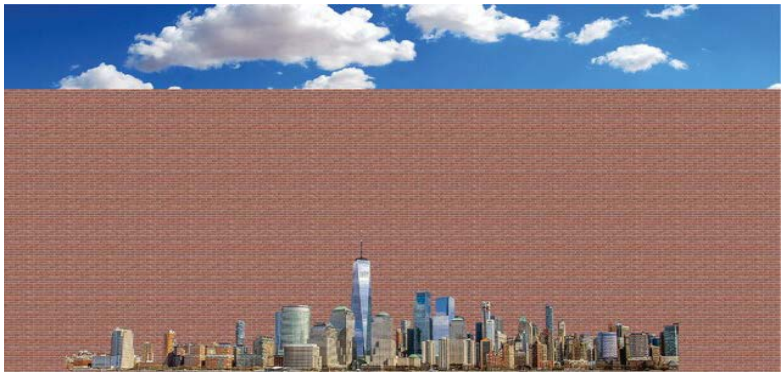


Figure caption: In 2020, humanity's total material extraction has surpassed 100 Gt per year. To put this mass into perspective, it is equivalent to building a concrete wall measuring 1000 m high and 1 m thick that encircles planet Earth every year anew. Approximately 50 Gt, equivalent to half of the extracted material, is disposed of as waste each year. This waste is equivalent to dismantling half of the concrete wall. The following year's wall, built adjacent to it, increases in thickness by 2.8 cm compared to the prior year. Based on current extraction rates, projections estimate annual mass extraction between 170 to 184 Gt by 2050. By 2050, the equivalent annual wall will have a diameter of approximately 1.75m if the current extraction rate persists.

Prof. DI Dr. techn. Ille C. Gebeshuber, Physics Professor @ TU Wien

Convenor **International Workshop on Bionic Engineering (IWBE 2025) & The 15th Plenary Meeting of ISO/TC 266 Biomimetics**, September 24-27, 2025, Vienna, Austria

Learning from nature leads to groundbreaking robotics technology

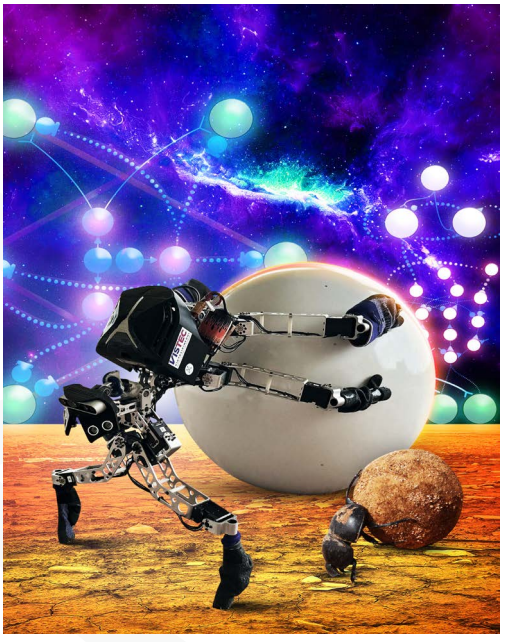
Binggwong Leung[1] , Stanislav Gorb[2], Poramate Manoonpong[1,3]

[1]Bio-inspired Robotics & Neural Engineering Lab, School of Information Science & Technology, Vidyasirimedhi Institute of Science and Technology, Rayong, Thailand
[2]Functional Morphology and Biomechanics, Zoological Institute, Kiel University, Kiel, Germany
[3]Embodied AI & Neurorobotics Lab, SDU Biorobotics, The Mærsk Mc-Kinney Møller Institute, University of Southern Denmark, Odense, Denmark

Recently, Advanced Science published a paper entitled "Nature's All-in-One: Multitasking Robots Inspired by Dung Beetles".

Dung beetles impressively coordinate their six legs to effectively roll large dung balls. They are also capable of rolling dung balls of varying weights across different terrains. However, the control mechanisms underlying the ability of dung beetles to reliably walk and simultaneously roll balls (multitasking behavior) of varying weights across a variety of terrains remain largely unknown and have not been fully translated to legged robots.

