Yanglong Lu
Assistant Professor
Department of Mechanical and Aerospace Engineering
Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong
+852 60670701
maeylu@ust.hk

EDUCATION

Ph.D. Georgia Institute of Technology, Atlanta, GA
Aug 2016 - Dec 2020 | Mechanical Engineering
Dissertation: *Physics based compressive sensing for additive manufacturing process monitoring*
Committee Members: Dr. Yan Wang (Chair), Dr. Alexander Alexeev, Dr. Mark Davenport, Dr. Steven Liang, Dr. Devesh Ranjan, Dr. Christopher Saldana

B.S. Georgia Institute of Technology, Atlanta, GA
Aug 2014 - May 2016 | Mechanical Engineering

Rutgers University – New Brunswick, New Brunswick, NJ
Sept 2012 - May 2014 | Mechanical Engineering

PROFESSIONAL POSITIONS

07/2022-present **Assistant Professor**
The Hong Kong University of Science and Technology

06/2021-06/2022 **Postdoctoral Research Fellow**:
University of Michigan

01/2021-06/2021 **Postdoctoral Researcher**
Georgia Institute of Technology

HONORS AND AWARDS

2022 The University of Michigan Postdoctoral Association Conference Award

2021 ASME CIE Best Ph.D. Dissertation Award

2019 Student travel grant for 2019 NAMRC/MSEC conference, National Science Foundation (NSF)

2017 ASME Design for Manufacturing and Life Cycle Conference Student Poster Competition Award, 2nd Place

Summer 2016 President's Undergraduate Research Travel Awards, Georgia Institute of Technology

Spring 2016 President's Undergraduate Research Awards, Georgia Institute of Technology

2013-2014 School of Arts and Sciences Excellence Award for the 2013-2014 academic year, Rutgers

CURRENT RESEARCH INTERESTS

- PROCESS MONITORING IN MANUFACTURING: In this research, traditional data-driven compressed sensing is extended to a new physics based compressive sensing scheme. The physics based compressive sensing protocols rely on physical knowledge of phenomena to monitor manufacturing processes with reduced sensing costs. The three-dimensional temperature and fluid velocity fields in manufacturing processes can be obtained by solving inverse problems with partial differential equation constrained optimization. Physics constrained dictionary learning schemes are also developed to improve sensing efficiency in cyber-physical systems and sensor networks.
- MULTI-PHYSICS MODELING AND SIMULATION: For multi-physics modeling and simulation, an open-source Python-based software package was developed to model and simulate temperature and velocity fields in the melt pool of metal additive manufacturing. The model and process parameters can be calibrated by solving an inverse problem when experimental data are available. Research interests in this direction include forward and inverse modeling of different multi-physics systems such as thermal-fluid, thermal-mechanical and fluid-mechanical systems.
- MACHINE LEARNING FOR SMART MANUFACTURING: Machine learning can be widely applied in manufacturing for different purposes. Because of a large amount of data can be collected during the processes, machine learning can help to extract useful and meaningful information and process data efficiently. Clustering and regression algorithms have been applied to predict manufacturing costs. Sparse dictionary learning has been used for data compression in monitoring manufacturing processes. The aim of this research is to explore advantages of machine learning in manufacturing systems which include quality control, machine health monitoring, machine calibration and supply chain management.
- HUMAN HEALTH MONITORING AND BIOMANUFACTURING: It is challenging to diagnose and prognose human health conditions because of limitations in data acquisition techniques and sensor accessibility. For instance, biomechanics such as aortic stiffness and wall stresses play important roles in identifying abnormalities of thoracic aorta. However, these quantities cannot be directly obtained from imaging techniques. In this research, physics-informed data-driven approaches will be developed to predict unmeasurable quantities based on measured data. For biomanufacturing, techniques to optimize structures of scaffolds and improve bioprinting processes will be developed. The optimization technique integrated with multiphysics models will be used to design scaffolds with desired material properties. The process monitoring and control technique will be developed to minimize defects such as non-homogeneous strands, strand fusion, strand collapse, and others in the extrusion-based bioprinting process.

