

Meng Yee (Michael) Chuah

1 Fusionopolis Way

Singapore 138632

+65-64082168

✉ michael_chuah@i2r.a-star.edu.sg

🌐 www.michaelchuah.net

✉ mcccxx@gmail.com

🌐 www.linkedin.com/in/michaelchuah

I am currently leading a team in developing capabilities for quadruped robots. The focus is on using learning-based methods for perceptual locomotion and terrain-awareness, enabling legged robots to safely and robustly navigate both urban areas and unstructured outdoor environments. My research interests lie at the intersection of legged locomotion and reinforcement learning, with the goal of encouraging widespread adoption of robots in society.

Current Position

July 2023 to Present **Senior Scientist, Robotics & Autonomous Systems (RAS)**, Agency for Science, Technology and Research (A*STAR), Institute for Infocomm Research (I²R).

www.a-star.edu.sg/i2r

Aug 2018 to June 2023 **Research Scientist, Robotics & Autonomous Systems (RAS)**, Agency for Science, Technology and Research (A*STAR), Institute for Infocomm Research (I²R).

www.a-star.edu.sg/i2r

Education

Jan 2013 to June 2018 **Doctor of Philosophy in Mechanical Engineering**, *Biomimetic Robotics Laboratory*, Massachusetts Institute of Technology (MIT), <http://biomimetics.mit.edu>.

Design Principles for Multi-Axis, Large Force Magnitude Sensor Arrays for Use in Human and Robotic Applications. This is a low-cost, lightweight, multi-axis force sensor for use on the MIT Cheetah robot. This sensor technology is being integrated into a pair of force sensing smart shoes for use in gait analysis.

Sep 2010 to Sep 2012 **Masters of Science in Mechanical Engineering**, *Massachusetts Institute of Technology (MIT)*, Cambridge, MA, 4.7/5.0.

Worked on the design and fabrication of the MIT Cheetah, which has been featured in CBS News, USA Today, TIME magazine, Discovery News, Huffington Post, Boston Herald, MIT News, and IEEE Spectrum.

Sep 2006 to Dec 2009 **Bachelor of Science in Mechanical Engineering, Minor in Robotics**, *Carnegie Mellon University (CMU)*, Pittsburgh, PA, 4.0/4.0.

Patents

Sep 2023 **Singapore Patent Application No. 10202302802R**, *Hybrid Actuator for Reconfigurable and Modular Mobile Robots*, Meng Yee (Michael) Chuah, Andrew Leong Jiacheng, Palanivelu Hari Prasanth, and Tan Chong Boon.

Mar 2023 **PCT Patent Application No. PCT/SG2023/050213 and Singapore Patent Application No. 10202203237Y**, *Method and system for navigating a robot*, Albertus Hendrawan Adiwahono, You Yangwei, Michael Chuah, Chen Tai Pang Lawrence, Chan Jian Le, Chan Chee Leong Raymond, Andrew Leong Jiacheng, Ng Kam Pheng, Wan Kong Wah, and Yau Wei Yun, <https://patents.google.com/patent/W02023191723A1/en>.

Apr 2022 **United States Patent No. US-11300397-B2**, *Compliant force sensing system*, Meng Yee (Michael) Chuah, Lindsay Epstein, Donghyun Kim, Juan Romero, and Sangbae Kim, <https://patents.google.com/patent/US11300397B2/en>.

PhD Thesis

Title **Design principles of multi-axis, large magnitude force sensors based on stress fields for use in human and robotic locomotion**

Supervisor Sangbae Kim

Download <https://dspace.mit.edu/handle/1721.1/119276>

Master Thesis

Title **Composite Force Sensing Foot Utilizing Volumetric Displacement of a Hyperelastic Polymer**

Supervisor Sangbae Kim

Download <http://dspace.mit.edu/handle/1721.1/78211>

Experience

Summer 2015 **Research Collaboration**, Ekso Bionics, Richmond, CA, www.eksobionics.com.
Evaluated the suitability of using my custom multi-axis force sensors for gait characterization on the Ekso Bionics powered robotic exoskeleton.

Jan 2010 to Aug 2010 **Research Engineer**, Singapore Institute of Manufacturing Technology (SIMTech), Singapore, www.simtech.a-star.edu.sg.
Conducted experiments on a cable-driven robotic arm using MATLAB[®] and OpenCV. Programmed and actuated a robotic hand using the Arduino[™] microcontroller.

Summer 2009 **Research Intern**, Singapore Institute of Manufacturing Technology (SIMTech), Singapore, www.a-star.edu.sg/simtech/Research/Research-Projects/tid/21/An-Omnidirectional-Mobile-Robot.aspx.
Modified a mobile wheel base design in SolidWorks to make it an omnidirectional mobile robot with powered caster wheels.

Technical Skills

Programming, Machine Learning, and Robotics Related

Programming C, C++, Java, Python, Git, Docker

OS Unix/Linux, Microsoft Windows

ML PyTorch, TensorFlow

Robotics Robot Operating System (ROS), Open Source Computer Vision Library (OpenCV).

Computer-Aided Design (CAD), Modeling, and Simulation software

CAD Autodesk Fusion360, OnShape, Certified SolidWorks[®] Associate (CSWA) CertificateID: C-HXQWAZCQSD
solidworks.virtualtester.com/#validate_button

Modeling and Simulation MATLAB[®], National Instruments (NI) LabVIEW[®], Abaqus[®] Finite Element Analysis (FEA) simulation

Rapid Prototyping and Fabrication skills

Machining Lathe, CNC mill, laser cutter, 3D printer, waterjet, polymer molding

Electronics Surface mount soldering, debugging embedded systems using oscilloscopes and logic analyzers.