Therefore, this study aims to unravel the control principles by which dung beetles roll dung balls and adapt their leg movements to roll balls stably over different terrains. Accordingly, we synthesize modular neural loco-manipulation control mechanisms based on ethological observations of the ball-rolling behavior of dung beetle Scarabaeus (Khepher) Lamarcki. These bio-inspired modular neural control mechanisms, coupled with the functional morphology and biomechanics of a dung beetle-like robot, can generate adaptive (multitasking) ball-rolling behavior. As a result, the robot can exhibit robust large ball-rolling capabilities across both even and uneven terrains, while adapting to various ball weights and types (soft and rigid) (see https://youtu.be/ScldrZ6n5Wc). It can roll a large ball with a superior object size-to-leg-length ratio compared to other bio-inspired robots, achieving an overall ball-rolling speed ranging from 10 to 20 cm/s. These accomplishments represent advancements not previously achieved by



Dung beetle-inspired multitasking robot driven by modular neural loco-manipulation control mechanisms. This innovative approach for large object transportation can potentially revolutionize future missions in space exploration, search and rescue, construction, inspection, and agriculture.

other robots.

To this end, the study originally demonstrates bio-inspired adaptive (multitasking) ball-rolling behavior in a dung beetle-like robot. This behavior involves both object manipulation and locomotion (loco-manipulation), achieved through an integration of bio-inspired neural control mechanisms and biomechanics. The identified control mechanisms can further serve as guiding principles for solving complex sensory-motor coordination in multifunctional robots engaged in dual tasks: locomotion and large object manipulation and transportation. Moreover, this study holds significance for the field of biological research by contributing to a refined scientific understanding of sensory-motor coordination underlying complex, adaptive (multitasking) loco-manipulation behaviors observed in animals.

The detail content is referred to: Leung, B., Gorb, S., & Manoonpong, P. (2024). Nature's All-in-One: Multitasking Robots Inspired by Dung Beetles. Advanced Science, 2408080.

See also Advanced Science News *https://www.advancedsciencenews.com/dung-beetles-inspire-a-new-generation-of-robot/*

Research on the vortex anti-clogging filtration mechanism inspired by Balaenid whales

Yawei Zhu, Henan University of Technology, China

Solid-liquid separation is widely used in daily life and practical engineering, such as sewage treatment, beverage purification, oil separation, medicine preparation, etc. Traditional industrial filters are often clogged and damaged. Filter-feeders, on the other hand, are rarely clogged.

According to the principle of function correlation, a mathematical model from the filter feeding behavior of balaenid whales is abstracted and established, and the flow field and particle information of the hydrodynamic filtration system of balaenid whales are modeled and analyzed respectively. Then, the computational fluid dynamics (CFD) and discrete element method (DEM) coupled simulation model are used for further refinement where the effects of particle space and shape, as well as particle-particle/wall interaction are considered. On this basis, a new bionic filter inspired by the filter feeding of balaenid whales is designed by 3D printing and manufacturing.

This study initially practices the bionic application from biological model to engineering design, and the vortex anti-clogging filtration mechanism proposed in the study has a wide range of application prospects and values.

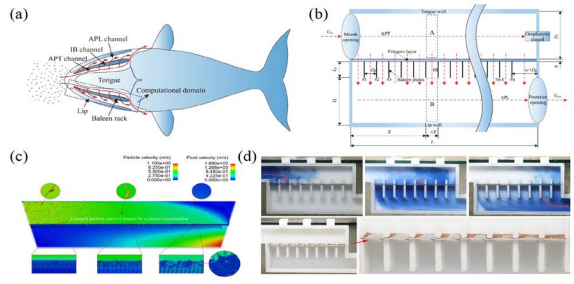


Figure 1. Integration of theory, simulation and experiment in biomimetic filtration of balaenid whale: (a) Intraoral flow pattern in balaenid whale feeding (dorsal cutaway view); (b) Geometric frame used in the theoretical model; (c) Perspective velocity cloud chart for the real shape case; (d) Experimental test of fluid visualization results and particle accumulation morphology.

