WENQI HU

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EMPLOYMENT

Group Leader Start from Jan 2019

- Physical Intelligence Department
- MPI-IS, Stuttgart, Germany

Post-doctoral Researcher 2014 ~ 2018

- Physical Intelligence Department
- MPI-IS, Stuttgart, Germany
- Funded by Alexander von Humboldt Postdoctoral Fellowship (2016 Feb ~ 2018 Feb)

Research Assistant 2010 ~ 2014

- Microfluidics and Nanofluidics Laboratory
- University of Hawai´i-Manoā, Honolulu, USA

EDUCATION

Ph.D. in Electrical Engineering 2009 ~ 2014

- University of Hawai´i-Manoā, Honolulu, USA

B.E. in Microelectronics 2005 ~ 2009

- University of Electronic Sci. & Tech. of China, Chengdu, China

HONORS & AWARDS

- Annual award, *in Design & Elektronik, WEKA-Fachmedien* 2018
- Günter Petzow Prize, *in Max Planck Institute for Intelligence Systems* 2018
- Alexander von Humboldt Postdoctoral Fellowship 2016
- Best Ph.D. graduate, *in School of Engineering, University of Hawai´i-Manoā* 2014
- Second Prize, *in NIST Mobile Microrobotics Challenge* 2014
- Cover issue and top 10% collection, *in Lab on a Chip* 2013
- Second Prize, *in Breakthrough Innovation Challenge, UH Shidler College of Business* 2013

- Second Prize, *in NIST Mobile Microrobotics Challenge* 2012
- Best Conference Paper Award Finalist *in IEEE International Conference on Robotics and* 2012 *Automation (ICRA)* 2012

FUNDING EXPERIENCE

Alexander von Humboldt Postdoctoral Fellowship

2016 ~ 2018

- Alexander von Humboldt Foundation, Germany
- Project Title: "Wireless microrobotic fetascopy for minimally invasive fetal medicine" Amount: € 73,600

National Robotics Initiative

2012 ~ 2015

- National Institutes of Health (NIH), USA
- Project Title: "Parallel, independent control of microrobots for microassembly of tissues"
- Amount: $ 250,000
- Propose jointly with Prof. Aaron Ohta

PATENTS

[1] **W. Hu**, M. Sitti, G. Z. Lum, and M. Mastrangeli, "Method of actuating a shape changeable member, shape changeable member and actuating system," PCT Patent Application No: 17/050666, January 13, 2017.A. Ohta,

[2] **W. Hu**, W. Shiroma, "Reversible actuation of liquid metals," provisional patent, filed on 2012.

[3] A. Ohta, **W. Hu**, K. Ishii, Q. Fan, "Optically actuated microrobots for cell and micro-object manipulation and assembly," provisional patent 61/652,817, 2012.

[4] A. Ohta, **W. Hu**, K. Ishii, X. Zhang, D. Garmire, "Bubble microrobots for micromanipulation and microassembly," provisional patent 61/481,129, 2011.

[5] A. Ohta, S. Namekar, W. Hu, "Smart cell culture platform," provisional patent 61/363,076, 2010.

JOURNAL PUBLICATITONS

Article in preparation

[1] Z. Ren*, **W. Hu***, X. Dong and M. Sitti "Multi-functional soft-bodied jellyfish-like swimming", *Co-First Authors.

[2] **W. Hu**, Z. Ren and M. Sitti "A crawling magnetic soft robot for drug delivery".

[3] X. Dong, G. Z. Lum, **W. Hu**, Z. Ren and M. Sitti "Magnetic cilia array for fluidic manipulation".

[4] G. Z. Lum*, Y. Zhou*, **W. Hu*** and M. Sitti "Programmble magnetic liquid metal", *Co-First Authors.

Article published

[1] **W. Hu***, G. Z. Lum*, M. Mastrangeli and M. Sitti, "Soft miniature robots with multimodal locomotion," *Nature*, vol. 554, pp. 81-85, 2018. *Co-First Authors

[2] Q. Fan, **W. Hu**, and A. T. Ohta. "Localized single-cell lysis and manipulation using optothermally-induced bubbles," *Micromachines*, vol. 8, no. 4, pp. 121, 2017.