PCB Design PCB schematic and layout software

Embedded Systems Microcontroller programming. Experience with Linux Single-Board Computers (SBC) such as Raspberry Pi, BeagleBone, and Odroid.

References

Google Scholar profile scholar.google.com/citations?hl=en&user=iBU4CfIAAAAJ

- [1] Garen Haddeler, Hari P. Palanivelu, Fabien Colonnier, Yung Chuen Ng, Albertus H. Adiwahono, Zhibin Li, Chee-Meng Chew, and Meng Yee Michael Chuah. “Real-time terrain anomaly perception for safe robot locomotion using a digital double framework”. In: *Robotics and Autonomous Systems* 169 (2023), p. 104512. ISSN: 0921-8890. DOI: <https://doi.org/10.1016/j.robot.2023.104512>. URL: <https://www.sciencedirect.com/science/article/pii/S0921889023001513>.
- [2] Garen Haddeler, Meng Yee (Michael) Chuah, Yangwei You, Jianle Chan, Albertus H. Adiwahono, Wei Yun Yau, and Chee-Meng Chew. “Traversability analysis with vision and terrain probing for safe legged robot navigation”. In: *Frontiers in Robotics and AI* 9 (2022). ISSN: 2296-9144. DOI: [10.3389/frobt.2022.887910](https://doi.org/10.3389/frobt.2022.887910). URL: <https://www.frontiersin.org/articles/10.3389/frobt.2022.887910>.
- [3] Garen Haddeler, Hari P. Palanivelu, Yung Chuen Ng, Fabien Colonnier, Albertus H. Adiwahono, Zhibin Li, Chee-Meng Chew, and Meng Yee Chuah. “Real-time Digital Double Framework to Predict Collapsible Terrains for Legged Robots”. In: *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2022, pp. 10387–10394. DOI: [10.1109/IROS47612.2022.9981613](https://doi.org/10.1109/IROS47612.2022.9981613).
- [4] Meng Yee (Michael) Chuah, Lindsay Epstein, Donghyun Kim, Juan Romero, and Sangbae Kim. “Bi-Modal Hemispherical Sensor: A Unifying Solution for Three Axis Force and Contact Angle Measurement”. In: *2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. <https://ieeexplore.ieee.org/abstract/document/8967878>. 2019, pp. 7968–7975. DOI: [10.1109/IROS40897.2019.8967878](https://doi.org/10.1109/IROS40897.2019.8967878).
- [5] Joao Ramos, Benjamin Katz, Meng Yee (Michael) Chuah, and Sangbae Kim. “Facilitating Model-Based Control Through Software-Hardware Co-Design”. In: *2018 IEEE International Conference on Robotics and Automation (ICRA)*. <https://ieeexplore.ieee.org/abstract/document/8460575>. 2018, pp. 566–572. DOI: [10.1109/ICRA.2018.8460575](https://doi.org/10.1109/ICRA.2018.8460575).
- [6] Meng Yee (Michael) Chuah and Sangbae Kim. “Improved normal and shear tactile force sensor performance via Least Squares Artificial Neural Network (LSANN)”. In: *2016 IEEE International Conference on Robotics and Automation (ICRA)*. <http://http://ieeexplore.ieee.org/abstract/document/7487123/>. May 2016, pp. 116–122. DOI: [10.1109/ICRA.2016.7487123](https://doi.org/10.1109/ICRA.2016.7487123).
- [7] Sangok Seok, Albert Wang, Meng Yee (Michael) Chuah, Dong Jin Hyun, Jongwoo Lee, David M. Otten, Jeffrey H. Lang, and Sangbae Kim. “Design Principles for Energy-Efficient Legged Locomotion and Implementation on the MIT Cheetah Robot”. In: *Mechatronics, IEEE/ASME Transactions on* 20.3 (June 2015). http://http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6880316, pp. 1117–1129. ISSN: 1083-4435. DOI: [10.1109/TMECH.2014.2339013](https://doi.org/10.1109/TMECH.2014.2339013).
- [8] Meng Yee (Michael) Chuah and Sangbae Kim. “Enabling Force Sensing During Ground Locomotion: A Bio-Inspired, Multi-Axis, Composite Force Sensor Using Discrete Pressure Mapping”. In: *Sensors Journal, IEEE* 14.5 (May 2014). <http://dspace.mit.edu/handle/1721.1/97549>, pp. 1693–1703. ISSN: 1530-437X. DOI: [10.1109/JSEN.2014.2299805](https://doi.org/10.1109/JSEN.2014.2299805).
- [9] Hsin-Liu (Cindy) Kao, Meng Yee (Michael) Chuah, Michael Degen, Jason Tucker, and Hiroshi Ishii. “LightBundle: Grasping Light Through Plant-inspired Interactions”. In: *Proceedings of the Extended Abstracts of the 32nd Annual ACM Conference on Human Factors in Computing Systems*. CHI EA ’14. <https://dl.acm.org/citation.cfm?id=2581194>. Toronto, Ontario, Canada: ACM, 2014, pp. 1849–1854. ISBN: 978-1-4503-2474-8. DOI: [10.1145/2559206.2581194](https://doi.org/10.1145/2559206.2581194). URL: <http://doi.acm.org/10.1145/2559206.2581194>.
- [10] Anirban Mazumdar, Meng Yee (Michael) Chuah, Michael S. Triantafyllou, and H. Harry Asada. “Design for precision multi-directional maneuverability: Egg-shaped underwater robots for infrastructure inspection”. In: *Robotics and Automation (ICRA), 2014 IEEE International Conference on*. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6907284. May 2014, pp. 2950–2956. DOI: [10.1109/ICRA.2014.6907284](https://doi.org/10.1109/ICRA.2014.6907284).

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