Paper Information:
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https://doi.org/10.1007/s42235-022-00247-4
https://doi.org/10.1063/5.0221595

Emerging 3D printed polymer-based drug loaded nanomaterials for Chronic wound healing

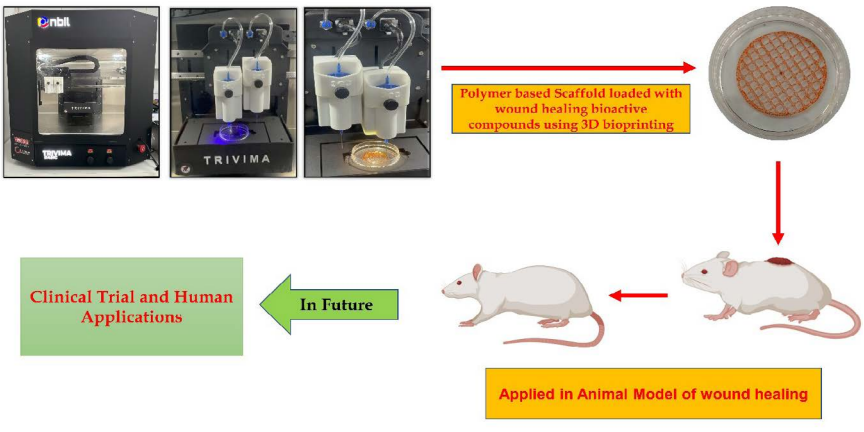
Saravanan Muthupandian*, Gulzar Ahmed Rather, and Aruchamy Mohanprasanth

AMR and Nanotherapeutics Lab, Department of Pharmacology, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Science (SIMATS), Chennai, India.

Wound healing is a complex and dynamic physiological process, orchestrated by various cytokines, growth factors (GFs), hormones, and different cell types. In a significant leap forward, three-dimensional (3D) bioprinting is emerging as a revolutionary technique in the production of wound dressings. Unlike traditional methods such as molding and casting, 3D bioprinting leverages advanced printing techniques and computer-aided design (CAD) to create complex, high-resolution, and anatomically accurate dressings. These innovative dressings can incorporate antibacterial and bioactive molecules, enhancing the healing process and offering patient-specific solutions.

The AMR and Nanotherapeutics Lab at Saveetha Dental College is at the forefront of research aimed at combating antimicrobial resistance (AMR) and cancer through the synthesis of various biomaterials. The AMR Lab has been actively engaged in research on various nanomaterials, with a particular focus on addressing critical health challenges. Currently, the lab is concentrating on the development of polymeric nanomaterials loaded with drugs, specifically designed for wound healing, oral cancer and other biomedical applications. By leveraging a 3D printing approach, the lab aims to create innovative, patient-specific treatments that enhance the healing process and improve clinical outcomes. Under the leadership of Prof. Dr. Saravanan Muthupandian, the lab is pioneering efforts in nanobiotechnology. Dr. Saravanan's research is particularly focused on the development of advanced biomaterials, 3D bioprinting technologies for custom wound dressings, and nanomaterials for drug delivery systems. Prof. Dr. Saravanan Muthupandian is recognized as a key faculty member of the Department of Pharmacology at Saveetha Dental College, with a significant impact on the different nano material synthesis. Through his work, the AMR and Nanotherapeutics Lab continues to strive in addressing some of the most pressing challenges in healthcare today.

The Lab headed by Dr. Saravanan, along with Dr. Gulzar (Project Scientist-I) and Mr. Aruchamy Mohanprasanth a JRF student, is spearheading a project to develop 3D bioprinting-based materials for chronic wound healing. This initiative has



Development of 3D-bioprinting based polymeric scaffolds for chronic wound healing

recently been supported by the installation of a state-of-the-art 3D bioprinter (Trivama, HiMedia, India) facility in our lab, funded by the Indian Council of Medical Research, (ICMR), Government of India [Fund approval Number: ICMR (2022-18903); IIRP-2023-8109]. This advanced equipment is set to play a crucial role in their ongoing research, enabling the creation of innovative, patient-specific treatments that promise to revolutionize wound care.

In our lab the 3D bioprinter operates using an extrusion-based system that deposits bioink through a pneumatic mechanism. This method is widely favoured for creating multilayer scaffolds in tissue engineering due to its versatility in handling a broad spectrum of biomaterials, including natural and synthetic polymers, cell-laden hydrogels, and cell aggregates. Moreover, it excels at managing high cell densities, varying material viscosities, and diverse crosslinking mechanisms, making it an ideal choice for advanced tissue engineering applications.

Knittable Electrochemical Yarn Muscle for Morphing Textiles in Air

Jiangtao Di, Suzhou Institute of Nano-Tech and Nano-Bionics (SINANO), CAS

The team of Prof. Jiangtao Di from Suzhou Institute of Nano-Tech and Nano-Bionics (SINANO), Chinese Academy of Sciences published an article entitled "Knittable electrochemical yarn muscle for morphing textiles" in volume 18, issue 13, 2024 of the journal ACS Nano and was selected as a cover paper.

