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Research Gate: https://www.researchgate.net/profile/Hongri_Gu

EDUCATION

Ph.D. in Mechanical Engineering, 01.2017-12.2021, ETH Zurich, Switzerland
Thesis: "Soft Intelligent Structures with Complex Magnetizations" (defense date: 26 Oct. 2021)
Advisor: Prof. Brad Nelson

M.Sc. in Micro and Nanosystems, 09.2014-11.2016, ETH Zurich, Switzerland
Advisor: Prof. Brad Nelson

Academic Cooperation Agreement Program, 02.2014-08.2014, Tokyo Institute of Technology, Japan

Young Scientist Exchange Program, 09.2012-08.2013, Tokyo Institute of Technology, Japan
Advisor: Prof. Shinichi Yokota

B.Eng. in Mechatronics Engineering, 09.2009-06.2014, Zhejiang University, China

EMPLOYMENT HISTORY

01.2022-now	Postdoctoral Associate, University of Konstanz, Germany (Advisor: Prof. Clemens Bechinger)
01.2017-12.2021	Scientific Assistant, Multi-Scale Robotics Lab, ETH Zurich, Switzerland
02.2014-08.2014	Research Assistant, Tokyo Institute of Technology, Japan

AWARDS AND RECOGNITIONS

05.2024	**CASCB Travel Grant**, (3k EUR)**,** Centre for the Advanced Study of Collective Behaviour
05.2023	**Best Poster Award for ICRA 2023 workshop: "Shrinking the Cutting Edge, Making Small-Scale Medical Robots for Humans",** IEEE Robotics and Automation Society
11.2022	**ETH Medal for outstanding doctoral thesis 2022**, (2k CHF), ETH Zurich
10.2022	**Best Talk Award for microTAS 2022 (runner up)**, (500 USD), Chemical and Biological Microsystems Society (CBMS) (>800 participants)
07.2021	**Chinese government award for outstanding self-financed students abroad of 2020**, (6k USD), China Scholarship Council
2020	**Top 50 Physics Articles**, Nature Communications
2011-2012	**Yilida-Liuyongling Scholarship**, (5k CNY), Elite Machinery Holdings Ltd. (1/323)
07.2012	**1st prize**, 5th National Undergraduate Mechanical Innovation Design Competition, Ministry of Education of P. R. China (Top 2%)
05.2012	**1st prize**, 9th Mechanical Design Competition in Zhejiang Province, Zhejiang Undergraduate Science and Technology Society (ranked 1st/270)
04.2012	**1st prize**, Mechanical Design Competition of Zhejiang University, Zhejiang University
05.2011	**3rd prize,** 8th "Zhou-Peiyuan" National Mechanics Competition, Chinese Society of Theoretical and Applied Mechanics, May 2011 (Top 5%)
05.2011	**1st prize**, Mechanics Tournament of Zhejiang Province, Zhejiang Provincial Society of Theoretical and Applied Mechanics
2011-2012 & 2010-2011	**1st prize,** Research and Innovation Scholarship, Zhejiang University
2010	**3rd Prize**, Undergraduate Physics Tournament in Zhejiang Province, Zhejiang Physical Society

FELLOWSHIPS and RESEARCH GRANTS

01.2022-12.2023 **Postdoc. Mobility Fellowship**, (96k CHF), Swiss National Science Foundation, topic: "Soft Robots Powered by Active Matter" (203203)

10.2012-08.2013 **JASSO Fellowship**, (960k JPY), Japan Student Service Organization, topic: "miniaturized electro-conjugate fluid micropumps"

PUBLICATIONS

Journal Articles

Hongri Gu*, Clemens Bechinger, Bradly J. Nelson, "Ultraslow robotics and its applications", *(in preparation)*

Hongri Gu, Anton Lüders, Clemens Bechinger*, "Sliding friction of a flake of artificial spin ice", *(in preparation)*

Xiaoli He, Hongri Gu, Yanmei Ma, Yuhang Cai, Huaide Jiang, Yi Zhang, Hanhan Xie, Ming Yang, Liang Guo, Chengzhi Hu, "Light-Patterning Semiconductor Nanoparticles by Modulating Surface Charges", ***Nature Communications*** (accepted)

Veit-Lorenz Heuthe, Emanuele Panizon, Hongri Gu*, Clemens Bechinger*, "Counterfactual reward enables collective transport using individually controlled swarm microrobots", ***Science Robotics*** *(in revision)*

Hongri Gu*, Yonglin Chen, Anton Lüders, Thibaud Bertrand, Emre Hanedan, Peter Nielaba, Clemens Bechinger, and Bradley J. Nelson, "Scalable high-throughput microfluidic separation of magnetic microparticles"*,* ***Device,*** 100403 (2024)

Hao jiang, Hongri Gu, Bradley J. Nelson, Teng Zhang*, "Numerical Study of Metachronal Wave Modulated Locomotion in Magnetic Cilia Carpets"*,* ***Advanced Intelligent Systems,*** 202300212 (2023).