[3] G. Z. Lum, Z. Ye, X. Dong, H. Marvi, O. Erin, **W. Hu**, and M. Sitti, "Shape-programmable magnetic soft matter," *Proceedings of the National Academy of Sciences USA*, vol. 113, no. 41, pp. E6007–E6015, 2016.

[4] M. Sitti, H. Ceylan, **W. Hu**, J. Giltinan, M. Turan, S. Yim, and E. Diller, "Biomedical applications of untethered mobile milli/microrobots," *Proceedings of the IEEE*, vol. 103, no. 2, pp. 205–224, 2015.

[5] Q. Fan, **W. Hu**, and A. T. Ohta, "Efficient single-cell poration by microsecond laser pulses," *Lab on a Chip*, vol. 15, no. 2, pp. 581–588, 2015.

[6] **W. Hu**, Q. Fan, and A. T. Ohta, "Interactive actuation of multiple opto-thermocapillary flow-addressed bubble microrobots," *Robotics and Biomimetics*, vol. 1, no. 1, p. 14, 2014.

[7] Q. Fan, **W. Hu**, and A. T. Ohta, "Laser-induced microbubble poration of localized single cells," *Lab on a Chip*, vol. 14, no. 9, pp. 1572-8, 2014.

[8] R. C. Gough, A. M. Morishita, J. H. Dang, **W. Hu**, W. A. Shiroma and A. T. Ohta, "Continuous electrowetting of non-toxic liquid metal for RF applications," *IEEE Access*, vol. 2, pp. 874-882, 2014.

[9] **W. Hu**, Q. Fan, and A. T. Ohta, "An opto-thermocapillary cell micromanipulator," *Lab on a Chip*, vol. 13, no. 12, pp. 2285–91, 2013. (**Cover Issue, Top 10% Collection in *Lab on a Chip***)

[10] **W. Hu**, K. S. Ishii, Q. Fan, and A. T. Ohta, "Hydrogel microrobots actuated by optically generated vapour bubbles," *Lab on a Chip*, vol. 12, no. 19, pp. 3821–6, 2012.

[11] **W. Hu**, K. S. Ishii, and A. T. Ohta, "Micro-assembly using optically controlled bubble microrobots," *Applied Physics Letters*, vol. 99, p. 094103, 2011.

[12] **W. Hu** and A. T. Ohta, "Aqueous droplet manipulation by optically induced marangoni circulation," *Microfluidics and Nanofluidics*, vol. 11, no. 3, pp. 307-306, 2011.

[13] K. S. Ishii, **W. Hu**, S. A. Namekar, and A. T. Ohta, "An optically controlled 3D cell culturing system," *Advances in OptoElectronics*, vol. 2011, pp. 1-8, 2011.

BOOK CHAPTER

[1] **W. Hu**, Q. Fan, A. T. Ohta, "Optical manipulation for biomedical applications," Optical MEMS for chemical analysis and biomedicine, 2016.

CONFERENCE PROCEEDINGS

[1] **W. Hu**, K. Ishii and A. T. Ohta, "Cell patterning in a hydrogel using optically induced dielectrophoresis," in *IEEE international conference on Optical MEMS and Nanophotonics (OMN)*, Singapore, Singapore, July 2016.

[2] J. H. Dang, A. M. Morishita, R. C. Gough, **W. Hu**, A. T. Ohta, and W. A. Shiroma， "Liquid-metal reconfigurable RF components and antennas," in *URSI National Radio Science Meeting*, Boulder, USA, January 2014.

[3] Q. Fan, **W. Hu**, and A. T. Ohta, "Molecular delivery and transfection by laser - induced oscillating microbubbles," *in 9th IEEE International Conference on Nano/Micro Engineered and Molecular Systems (IEEE-NEMS)*, Honolulu, USA, April 2014.