In this article, the research groups developed an intelligent morphing textile by knitting electrochemical artificial muscles. The group proposed a strategy to realize the continuous preparation of the sheath-core artificial muscle yarns characterized by a flexible structure, low driving voltage, and fast response. The intelligent morphing textile could be achieved by knitting the continuous flexible yarns over the soft fabric which acted as a scaffold and electrolyte container. Morphing textiles could generate a larger driving force than a single artificial muscle yarn and the knitting structure should be designed specially. The muscle yarns with the same twist level but opposite twist directions were interlaced with equal intervals to prevent the fabric from twisting during the contraction. Meanwhile, the muscle yarns and auxiliary yarns were arranged to avoid contact. The textile could perform variable deformations in the air by independently controlling each artificial muscle yarn without short-circuit.

This study proposed a new strategy to make morphing textiles featured with flexible structure, programmable motion modes, air-working ability, and no thermal effect, and demonstrated the application prospects in wearable devices.

Defect by design: Harnessing the “petal effect” for advanced hydrophobic surface applications

By Min mo and Yihua Zheng, Advanced Materials Industry Institute of Guangxi Academy of Science, Guangxi Academy of Sciences, Nanning 530007, China, yhzhengjlu@126.com*

Building upon years of dedicated research in bionic composite functional material surfaces and interfaces, Dr. Yihua Zheng—an associate researcher and senior engineer at the Guangxi Academy of Sciences and a graduate of Jilin University's Bionic Science and Engineering program—has made important contributions in a new study.

In 2019, during his Ph.D. studies at Jilin University under Professor Chengchun Zhang, Dr. Zheng explored how natural phenomena like the "petal effect" and the "lotus leaf effect" influence water behavior on biomimetic surfaces. Continuing this research at the Guangxi Academy of Sciences, he investigated how designed surface defects can enhance water adhesion(Fig. 1).