Hongri Gu*, Marino Möckli, Claas Ehmke, Minsoo Kim*, Matthias Wieland, Simon Moser, Clemens Bechinger, Quentin Boehler*, Bradley J. Nelson*, "Self-folding soft robotic chains with reconfigurable shapes and functionalities", ***Nature Communications*** 14, 1263 (2023).

Bradley J. Nelson*, Pierre Dupont, Dario Floreano, Ken Goldberg, Hongri Gu, Neil Jacobstein, Cecilia Laschi, Hod Lipson, "What we look for at *Science Robotics*" (editorial), ***Science Robotics*** 7, no. 71 (2022).

Hongri Gu*, Emre Hanedan, Quentin Boehler, Tian-Yun Huang, Arnold J. T. M. Mathijssen*, Bradley J. Nelson*, "Artificial microtubules for fast and collective transport of magnetic microcargos", ***Nature Machine Intelligence*****,** 4, 678–684 (2022).

Tianyun Huang*, Hongri Gu*, Bradley J. Nelson*. "Increasingly intelligent micromachines" (review) ***Annual Review of Control, Robotics, and Autonomous Systems***, 5 (2022).

Hongri Gu, Thibaud Bertrand, Quentin Boehler, Christophe Chautems, Nikolay V. Vasilyev*, Bradley J. Nelson*. "Magnetically Active Cardiac Patches as an Untethered, Non-Blood Contacting Ventricular Assist Device" ***Advanced Science***, 2000726 (2020).

Hongri Gu, Quentin Boehler, Haoyang Cui, Eleonora Secchi, Giovanni Savorana, Carmela De Marco, Simone Gervasoni, Quentin Peyron, Tian-Yun Huang, Salvador Pane, Ann M. Hirt, Daniel Ahmed, Bradley J. Nelson*. "Magnetic Cilia Carpets with Programmable Metachronal Waves" ***Nature Communications*** 11, 2637 (2020).

Pengfei Liu, Simone Gervasoni, Claudio Madonna, Hongri Gu, Andrea Coppo, Salvador Pané, Ann M Hirt*. "Response of remanent magnetization to deformation in geological processes using 3D-printed structures" ***Earth and Planetary Science Letters***, 539 (2020): 116241.

Jizhai Cui*, Tian-Yun Huang*, Zhaochu Luo, Paolo Testa, Hongri Gu, Xiang-Zhong Chen, Bradley J. Nelson, and Laura J. Heyderman. "Nanomagnetic encoding of shape-morphing micromachines." ***Nature*** 575, no. 7781 (2019): 164-168.

Hongri Gu, Quentin Boehler, Daniel Ahmed, and Bradley J. Nelson*. "Magnetic quadrupole assemblies with arbitrary shapes and magnetizations" ***Science Robotics*** 4, no. 35 (2019).

Dong Han*, Hongri Gu*, Joon-wan Kim*, and Shinichi Yokota*. "A bioinspired 3D-printed hybrid finger with integrated ECF (electro-conjugate fluid) micropumps." ***Sensors and Actuators A: Physical*** 257 (2017): 47-57.

Conference Proceedings

Laura Pruszko, Hongri Gu, Julien Bourgeois, Yann Laurillau, Céline Coutrix, "Modular Tangible User Interfaces: Impact of Module Shape and Bonding Strength on Interaction", ***TEI 2023***, Warsaw, Poland, February 2023

Dong Han, Hongri Gu, Joon-wan Kim, Shinichi Yokota, Kazuya Edamura, "A Novel 3D-Printed Finger Integrated with ECF Micropump", ***the 6th International Conference on Manufacturing, Machine Design and Tribology (ICMDT)***, Okinawa, Japan, April 2015

Hongri Gu, Joon-wan Kim, Shinichi Yokota, Kazuya Edamura, "3 Triangular Prism Electrodes Design for Electro-Conjugate Fluid Micropump", ***9th JFPS International Symposium on Fluid Power (JFPS)***, Matsue, Japan, 2014