PUBLICATIONS

Refereed Journal Articles

1. Malashkhia, L., Liu, D., **Lu, Y.**, & Wang, Y. (2022). Physics-Constrained Bayesian Neural Network for Bias and Variance Reduction. *Journal of Computing and Information Science in Engineering*, 1-13.
2. **Lu, Y.**, & Wang, Y. (2022) Structural Optimization of Metamaterials Based on Periodic Surface Modeling, *Computer Methods in Applied Mechanics and Engineering*, 395, 115057.
3. **Lu, Y.**, & Wang, Y. (2021) Physics Based Compressive Sensing to Monitor Temperature and Melt Flow in Laser Powder Bed Fusion, *Additive Manufacturing, 47*, 102304.
4. **Lu, Y.**, Shevtshenko, E. & Wang, Y. (2021) Physics Based Compressive Sensing to Enable Digital Twins of Additive Manufacturing Processes, *Journal of Computing and Information Science in Engineering*, *21*(3), 031009.
5. **Lu, Y.**, & Wang, Y. (2020) A Physics-Constrained Dictionary Learning Approach for Compression of Vibration Signals, *Mechanical Systems and Signal Processing*, *153*, 107434.
6. **Lu, Y.**, & Wang, Y. (2020). Physics Based Compressive Sensing Approach to Monitor Turbulent Flow. *AIAA journal*, *58*(8), 3299-3307.
7. **Lu, Y.**, & Wang, Y. (2019). An efficient transient temperature monitoring of fused filament fabrication process with physics-based compressive sensing. *IISE Transactions*, *51*(2), 168-180.
8. **Lu, Y.**, & Wang, Y. (2018). Monitoring temperature in additive manufacturing with physics-based compressive sensing. *Journal of manufacturing systems*, *48*, 60-70.
9. Chan, S. L., **Lu, Y.**, & Wang, Y. (2018). Data-driven cost estimation for additive manufacturing in cybermanufacturing. *Journal of manufacturing systems*, *46*, 115-126.

Under Review

1. **Lu, Y.**, & Wang, Y. A Physics-Constrained Dictionary Learning Scheme to Improve Efficiency of Imaging Systems in Additive Manufacturing Process Monitoring, *Additive Manufacturing*, under review

In Preparation

1. **Lu, Y.**, & Burris, N., Identification of Thoracic Aortic Aneurysm Based on Statistical Shape Model.
2. **Lu, Y.**, Burris, N. & Figueroa, A., Inverse Optimization Technique to Identify Aortic Wall Mechanics.
3. Thoracic Aortic Aneurysms: A Multiparametric Evaluation of Wall Abnormalities

Refereed Book Chapters

1. Sestito J.M., Liu D., **Lu Y.**, Song J.-H., Tran A.V., Kempner M.J., Harris T.A.L., Ahn S.- H., and Wang Y. (2021) Multiscale process modeling of shape memory alloy fabrication with directed energy deposition. *Manufacturing in the Era of 4th Industrial Revolution - Vol. 1. Recent Advances in Additive Manufacturing*, eds. by H. Bruck, Y. Chen, and S.K. Gupta (World Scientific), Ch.3, pp. 41-76.

Refereed Conference Proceedings

1. **Lu. Y**., and Wang, Y. "Additive Manufacturing Process Monitoring Based on Compressed Sensing and Physics-Constrained Dictionary Learning." *Proceedings of the ASME 2022 International Additive Manufacturing Conference*, October. 19-20, 2022, Lisbon, Portugal.
2. **Lu. Y**., and Wang, Y. "Concurrent Shape and Topology Optimization of Metamaterials Based on Periodic Surface Modeling." *Proceedings of the ASME 2022 International*

Design Engineering Technical Conferences & Computers and Information in Engineering Conference, Aug. 14-17, 2022, St. Louis, Missouri.

