

Hang Xu, PhD

1. Personal details

Webpage: <https://www.hxlab.org/>

Email: hang.xu@concordia.ca

Tel: +1 5145787160

Research Interest: functional structure and composite material for aerospace, multiscale mechanics, 3D printing

Google Scholar: <https://scholar.google.com/citations?user=-GmwEjUAAAAJ&hl=en>

2. Work experience

- Sep. 2022 - **Assistant Professor**, Department of Mech., Ind., and Aero. Eng., **Concordia University**, Canada
Present
- ◆ Develop functional/smart aerospace structures
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- Jan. 2020 - **Research Associate**, Department of Materials, **Imperial College London**, UK
May. 2022
- ◆ Develop multi-stable structures and metamaterials for 1) programmable morphing, 2) phase transformation induced plasticity, 3) soft robots with contour recognition via artificial intelligence (AI) algorithms, and 4) medical balloon catheters for Atrial Fibrillation (AFib) treatment.
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- Jul. 2019 - **Industrial Post-doc, Aeroderivative Gas Turbine Team**, **Siemens Power & Gas** & **McGill University**, Canada
Jan. 2020
- ◆ Developed a finite element analysis (FEA) framework for anisotropic nonlinear constitutive modeling of superalloy (e.g., Hastelloy) **additive manufactured** (e.g., via SLM method) for **gas turbine** metallic parts.
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- Set. 2018 - **Post-doc**, Mechanical Engineering, **McGill University**, Canada
Jun. 2019
- ◆ Developed structures and metamaterials for thermally actuated **deployable mechanisms**.
 - ◆ Developed **multi-material additive manufacturing process** for materials of tunable thermal expansion.

3. Education

- Set. 2013 - **Ph.D., Mechanical Engineering**, **McGill University**, Canada (Supervisor: Prof. Damiano Pasini)
Aug. 2018
- ◆ Developed functional metamaterials with tunable thermal expansion and high structural efficiency.
 - ◆ Project: designed low-thermal-expansion metamaterials with the **MDA Corp.** for **satellite structures**.
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- Set. 2011 - **M.S., Aircraft Design**, **Beijing University of Aeronautics and Astronautics (BUAA, Beihang Uni.)**, China
Dec. 2013
- ◆ Research field: **aircraft structural mechanics** and optimization of stiffened panel stability.
 - ◆ Project: structural design and analysis of airborne medical facilities in the Institute of Aviation Medicine.
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- Set. 2007 - **B.S., Aircraft Design and Engineering**, **Shenyang Aerospace University**, China
Aug. 2011
- ◆ Research field: **aircraft aerodynamics** and aircraft components design.
 - ◆ Project: designed **high-lift multi-element** airfoil in Shenyang Aircraft Design Institute (intern).

4. Grant, funding, and honor

- Grant**
- ◆ Head of Department's Fund (Imperial College, 2021): **PI** for: bi-stable expandable metamaterials
 - ◆ Dame Julia Higgins Engineering Postdoc Collaborative Research Fund (Imperial College, 2021): **1) PI** for: metamaterials for contour recognition via AI; **2) Collaborator** for: metamaterial wearable sensor
 - ◆ Mitacs Accelerator Program (2019–2020, 8-month, #12561): I applied for \$30k to carry on joint research in Siemens Power and Gas (post-doc intern, 50% time) and at McGill (post-doc, 50% time).
 - ◆ Chinese Scholarship Conceal (CSC) Scholarship (48-month): I applied for \$80k for my doctoral research.
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- Funding**
- ◆ Research Associate Fellowship: £105k (2020–2022, 30-month), Imperial College London.

- ◆ Natural Sciences and Engineering Research Council of Canada (NSERC, 2017–2018, 12-month, I239081C0G & I208241C0G): \$25k for my post-doc research at McGill University.
- ◆ McGill Engineering Doctoral Award (MEDA): \$72k (2013–2017, 48-month), McGill University.

- Honor**
- ◆ **UK:** Excellent contribution to research in Covid-19 pandemic, Imperial College London (2020).
 - ◆ **Canada:** Winner of the Design Challenge of 3D-Printing Workshop, McGill University (2019).
 - ◆ **China:** Outstanding Graduate of Beijing (2013); Chinese National Scholarship (2009).

