Luke Scime

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EDUCATION

Doctor of Philosophy in Mechanical Engineering — **May 2018**
Dissertation on Additive Manufacturing Process Optimization and In-Situ Monitoring — Pittsburgh, PA
Carnegie Mellon University (GPA: 3.97/4.00)

Master of Science in Mechanical Engineering — **May 2016**
Qualifying topic in Advanced Heat Transfer — Pittsburgh, PA
Carnegie Mellon University (GPA: 3.96/4.00)

Bachelor of Science in Mechanical Engineering — **May 2014**
Minor in Electrical Engineering — Gainesville, FL
The University of Florida (GPA: 4.00/4.00)

CAREER FOCUS

My research focus is engineering scalable data analytics tools and digital infrastructure to speed the adoption of Additive Manufacturing (AM) processes by U.S. industry. Leveraging Artificial Intelligence (AI) and computer vision, I develop real-time process monitoring and data visualization software stacks for powder bed AM technologies (L-PBF, EB-PBF, and binder jetting). I am dedicated to ensuring laboratory safety and I have a life-long passion for engaging young students and building their confidence in STEM.

ENGINEERING EXPERIENCE

R&D Staff Scientist — **April 2023 – Now**
R&D Associate Staff Scientist — **May 2019 – April 2023**
Oak Ridge National Laboratory — Oak Ridge, TN

- Leading development of *Peregrine*, an AI-based data analysis and visualization tool for powder bed printers. *Peregrine* is printer and sensor agnostic, tested on 20 different platforms, with around 20 active ORNL users and licenses assigned to 16 companies and universities. *Peregrine* has now been deployed, and is collaboratively developed, across 12 DOE, NNSA, and DOD sites.
- Leading a multi-year effort to integrate 19 powder bed printers and their post-processing operations into the Digital Platform. Includes developing sensor hardware, deploying compute and networking infrastructure, designing software tools, and creating part tracking mechanisms.
- Leading the Augmented Intelligence Relay (AIR) team to demonstrate prediction of local tensile properties of L-PBF components using digitally twinned datasets for the AMMT nuclear program.
- Acquired $320k in CRADA funding for AM process monitoring activities and participated in technical collaborations with Raytheon, Cummins, GE, and EOS.
- Assisting with roadmap and proposal documents for multi-year DOE EERE and DOE NE programs.
- Engaging with 40+ visiting companies, government agencies, and universities each year.
- Curating and publicly releasing powder bed printing datasets accessed by 14+ external entities.
- Leading development of *Pigeon*, an AI image segmentation tool and API which is used by ORNL researchers for microscopy, robotics, DED printing, and electronics printing.

Postdoctoral Researcher — **June 2018 – April 2019**
Oak Ridge National Laboratory — Oak Ridge, TN

- Invented the DSCNN neural network for segmenting high resolution, multi-modal image data.
- Developed powder bed data analysis and visualization tools for the AMO and GVSC programs.
- Developed computer vision tools for high-speed melt pool imaging data from DED processes.

Founder **May 2018 – December 2021**
Manufacturing Software Solutions, LLC Pittsburgh, PA

- Sold an AI software developed at CMU for EOS M290 (L-PBF) anomaly classification to 3 entities.

PhD Research Assistant **August 2014 – May 2018**
Carnegie Mellon University Pittsburgh, PA

- Dissertation entitled *Methods for the Expansion of Additive Manufacturing Process Space and the Development of In-Situ Process Monitoring Methodologies*.
- Classified L-PBF melt pool morphologies based on high-speed visible-light camera data and correlated them with processing defects (e.g., keyholing porosity) using machine learning.
- Classified surface-visible, millimeter-scale laser powder bed anomalies based on visible-light camera data using a modified multi-scale convolutional neural network.
- Developed new laser scan strategies to increase low cycle fatigue life of In718 L-PBF parts by 2x.
- Studied the impact of non-standard powders for on part surface roughness and porosity in L-PBF.
- Mapped the influence of L-PBF process parameters on melt pool geometry and defect variability for the AlSi10Mg and In718 material systems using experimental and basic analytical techniques.
- Engaged with 50+ companies and government agencies via the NextManufacturing Consortium.

Lab Group Safety Coordinator **January 2016 – May 2018**
Carnegie Mellon University Pittsburgh, PA

- Collaborated with GBBN Architects, contractors, and CMU administration for two years to design an advanced manufacturing laboratory including layout, MEP specifications, and work controls.
- Operated, implemented training for, and performed maintenance on an EOS M290 L-PBF printer, an ExOne Innovent binder jet printer, a 1600 ˚C heat treatment furnace, and a wire EDM.
- Developed new safety protocols alongside EH&S to ensure a safe working environment for the entire research group and served as a member of the Graduate Student Safety Subcommittee.

Internship **Summer 2013**
DEKA Research and Development Manchester, NH

- Performed CAD and assembly work on a medical device leveraging SLS nylon AM for prototyping.
- Created a data acquisition system with documentation to meet US PTO and FDA requirements.