[4] **W. Hu**, Q. Fan, A. H. Nicholas, M. C. Hagenow, and A. T. Ohta, "Bubble micro-manipulator for cooperative micro-manipulation," in *9th IEEE International Conference on Nano/Micro Engineered and Molecular Systems (IEEE-NEMS)*, Honolulu, USA, April 2014.

[5] **W. Hu**, Q. Fan, and A. T. Ohta, "Assembly of cell-laden microgels by an optically controlled bubble manipulator," in *17th International Conference on Miniaturized Systems for Chemistry and Life Sciences (μTAS)*, Freiburg, Germany, October 2013.

[6] W. G. Tonaki, **W. Hu**, A. T. Ohta, and W. A. Shiroma, "A reconfigurable, liquid-metal-based low-pass filter with reversible tuning," in *IEEE MTT-S International Wireless Symposium (IWS)*, Beijing, China, April 2013.

[7] **W. Hu**, Q. Fan, W. Tonaki, and A. T. Ohta, "Bubble-driven light-absorbing hydrogel microrobot for the assembly of bio-objects," *in 35th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, Osaka, Japan, July 2013.

[8] Q. Fan, **W. Hu**, and A. T. Ohta, "Light-induced microbubble poration of localized cells," in *35th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, Osaka, Japan, July 2013.

[9] **W. Hu**, Q. Fan, K. S. Ishii, and A. T. Ohta, "An opto-thermocapillary cell manipulator," in *16th International Conference on Miniaturized Systems for Chemistry and Life Sciences (μTAS)*, Okinawa, Japan, October 2012.

[10] A. T. Ohta, S. Guo, B. J. Lei, **W. Hu**, and W. A. Shiroma, "A liquid-metal tunable electromagnetic-bandgap microstrip filter," in *IEEE International Conference on Wireless Information Technology and Systems (ICWITS)*, Maui, USA, November 2012.

[11] S. Guo, B. Lei, **W. Hu**, W. A. Shiroma, A. T. Ohta, "A tunable low-pass filter using a Liquid-Metal Reconfigurable Periodic Defected Ground Structure," *Proceedings of International Microwave Symposium (IMS)*, Montreal, Canada, June 2012.

[12] B. J. Lei, **W. Hu**, A. T. Ohta, and W. A. Shiroma, "A liquid-metal reconfigurable double-stub tuner," *Proceedings of International Microwave Symposium (IMS)*, Montreal, Canada, June 2012.

[13] **W. Hu**, K. S. Ishii, and A. T. Ohta, "Micro-assembly using optically controlled bubble microrobots in saline solution," in *IEEE International Conference on Robotics and Automation (ICRA)*, Saint Paul, USA, May 2012. (**Best Paper Award Finalist**)

[14] K. S. Ishii, **W. Hu**, and A. T. Ohta, "Cooperative micromanipulation using optically controlled bubble microrobots," in *IEEE International Conference on Robotics and Automation (ICRA)*, Saint Paul, USA, May 2012.

[15] **W. Hu**, K. S. Ishii, and A. T. Ohta, "Micro-assembly using optically controlled bubbles," in *16th International Conference on Optical MEMS and Nanophotonics*, Istanbul, Turkey, August 2011.

DISSERTATION

[1] PhD dissertation, "Opto-thermal micro-transportation for cellular microbiology", march 2014. (Advisor: Prof. Aaron Ohta)