5. Teaching

- ◆ **Associate Fellowship of Higher Education Academy accreditation (AFHEA), UK (2022)**
- ◆ **Lecturer, teaching assistant, and grader (2016-2017):** course ‘Cellular (Architected) Materials’ (McGill, 30 students): I was the **lecturer** of weekly two-hour FEA software application sections and exercise lectures on deformable solid mechanics and tensor analysis. I graded the homework, exams, and final projects.
- ◆ **Tutoring (2014-2015):** course ‘Mechanical Eng. Project’, a hands-on project (McGill, 4 UG students): I gave informational lectures; provided one-on-one tutorials for fabrication, testing, and numerical simulation.
- ◆ **Grader (2012-2013):** course ‘Finite Element Method’ (BUAA, 30 graduate students): I graded homework and final examination; introduced and graded the final project.

6. Supervision activities

- ◆ **Master students 1)** 2020-2021, Imperial College: I supervised one MSc and one MEng student for their final projects. The MEng student ranked top 20%. **2)** 2016-2018, McGill: I provided a Master student with informational lectures and tutorials of fabrication, experiments, experimental data analysis, and numerical simulation. He published three journal papers that constructed the main components of his master thesis.
- ◆ **Summer students (2016-2018, McGill):** I served as a graduate assistant mentor for four summer students for their Summer Undergraduate Research in Engineering (SURE) program. One of the summer students won the first prize in the SURE program (2017).
- ◆ **Undergraduate student (2013, BUAA):** I provided two undergraduate students with informational lectures, tutorials of numerical simulation, and supervision of their thesis in aircraft design.

7. Professional service and evidence of esteem

- Conference organizing**
- ◆ **Chair** of the Porous and Cellular Materials Session in the 18th ICCS, June 2015, Lisbon, Portugal
 - ◆ **Vice President** of the Graduate Council to organize the 9th Graduate Students Academic Forum BUAA
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- Campus service**
- ◆ **Senior Lab Member** (2020-now, Imperial College) for equipment maintenance, training, and cleaning.
 - ◆ **Lab manager** (2017-2019, Pasini Group, McGill University) for equipment maintenance and training.
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- Invited talks**
- ◆ **1)** School of Civil Aviation, 8th Northwestern Polytechnical Uni. Aoxiang Forum, 2021; **2)** Beijing Uni. of Aeronautics & Astronautics 10th Vision Forum, 2021; **3)** Dalian Uni. of Tech. Xinghai International Forum, 2019
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- Reviewers**
- ◆ **Review editor of journals:** *Nature Communications*, *Journal of Materials Science*, *Composites Science and Technology*, *Frontiers in Mechanical Engineering*, *Fibers and Polymers*, and *Journal of Visualized Experiments*
 - ◆ **Editor of the conference:** *The 9th Graduate Students Academic Forum BUAA, 2012*
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- Memberships**
- ◆ Materials Research Society (**MRS**); American Physical Society (**APS**); McGill Institute for Aerospace Engineering (**MIAE**); Research Center for High-Performance Polymer and Composite Systems (**CREPEC**, Ca)
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- Outreach**
- ◆ The 6th Montreal Industrial Problem-Solving Workshop, 2015. Ultralight Lattice for Pratt & Whitney Ca.

Publications

Doctoral thesis Xu H., Multiscale Architected Materials with Tunable Thermal Expansion, McGill University, Montreal, Canada, 2018

Book Chapter Xu H. and Pham M.S., 1.8 Multimaterial Metal Printing, Additive Manufacturing for Multifunctional and Multiscale Metallic Lattice Structure. (in process)

Journal articles 10. Xu H., Dohm J., and Pham M.S., Digital Meta-structures with Reprogrammable Quantized Morphing, (to be submitted)

9. Xu H. and Pham M.S., Multi-stable mechanical metamaterials with programmable morphing, (currently under review)

8. Xu H. and Pham M.S., Damage-tolerant 3D printed architected materials with phase transformation induced plasticity, (currently under review)

7. Leng J., Xu H., Schaezner M., Pham M. Q., Bourgeois G., Shanian A., and Pasini D., Generalized tessellations of superelliptical voids in low porosity architected materials for stress mitigation, *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, Vol 477, 2246, 2021.

6. Xu H., Farag A., Ma R., Pasini D., Thermally Actuated Hierarchical Lattices with Large Linear and Rotational Expansion, *Special Issue on Architected Materials, ASME Journal of Applied Mechanics*, 2019.

5. Xu H., Farag A., Pasini D., Routes to Program Thermal Expansion in Three-dimensional Lattice Metamaterials Built from Tetrahedral Building Blocks, *Journal of the Mechanics and Physics of Solids*, Vol. 117, pp. 54-87, 2018.

4. Xu H., Farag A., Pasini D., Multilevel Hierarchy in Bi-material Lattices with High Specific Stiffness and Unbounded Thermal Expansion, *Acta Materialia*, Vol. 134, pp. 155-166, 2017.