Hongri Gu, Joon-wan Kim, Shinichi Yokota, Kazuya Edamura, "ECF Micropump by Using the triangular prism electrode and tapered slit electrode pairs"(in Japanese), ***JSME Conference of Machine Design and Tribology***, Nagano, Japan, 2014

Hongri Gu, Joon-wan Kim, Shinichi Yokota, Kazuya Edamura, "Study on Output Characteristics of downsized ECF micropump", ***International Conference on Mechatronics Technology (ICMT)***, Jeju Island, Korea, 2013

Hongri Gu, Joon-wan Kim, Shinichi Yokota, Kazuya Edamura, "Study on ECF effect by miniaturizing electrodes pairs"(in Japanese), ***2013 Annual Conference of Japanese Society of Mechanical Engineering***, Okayama, Japan, 2013

INVITED TALK AND CONFERENCE PRESENTATIONS

"Application and productization of micro and nanorobots", ***CSMNT Summer School on micro and - nano robotics***, TBD, 2023

"Self-folding soft-robotic chains with reconfigurable shapes and functionalities", ***ICRA 2023 workshop: "Shrinking the Cutting Edge, Making Small-Scale Medical Robots for Humans",*** London, 29 May, 2023 **(Best Poster)**

"Self-folding soft-robotic chains for minimally invasive surgeries", ***RoboSoft 2023 workshop: "When Soft Robots get Small: Current Trends and New Perspectives in the Fabrication, Design and Application of Small-Scale Soft Robots",*** Singapore, 3 April, 2023

"Fast and Robust Transport of Magnetic Microparticles on Artificial Microtubules", ***μTAS 2022***, Hangzhou, 23-27 October, 2022 **(Best Talk)**

"Soft robots powered by magnetically driven active particles", ***DPG Meeting of the Condensed Matter Section***, Regensburg, 5-9 September, 2022

"Artificial Microtubules for Rapid and Collective Transport of Magnetic Microcargoes", ***Max Bergmann Symposium 2022***, Dresden, 9-10 June, 2022

"Soft robotic structures with complex magnetizations", ***Engineering and Applied Science Forum (for Ph.D., Postdoc, and Young faculty)***, 13 December, 2020

"Artificial Magnetic Cilia Carpets with Programmable Metachronal Waves", ***Microswimmers International Conference 2020 "Motile Active Matter" (online)***, oral presentation, 29 October, 2020

"Magnetic Quadrupole Assemblies with Arbitrary Shapes and Magnetizations", ***MaP Graduate Symposium 2020 (online)***, poster presentation, 1-2 July, 2020

"Artificial Magnetic Cilia Carpets with Programmable Metachronal Waves", ***International conference on magnetic fluid (ICMF 2019)***, oral presentation, Paris, 9 July, 2019

"Complex Pumping by close-packing the active magnetic particles in fluidic networks", ***Applied Mathematics Seminar***, University of York, 28 April, 2017

"Design and application from single to swarm microrobots", ***International Workshop on Stochastic Thermodynamics and Active Matters***, Beijing, 15-16 August, 2016

"ECF Micropump by Using the triangular prism electrode and tapered slit electrode pairs", ***JSME Conference of Machine Design and Tribology***, Nagano, Japan, 21-22 April, 2014

"Study on ECF effect by miniaturizing electrodes pairs", ***2013 Annual Conference of Japanese Society of Mechanical Engineering***, Okayama, Japan, 8-11 September, 2013

EDITORIAL AND REVIEW WORKS

I worked as an editorial assistant to Prof. Bradley Nelson to handle submissions for ***Science Robotics*** and ***Annual Review of Control, Robotics, and Autonomous Systems*** focused on micro robotics, medical robotics, and soft robotics. **(> 80 submissions from 09.2018 to 12.2021)**

Editorial board (junior members): ***Biomimetic Intelligence and Robotics***

Occasional guest editor for peer-reviewed journals: ***Proceedings of the National Academy of Sciences.***

Occasional reviewer for peer-reviewed journals: ***Science Robotics, Nature Communications, Science Advances, Advanced Materials, Advanced Functional Materials, Advanced Intelligent Systems, Research, Small, Smart Materials and Structures, Cell Reports Physical Science, Sensors and Actuators B: Chemical, IEEE Robotics and Automation Letters, Physics of Fluids***

Occasional reviewers for book publishers: Taylor & Francis Group-CRC Press

TEACHING

Biorobotics (Spring 2022), INF-15500, guest lecturer: Bio-inspired robotics at the small scale, University of Konstanz

Training Course of 3D printers (09.2017-12.2021), Multi-Scale Robotics Lab, ETH Zurich

Bachelor and Master projects, Institute of Robotics and Intelligent Systems, ETH Zurich

Studies on Mechatronics (09.2017-now), Institute of Robotics and Intelligent Systems, ETH Zurich

PATENT

CN102733163B "Efficient practical clothes folding machine", Invention Patent, China National Intellectual Property Administration, granted on 17.12.2014.