3. Bian, Z., Zhong, J., **Lu. Y**., Hatt, C., and Burris, N. "LitCall: Learning Implicit Topology for CNN-based Aortic Landmark Localization." *Proceedings of Medical Imaging 2022,* Feb. 20-23, 2022, San Diego, California.
4. **Lu, Y.**, and Wang, Y. "Machine Fault Diagnosis of Fused Filament Fabrication Process with Physics-Constrained Dictionary Learning." *Proceedings of 49th Annual North American Manufacturing Research Conference (NAMRC 49),* June 21-25, 2021, Cincinnati, Ohio.
5. **Lu, Y.**, and Wang, Y. "Physics-Constrained Dictionary Learning for Selective Laser Melting Process Monitoring." *Proceedings of the 2021 IISE Annual Conference,* May 22-25, 2021.
6. **Lu Y.** and Wang Y. "An improvement of physics based compressive sensing with domain decomposition to monitor temperature in fused filament fabrication process." *Proceedings of 2019 ASME 14th International Manufacturing Science and Engineering Conference (MSEC2019)*, June 10-14, 2019, Erie, Pennsylvania, Paper No. MSEC2019-2899.
7. Song R., **Lu Y.**, Telenko C., and Wang Y. "Manufacturing energy consumption estimation using machine learning approach." *Proceedings of 2017 ASME International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (IDETC/CIE2017)*, Aug. 6-9, 2017, Cleveland, Ohio, Presentation No. DETC2017-67679 (Design for Manufacturing and Life Cycle Conference Student Poster Competition Award 2nd Place)
8. Liu J., Hu Y., **Lu Y.**, Wang Y., Xiao L., and Zheng K. "A remote health condition monitoring system based on compressed sensing." *Proceedings of 2017 IEEE International Conference on Mechanical, Systems and Control Engineering (ICMSC 2017)*, May 19-21, 2017, St. Petersburg, Russia.

Conference Presentations

1. **Lu Y.**, Hong S., Ahn S., and Wang Y. "Physics-Based Compressive Sensing and Physics-Constrained Dictionary Learning to Monitor Laser Powder Bed Fusion Process." *Additive Manufacturing Benchmarks 2022*, August 15-18, 2022, Bethesda, Maryland.
2. **Lu Y**. and Wang Y. "Monitoring thermofluid field of melt pool in laser powder bed fusion wit physics based compressive sensing." *Proceedings of the 2022 IISE Annual Conference,* May 21-24, 2022. Seattle, Washington.
3. Garcia-Morales J., Meng Y., and **Lu Y**. "Medical image classification based on physics-constrained dictionary learning", *National Conference on Undergraduate Research*, April 4-8, 2022.
4. **Lu Y.** and Wang Y. "Physics **based compressive** sensing for melt pool monitoring in laser powder bed fusion." *IS&T Electronic Imaging 2022*, January 16-20, 2022.
5. **Lu Y.** and Wang Y. "Process temperature monitoring with physics-based compressive sensing." *2017 Annual International Solid Freeform Fabrication Symposium (SFF Symp 2017)*, August 7-9, 2017, Austin, Texas.
6. **Lu Y.**, Yang C., and Wang Y. "Process-oriented data exchange for interoperable and verifiable additive manufacturing." *2016 ASME Manufacturing Science and Engineering Conference (MSEC2016) / The 44th SME North America Manufacturing Research*

Conference (NAMRC), June 27-July1, 2016, Blacksburg, Virginia, USA, MSEC2016-8711.

7. **Lu Y.**, Yang C., and Wang Y. "Process-oriented data exchange for interoperable and verifiable additive manufacturing." *11th Annual Undergraduate Research Spring Symposium*, April 2017 Georgia Institute of Technology.

Patents

1. "Hybrid Compressed Sensing to Monitor Manufacturing Processes," U.S. Provisional Patent Application No. 62/533,744. July 18, 2017.
2. "Physics Based Compressive Sensing to Measure Turbulent Fluid Flows," U.S. Provisional Patent Application No. 63/027,445. May 20, 2020.