3. Wang Y., Xu H., Pasini D., Multiscale Isogeometric Topology Optimization for Lattice Materials, *Computer Methods in Applied Mechanics and Engineering*, Vol. 316, pp. 568-585, 2017.

2. Xu H. and Pasini D., Structurally Efficient Three-dimensional Metamaterials with Controllable Thermal Expansion, *Scientific Reports*, Vol. 6, pp. 34924, 2016.

1. Xu H. and Xu Y., Research on the Impact of Carrier-Based Aircraft's High Lift Device on the Thin Airfoil's Lift Coefficient, *Aircraft Design (China)*, Vol. 2, pp. 1-7, 2014

Conference abstracts 15. Xu H., Pham M. S., Multi-stable architected materials with high-mobility morphing, *18th European Mechanics of Materials Conference (EMMC18)*. April 2022, Oxford, UK.

14. Oosterbeek R., Xu H., Jeffers J., Overcoming the strength-modulus tradeoff using double network metamaterial lattices, *International Conference on Programmable Materials, 2022*, Hybrid Event

13. Sanz-Pena I., Carrero N. R., Xu H., Hopkins M., 3D Printed Soft Metamaterial Force Sensors for Gait Monitoring Using TPU-Graphene Composites, *27th Congress of the European Society of Biomechanics (ESB2022)*, 2022, Porto, Portugal

12. Leng J., Xu H., Schaezner M., Pham M. Q., Bourgeois G., Shanian A., and Pasini D., Optimized Superelliptical Voids in Generalized Tessellation of Low Porosity Architected Materials for Stress Mitigation, *Society of Engineering Science (SES) Annual Conference 2021*. October 2021, online. (Poster)

11. **Xu H.** and Pham M.S., Multi-stable metamaterials with programmable morphing, *10th Imperial College Materials Postdoc & Fellow Symposium*, September 2021, London, UK.
10. **Xu H.**, Farag A., and Pasini D., Routes to Program Thermal Expansion in Three-dimensional Lattices Built from Tetrahedral Building Blocks, *IUTAM Symposium Architected Material Mechanics*. September 2018, Chicago, USA.
9. Farag A., **Xu H.** and Pasini D., Thermally Actuated Planar Lattices with High Fractal Stiffness, *IUTAM Symposium Architected Material Mechanics*. September 2018, Chicago, USA.
8. **Xu H.** and Pasini D., A Class of 3D Low CTE Lattice Materials that are Stiff and Strong, in *the 12th Annual CREPC Symposium*. December 2017, Montreal, Canada. (Poster)
7. **Xu H.** and Pasini D., Stiff and Strong Octet Lattice with Tunable Coefficient of Thermal Expansion, *The 24th ICTAM*, August 2016, Montreal, Canada.
6. **Xu H.**, Liu L., Pasini D., Multifunctional Lattices with Low Thermal Expansion and Low Thermal Conductivity, *APS 2016*, April 2016, Baltimore, US.
5. **Xu H.** and Pasini D., A Class of Low CTE 3D Lattices that are Stiff and Strong, *MRS 2015 Fall Meeting and Exhibit*, November 2015, Boston, US.
4. **Xu H.** and Pasini D., Bi-material Lattice with High Stiffness and Strength for Low Thermal Expansion, *The 18th ICCS*, June 2015, Lisbon, Portugal.
3. **Xu H.** and Pasini D., Bi-material Lattice with High Stiffness and Strength for Low Thermal Expansion, in *MIAE*. 2015, McGill University. (Poster)
2. **Xu H.** and Pasini D., A Class of Low CTE Lattice Materials that are Stiff and Strong, in *MERS*. October 2015, Montreal, Canada. (Poster)
1. **Xu H.** and Xu Y., High Lift Research for A Fighter-Type, Multi-Element Airfoil, *Proceedings of the 9th Graduate Students Academic Forum BUAA*, 2012, Beijing, China.

Patents

3. Kanagaratnam P., Linton N., Temelkuran B., **Xu H.**, Abdelaziz M., Pham M. S., and Wang L., A System for Clinical Targeting of Atrial Arrhythmias, *Imperial College Invention Disclosure*, Application submitted
2. Pasini D. and **Xu H.**, Lattice Metamaterial Having Programed Thermal Expansion, US Patent App. 16/622,600, 2021
1. Pasini D. and **Xu H.**, Lattice Material Having Programed Thermal Expansion, Publication Number: W0/2018/227302, International Application No.: PCT/CA2018/050723