STUDENT SUPERVISION

I have supervised 4 master's theses, 7 semester projects, and 6 bachelor's theses for students from the Department of Mechanical Engineering, Electrical Engineering, and Health Science at ETH Zurich, Imperial College London, and Karlsruhe Institute of Technology. I also cosupervised Ph.D. exchange student at the University of Konstanz.

PhD student (Siyuan Wang)

Master thesis (Molly Abraham, Martin Albrecht, Emre Hanedan, Shiyang Zhou)

Semester project (Yonglin Chen, Jonathan Ocampo Chavez, Philipp Fritz, Simon Moser, Emre Hanedan, Haoyang Cui, Thibaud Bertrand)

Bachelor thesis (Marino Möckli, Alberic de Tessieres, Raffael Kunz, Denis Huber, Matthias Wieland, Thibaud Bertrand)

Some of their thesis research has been published in scientific journals, including *Nature Communications* and *Advanced Science*.

REFERENCES

Bradley Nelson, Professor of Robotics and Intelligent Systems, ETH Zurich, CLA H1.1, Tannenstrasse 3, 8092 Zürich, Switzerland, email bnelson@ethz.ch

Clemens Bechinger, Professor of the Physics Department, University of Konstanz, P1009, Universitätsstraße 10, 78464 Konstanz, Germany, email clemens.bechinger@uni-konstanz.de

Quentin Boehler, Senior Scientist at Multi-Scale Robotics Lab, ETH Zurich, CLA H15.2, Tannenstrasse 3, 8092 Zürich, Switzerland, email qboehler@ethz.ch

Arnold Mathjissen, Assistant Professor of Department of Physics & Astronomy, University of Pennsylvania, 209 South 33rd Street, PA 19104, Philadelphia, United States, email amaths@upenn.edu

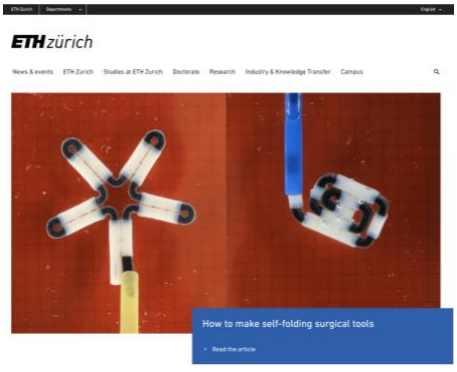
Major Scientific Achievement 1: Programmable magnetic assemblies for robotic materials and medical devices

Engineers always want to build things with maximum freedom. Unfortunately, only a few artificial systems can claim to assemble arbitrary designs in two dimensions, including DNA origami, textured mechanical metamaterials, and robotic swarms. We introduced quadrupoles as magnetic assembly modules to achieve this with only magnetic interactions (***Sci. Rob. 2019***). The quadrupole modules break the constraint of dipole symmetry, providing a new paradigm for magnetic assemblies from micrometer-scale colloidal particles to centimeter-scale modular robots. We provide a simple step-by-step method for magnetic assemblies with arbitrary shapes and arbitrary magnetizations. We demonstrate that quadrupole assemblies provide a unique approach to synthesize emoji images, magnetic metamaterials, and soft robotic chains that can self-fold into minimally invasive surgical tools (***Nat. Commun. 2023***).

Representative papers:
[1] Hongri Gu, et al. "Self-folding soft robotic chains with reconfigurable shapes and functionalities", Nature Communications 14, 1263 (2023). https://doi.org/10.1038/s41467-023-36819-z
[2] Hongri Gu, et al. "Magnetic quadrupole assemblies with arbitrary shapes and magnetizations" Science Robotics 4, no. 35 (2019). https://doi.org/10.1126/scirobotics.aax8977

Contribution:
conceived the idea, performed the experiments, performed data analysis, managed the research team, and wrote the papers.