Invited Seminar Presentations

1. (Feb 2022) "Advanced Sensing Techniques to Efficiently Monitor Manufacturing Processes", City University of Hong Kong
2. (Nov 2021) "Advanced Sensing Techniques to Efficiently Monitor Manufacturing Processes", University of Missouri
3. (Oct 2021) "Advanced Sensing Techniques to Efficiently Monitor Manufacturing Processes", University of Louisville
4. (Dec 2019) "Physics Based Compressive Sensing for Additive Manufacturing Process Monitoring", Nanjing University, Nanjing, China
5. (Dec 2019) "Physics Based Compressive Sensing for Additive Manufacturing Process Monitoring", Huazhong University of Science & Technology, Wuhan, China

TEACHING EXPERIENCES

Spring 2023: **Assistant professor**, Hong Kong University of Science and Technology
Course: Computer-Aided Design and Manufacturing

Fall 2023: **Assistant professor**, Hong Kong University of Science and Technology
Course: Mechanisms of Machinery

Spring 2020: **Teaching Practicum Guest Lecturer**, Georgia Institute of Technology
Course: Interactive CAD and CAE

Spring 2018- 2020: **Graduate Teaching Assistant**, Georgia Institute of Technology
Course: Computer-Aided Design

PROPOSAL WRITING EXPERIENCE

- Contributed to a National Institutes of Health (NIH) proposal on "Development of an Image-Based, Computationally Efficient, Multi-Parametric Analysis Pipeline to Identify Disease Phenotypes of Aortic Wall Stress and Three-Dimensional Growth". (September 2021)
- Wrote a proposal on "Inverse Optimization Methods for Longitudinal Estimation of Aortic Wall Mechanics in Ascending Aortic Aneurysm" for American Heart Association Postdoctoral Fellowship. (August 2021)
- Contributed to a National Science Foundation (NSF) proposal on "Digital Twins of Metal Additive Manufacturing Processes". (May 2021)
- Contributed to a letter of intent funded by Department of Energy on "Physics Based Compressive Sensing for Efficient Data Exchange in Distributed Research Infrastructure". (April 2021)

- Contributed to a proposal funded by NSF Engineering Research Center for Cell Manufacturing Technologies (CMaT) on "Temperature Monitoring of Bioreactor with Physics Based Compressive Sensing". (January 2021)
- Contributed to a proposal funded by American Makes on "Physics Based Compressive Sensing for Metal Additive Manufacturing Process Monitoring". (September 2020)
- Contributed to a proposal funded by NSF on "Scalable Distributed Sensing for Process Monitoring Cybermanufacturing". (December 2017)

RESEARCH EXPERIENCES

06/2021 – 06/2022 **Postdoctoral Research Fellow**: Detection and quantification of aortic enlargement in aneurysm (Advisor: Dr. Nicholas Burris and Dr. C. Alberto Figueroa)
University of Michigan, Ann Arbor, MI

- Reconstruct 3D model with Vascular Deformation Mapping technique from CT image
- Classify thoracic aortic aneurysm growth phenotypes with statistical shape model and machine learning techniques
- Estimate aortic mechanics with inverse optimization methods
- Identify aortic wall stresses with physics-based compressive sensing

01/2021 – 06/2021 **Postdoctoral Researcher**: Manufacturing process monitoring and topology optimization (Advisor: Dr. Yan Wang)
Georgia Institute of Technology, Atlanta, GA

- Extend physics-based compressive sensing by incorporating high-fidelity models to monitor melt pool in metal based additive manufacturing
- Develop a physics-constrained dictionary learning scheme to improve the efficiency of data collection and classify machine states in additive manufacturing
- Extend the developed approaches for different applications to improve the sensing efficiency.
- Optimize geometry of heat sink for chip cooling with Bayesian optimization
- Optimize arrangement of transducers for underwater communication with acoustic signals

08/2016 – 12/2020 **Graduate Research Assistant**: Physics-based compressive sensing
Georgia Institute of Technology, Atlanta, GA