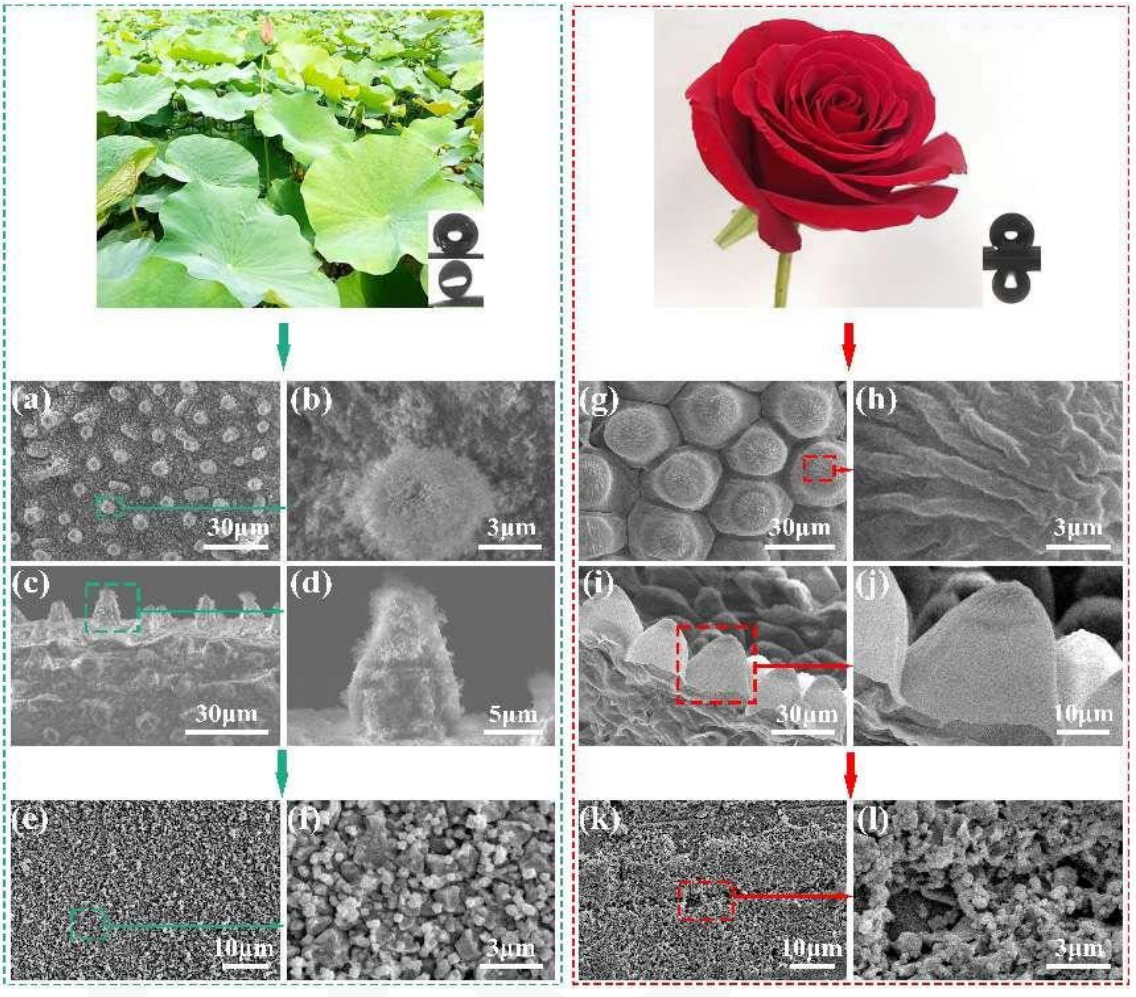


Figure 1. Comparative Analysis of Wettability and Surface Microstructures of Natural Lotus Leaves and Rose Petals

Inspired by the high water retention of rose petals due to microscopic surface defects and capillary forces—the "petal effect"—the study reveals that intentionally introducing defects can improve water retention on hydrophobic surfaces. This contrasts with the "lotus leaf effect," where water repellency is achieved through micro- and nano-scale structures(Fig. 2).

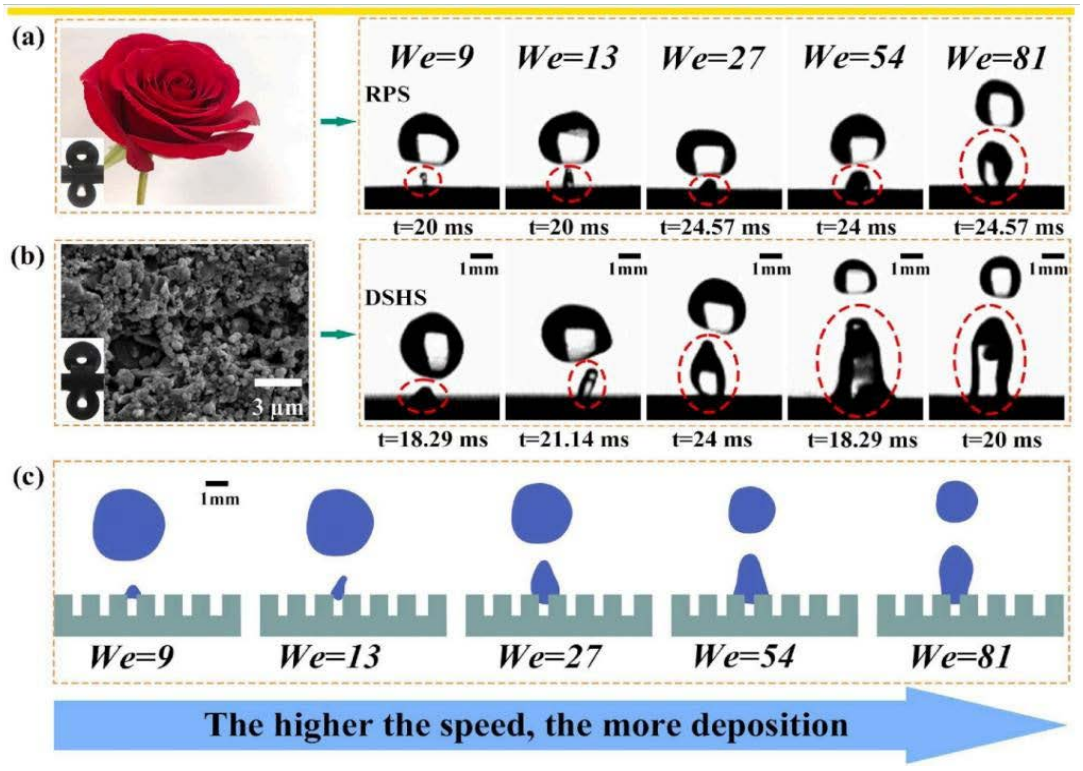


Figure 2. The water adhesion effect on "petal effect" surfaces increases sharply with increasing impact velocity

These findings provide valuable insights for applications requiring water retention, such as the maintenance of marine and aerospace equipment. By understanding and harnessing the "petal effect," engineers can design surfaces that meet specific performance requirements, emphasizing the importance of surface structure in material science.