Recognition:
- Best Poster Award for ICRA 2023 workshop: "Shrinking the Cutting Edge, Making Small-Scale Medical Robots for Humans", IEEE Robotics and Automation Society.
- ETH homepage coverage: "How to make self-folding surgical tools" (12.04.2023)
- ETH homepage coverage: "Magnets for the second dimension" (11.11.2019)



Major Scientific Achievement 2: World's smallest robust microrobotic delivery method

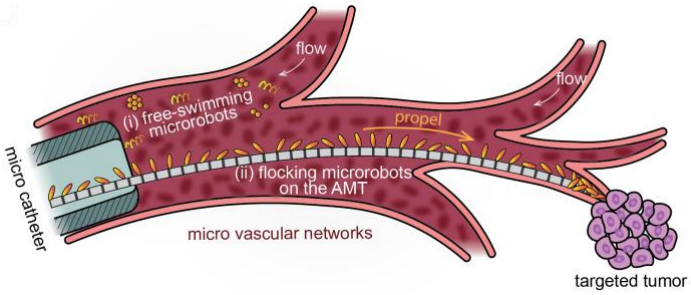
Microrobots can deliver drug molecules to targeted tissues, minimizing overall side effects. Existing mobile microrobots have relatively low speeds, and it is difficult to swim against the complex fluid flows inside the human body. We have developed a robust microrobot delivery method (***Nat. Mach. Intell. 2022***) that overcomes these challenges and provides rapid transport of microparticles without the need for an enclosing lumen to hold the particles together - just as kinesins walk along microtubules, the microcargoes actively walk out along a thin filament via micropatterned magnetic stepping stones. The strong magnetic field gradient in the vicinity of the micromagnets allows for strong dynamic anchoring and propulsion along the artificial microtubules at unprecedented speeds. The microrobots can even propel against strong fluid flows, which we quantified with detailed

experiments and theoretical modeling. Finally, we have demonstrated that this technology is capable of precisely delivering numerous microparticles at very high concentrations to a specific location within a branching microfluidic channel network (***Device, 2024***). This technology takes a large step forward from science fiction to real-world applications.
This research was presented at microTAS 2022, where it won the Best Talk Award (runner-up) and was widely covered in the media, including a 'News and Views' article on Nature Machine Intelligence.

Representative papers:
[1] Hongri Gu, et al. “Scalable high-throughput microfluidic separation of magnetic microparticles”, Device, 100403 (2024). https://doi.org/10.1016/j.device.2024.100403
[2] Hongri Gu, et al. “Artificial microtubules for fast and collective transport of magnetic microcargoes”, Nature Machine Intelligence, 4, 678–684 (2022). https://doi.org/10.1038/s42256-022-00510-7

Contribution:
conceived the idea, managed the research, performed the experiments, developed the theoretical model, performed data analysis, wrote the paper

Recognition:
- Best Talk Award at microTAS 2022 (runner up), (500 USD), Chemical and Biological Microsystems Society (CBMS)
- University of Pennsylvania homepage cover: “Inspired by nature, artificial microtubules can work against a current to transport tiny cargoes” (21.07.2022)
- News and views article in Nature Machine Intelligence: "Delivering microcargo with artificial microtubules" by Gerhard Gompper (4, 663–664, 2022)



Major Scientific Achievement 3: Magnetic cilia carpets with programmable metachronal waves

As the oldest microactuator, cilia are ubiquitous in nature. We have developed a highly customizable soft robotic system for cilia research (***Nat. Commun. 2020***). Unlike existing artificial cilia, we provide a simple method for fabricating hundreds of customized magnetic cilia with programmable metachronal waves. This level of system integration and complexity has only been possible through computer simulation. To demonstrate the power of this soft robotic platform, we experimentally confirm for the first time two important numerical findings about fluid transport on ciliated carpets. Furthermore, inspired by the giant African millipede, we show that metachronal waves can propel a soft robot. This robotic platform provides a powerful tool to make new discoveries in basic cilia research and to inspire new soft robot designs for biomedical applications.

Representative papers:
[1] Hongri Gu, et al. “Magnetic Cilia Carpets with Programmable Metachronal Waves” Nature Communications 11, 2637 (2020). https://doi.org/10.1038/s41467-020-16458-4

Contribution:

conceived the idea, managed the research, performed the experiments, performed data analysis, and wrote the paper.

Recognition:

- ESI highly cited papers in physics
- Nature Communications's top 50 physics articles in 2020.
- ETH homepage coverage: "Walking like a millipede" (09.06.2020)