MEDIA COVERAGE

- "A mini, magnetic, all-terrain robot", Nature Videos, Feb 2018, link
- "A Mini, Magnetic, All-Terrain Robot", Scientific American, Feb 2018, link
- "Kleinstroboter: Medizinische Zukunft?", ZDF, Jan 2018, link
- "This Tiny Robot Walks, Crawls, Jumps and Swims. But It Is Not Alive", New York Times, Jan 2018, link
- "Tiny Robot Marks a Step Toward Using Devices Inside Humans", Wall Street Journal, Jan 2018, link
- "Forscher entwickeln Miniroboter zum Schlucken", Der Spiegel, Jan 2018, link
- "Der Roboter in mir", Süddeutsche Zeitung, link
- "An all terrain, tiny robot", Nature Podcast, Jan 2018, link
- "Microrobotics team excels once again at international challenge," *UH News*, June 2014, link
- "Microbots Made of Bubbles Have Engines Made of Lasers," *IEEE Spectrum*, May 2012, link
- "Researchers Turn Bubbles into Laser Controlled Microrobots," *Gizmodo*, May 2012, link
- "NIST contests in China put next-gen robot technologies to the test," *National Institute of Standards and Technology (NIST) Tech Beat*, June 2011, link
- "Hawaii team places second in tiny robot competition," *Hawaii News Now via Associated Press*, May 2011. Also covered by *Hawaii Telegraph*, *Pittsburgh Tribune Review*, *India Times*

RESEARCH EXPERIENCE

Magnetic Soft Miniature Robot

I invented a type of untethered millimeter-scale soft robots, which can be magnetically-actuated to achieve multiple modes of locomotion to navigate in complex landscapes. These robots can swim inside and on the surface of liquids, climb liquid menisci, roll and walk on solid surfaces, jump over obstacles, crawl within narrow tunnels, and they can reversibly transit across liquid and solid surfaces in unstructured environments. They can additionally execute pick-and-place tasks and carry-and-release of cargos. The demonstrated versatility and functionalities of these miniature soft robots are promising toward future medical applications, such as minimally invasive operations and targeted active drug delivery.

Optically Addressed Bubble Microrobots

I invented an optically addressed bubble microrobot, which resolved the long-term challenge of parallel controlling multiple robots in microscale. This idea enables convenient cooperative manipulation by multiple microrobots and greatly increases the system throughput. I demonstrated that these robots can cooperatively pattern microscale

biomedical materials such as single cell and cell blocks.

Light Induced Cell Poration

I jointly proposed the idea of using laser-induced microbubbles to porate the membranes of a single cell, into which desired molecules are then accurately delivered. To enable this, microsecond laser pulses were focused on an optically absorbent substrate, creating a vapor bubble. The shear stress accompanying the bubble size oscillation was able to porate nearby cells. The proposed method demonstrated a high poration efficiency on a single cell while not disturbing surrounding cells. This technique can be used for implementing cell therapy in the future.

Liquid Metal Microwave Device

I jointly proposed the idea of applying the liquid metal in the design of microwave filters and tuners. By using electrowetting, the liquid metal inside microfluidic channels can form adjustable and reconfigurable circuits. Compared with conventional counterparts, these novel circuits have more working modes.

TEACHING EXPERIENCE

Teaching Assistant

- EE 211 – Basic Circuit Analysis I 2013
- EE 211 Lab – Basic Circuit Analysis I 2009

Undergraduate Student Advisee

- Arınç Bulgur (University of Texas at Austin), summer internship 2018
- Michael Hagenow (Tufts University), summer internship 2012
- Alexander Nicholas (University of Hawaii), summer internship 2012
- Eric Wong (University of Pennsylvania.), summer internship 2011
- Triston Martinez (University of Hawaii), summer internship 2010

Graduate Student Advisee

- Ziyu Ren (MPI-IS), PhD student 2017 ~ Present
- Lisa Boehles (University of Stuttgart) 2018 ~ Present
- Tianlu Wang (MPI-IS), PhD student 2018 ~ Present

PROFESSIONAL ACTIVITIES

- Co-editor, special issue in Micromachines titled “Cell and micro-object manipulation and assembly”
- Reviewer, IEEE International Conference on Robotics and Automation (ICRA 2018)
- Reviewer, Journal of Micro-Bio Robotics
- Reviewer, Lab on a Chip

INVITED TALK

- “Soft Robotics at Small Scales”, Workshop, Livorno, Italy April 24th- 2018
- “RoboSoft Workshop + Bioinspiration & Biomimetics”, Workshop, Livorno, Italy April 24th- 2018
- “Small-scale robot”, Invited class talk, University of Heidelberg May 22nd- 2018