- Developed a framework to monitor the temperature distribution and velocity field in additive manufacturing
- Integrated the physical model in applications with the compressive sensing approach to improve the compression ratio, efficiency and accuracy.
- Reduced the number of sensors in the monitoring system to improve the efficiency of data collection

08/2016 –12/2017 **Graduate Research Assistant**: Data-driven cost estimation for manufacturing
Georgia Institute of Technology, Atlanta, GA

- Predicted the manufacturing cost based on features extracted from 3D CAD model or 2D engineering drawings
- Used Apache Cassandra as database and Apache Spark as computing system
- Applied clustering and regularization regression algorithms to predict costs
- The project was supported in part by the National Science Foundation and the Digital Manufacturing and Design Innovation Institute (DMDII)

01/2015 – 05/2016 **Undergraduate Research Assistant**: Optimization of 3D printer
Georgia Institute of Technology, Atlanta, GA

- Worked as the awardee of President's Undergraduate Research Awards, Spring 2016
- Investigated the solution to improve the efficiency and precision of current Rapid Prototyping techniques
- Gained high level of CAD skills for both 2D and 3D designs, including Finite Element Analysis using Siemens NX10
- Acquired substantial experience in using commercial 3D printers and related software tools

INDUSTRY EXPERIENCES

02/2016 – 03/2017 Co-founder of SolCharged, LLC

- Designed surveys and distributed to top solar technology application centers; received feedback on specific customer needs
- Prepared weekly meetings and gave detailed presentations to mentors and sponsors from the US Dept. of Energy, and effectively illustrated the company's recent operating information
- Responsible for the company's internal operations and risk management.
- Optimized the design of products with CAD and simulation tools, and made prototype for industrial applications.

UNIVERSITY AND COMMUNITY SERVICE

Journal Review

- Journal of Manufacturing Systems
- PLOS One
- Journal of Computing and Information Science in Engineering
- Computers & Industrial Engineering
- IEEE Transactions on Industrial Informatics
- IEEE Transactions on Industrial Electronics
- Additive Manufacturing
- Materials
- Applied Sciences
- Processes
- Energies
- Sensors

- Scientific Reports

Conference Proceedings Review

- ASME IDETC/CIE 2022 conference
- ASME IDETC/CIE 2020 conference
- ASME IDETC/CIE 2019 conference
- ASME MSEC 2019 conference
- ASME IDETC/CIE 2018 conference

Proposal Review

- Undergraduate Research Opportunities Program (PURA), Georgia Institute of Technology. Budget: $1500 salary and $1000 travel award

Ph.D. Thesis Committee

- Kehinde Sikirulai OYETUNDE, Algorithmic development of Kriging-based methods for complex problems via improved kernel and hyperparameter selection (2022)

MENTORSHIP

Final year design projects

- Siu Nga Lam, Tsz Long Lee, Qihua Huang, Wang Lan Chan: 2022-2023. Project: Design and Build multifunctional Bioprinter

Undergraduate students

- Jaslin Garcia-Morales: Fall 2021. Research project: Medical image classification
- Yang Meng: Fall 2021. Research project: Medical image classification
- Dustin Coha: Fall 2020. Research project: Blood flow modelling.
- Louis Cardot: Summer 2020. Research project: Processing of thermal and x-ray images in metal additive manufacturing process.
- Alizay Shah: Spring 2020. Research project: Statistical machine learning for battery health diagnostics and prognostics.
- Boce Xue: Summer 2016. Research project: Design of a hybrid system by including additive and subtractive manufacturing processes.
- Olvis Hernandez: Summer 2016. Research project: Design of a hybrid system by including additive and subtractive manufacturing processes.
- Dong Yeon (Justin) Yoo: Spring 2017. Research project: Development of GUI to predict the manufacturing cost based on features extracted from 3D CAD model or 2D engineering drawings
- Yufeng Wang: Spring 2017. Research project: Development of GUI to predict the manufacturing cost based on features extracted from 3D CAD model or 2D engineering drawings.