For more details : https://doi.org/10.1016/j.jcis.2024.05.192

International Workshop on Bionic Engineering (IWBE 2025)

The 15th Plenary Meeting of ISO/TC 266 Biomimetics

September 24-27, 2025, Vienna, Austria

Host: International Society of Bionic Engineering (ISBE)

ISO/TC 266 Biomimetics

Organizers:

TU Wien

Jilin University

Beijing Research Institute of Automation for Machinery Industry Co., Ltd.

More infomation is coming soon!

The Joint 99th American Chemical Society (ACS) Colloids & Surface Science Symposium & 18th International Association of Colloid and Interface Scientists (IACIS) Conference (Colloids2025) is accepting abstracts!

Submission deadline: January 17, 2025

Abstracts are now being accepted for the Colloids2025 Conference (*https://colloids2025.com/*), which runs during **June 22 - 26, 2025**, at the **University of Alberta in Edmonton, Canada**. This must-attend event for colloid and interface researchers features 16 technical tracks in the following areas

1. Additive manufacturing and colloidal metamaterials
2. AI Methods in Surface and Colloid Sciences
3. Biological, Bio-Inspired, and Biomimetic Colloids and Interfaces
4. Capillary Phenomenon and Field Effects
5. Colloids for Sustainability and Energy
6. Colloidal Systems for Food: production, processing and sustainability
7. General Aspects of Colloid and Interface Science
8. Industrial Applications of Colloid and Surface Systems
9. Microfluidics and Nano/Biosensing Devices
10. Molecules and Particles at Fluid Interfaces
11. Rheology and Tribology of Complex Fluids
12. Self and Directed Assembly
13. Soft Matter
14. Surfactants and Colloidal systems in Resource Extraction
15. Surfactants and Emulsions
16. Wetting and Adhesion

The Colloids2025 Conference brings together the most active researchers in academia, government, and industry—professionals and students—to engage, discuss, and innovate in the areas of colloid, surface, and interface science and technology. This premier destination for industry professionals provides five days of learning, technical presentations, business development, and networking opportunities.

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The aims of the workshop are to

- Present IFToMM as an active world organization that can contribute to United Nations 2030 Development Agenda
- Present and highlight all the research activities realized in IFToMM community that can contribute to reach some target within SDGs, Sustainable Development Goals
- Increase the awareness related to SDGs in IFToMM scientific community
- Generate a network of active researchers, with specific interest on effects of new technologies on sustainable world
- Foster dialogue between technologists and humanists.

Workshop Topics

Papers are welcome on topics related to the aspects of theory, design, practice and application of the Mechanism and Machine Science, which can give some contribution in reaching one or more Sustainable Development Goals, including but not limited to

- Biomechanical Engineering
- Linkage and mechanical control
- Sustainable Energy Systems
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- Green Tribology
- Socio-Technical Systems for sustainable and inclusive development
- Education
- Terminology
- Computational Kinematics
- Gearing and Transmissions
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- Multibody Dynamics
- Micromachines
- Engines and Powertrains
- History of Mechanism and Machine Science
- Transportation Machinery

Paper submission, proceedings

Authors are kindly invited to submit a full paper for a Scopus indexed book of the Springer Series *Mechanisms and Machine Science*. after payment of a full registration fee.
Authors who are interested to presentation-only participation can contact the secretariat providing a title and short abstract.

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Best Paper awards will be given in categories of Research, Application, and Student Work.

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Regular (non-IFToMM m.o.)	**500 €**	**550 €**
Student	**350 €**	**400 €**
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Newsletter

ISBE Newsletter

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Volume 13, Issue 4, 2024

ISBE NEWSLETTER

Contact - Office of Secretariat, ISBE

Address: C508 Dingxin Building, Jilin University, 2699 Qianjin Street,
Changchun 130012, P. R. China

Tel/ Fax: +86-431-85166507

E-mail: gyue@isbe-online.com; secretariat@isbe-online.com

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