Internship **Summer 2011 and 2012**
NASA Independent Verification & Validation Facility Fairmont, WV

- Programmed the inverse kinematics for a 5-DoF robotic arm used for testing V&V procedures.
- Developed a multi-robot system for cooperative room mapping used for testing V&V procedures.

UNDERGRADUATE RESEARCH EXPERIENCE

Individual Senior Design Project **Spring 2014**
Intelligent Machines Design Lab Gainesville, FL

- Created an autonomous robot to locate proxy sea turtle nests using a camera and other sensors.
- Performed electrical and mechanical design and fabrication, and software development tasks.

Group Senior Design Project **Fall 2013 and Spring 2014**
Integrated Product and Process Design Gainesville, FL

- Developed a device to detect aerosolized sulfuric acid in a processing tower for Mosaic Fertilizer.
- Performed mechanical and electrical design and fabrication, and software development tasks.

MENTORING AND TEACHING EXPERIENCE

Secret City Wildbots FIRST Robotics Team **2018 – Now**

- Dedicating 700+ hours each year to mentoring high school and middle school students, primarily in the areas of programming (LabVIEW and Python), embedded electronics, and pneumatics.
- Teaching advanced controls concepts including sensor fusion, continuous pose estimation, autonomous pathing, feedback and feedforward controllers, and fault-tolerant design.
- Assisting with Scrum, drive team, systems engineering, and mechanical design and fabrication.

Oak Ridge National Laboratory **2018 – Now**

- Mentoring an ORNL staff member working on their master's degree at UT-Knoxville.
- Mentored one postdoctoral researcher.
- Mentored four high school seniors for the ORHS Math Thesis Program.
- Guest lectured on AI and AM topics for various courses at WPI and CMU.

Carnegie Mellon University **2014 – 2018**

- Completed the Eberly Center's Future Faculty program and attended workshops on course design, teaching philosophy, and fostering inclusive learning environments. Created a syllabus for an undergraduate heat transfer course based on modern pedagogy research.
- Prepared and presented recitation lectures, held office hours, graded exams, and developed content for an introduction to mechanical engineering and statics course.
- Proctored labs, held office hours, and graded lab reports for a vibration and controls course.
- Mentored two PhD students in AI and computer vision techniques.

VOLUNTEER EXPERIENCE

FIRST Robotics Competition

- Lead controls systems mentor for the Secret City Wildbots (FRC 4265) **2018 – Now**
- Lead Robot Inspector at 2 regional competitions **2017 – 2018**
- Robot Inspector or Controls Systems Advisor at 6 local and regional competitions **2011 – 2016**
- Assistant mentor for Mountaineer Area Robotics (FRC 2614) **2010 – 2012**

FIRST Lego League

- Robot Design Judge or Referee at 10 local, regional, and national competitions **2008 – Now**

HONORS AND AWARDS

- UT-Battelle, Excellence in Science and Technology, Technology Transfer Award **2022**
- Federal Laboratory Consortium, Excellence in Technology Transfer Award **2021**
- Oak Ridge National Laboratory Innovation Award **2021**
- FIRST Robotics Competition Regional Woodie Flowers Mentoring Award **2021**
- Dept. of Mech. Eng., Milton Shaw PhD Travel Award **2018**
- Worcester Polytechnic Institute, STEM Faculty Launch program delegate **2017**
- Dept. of Mech. Eng., Jeremiah Mpagazehe PhD Student Service Award **2017**
- University of Florida Anderson Scholar of Highest Distinction **2012**
- National Merit Finalist and University of Florida scholarship recipient **2010**
- FIRST Robotics Competition Dean's List International Award Winner **2010**
- National Youth Science Camp, West Virginia delegate **2010**

PATENTS

1. **L. Scime**, V. Paquit, D. Goldsby, W. Halsey, C. Joslin, D. Richardson, D. Rose, D. Siddel. Systems and Methods for Powder Bed Additive Manufacturing Anomaly Detection. U.S. Patent 11,458,542.

JOURNAL PUBLICATIONS AND DATASETS

Citations: 1,277
H-index: 10

1. O. Rahman, S. Venkatakrishnan, **L. Scime**, P. Brackman, C. Fredrick, R. Dehoff, V. Paquit, A. Ziabari. *Deep Learning Based Workflow for Accelerated Industrial X-Ray CT*. ICEP. Accepted 6/2023.
2. **L. Scime**, D. Goldsby, V. Paquit. M*ethods for Rapid Identification of Anomalous Layers in Laser Powder Bed Fusion*. Manufacturing Letters. Accepted 1/2023.
3. Z. Snow, **L. Scime**, A. Ziabari, B. Fisher, and V. Paquit. *Observation of Spatter-Induced Stochastic Lack of Fusion in Laser Powder Bed Fusion Using In Situ Process Monitoring.* AMJ. 1/2023.
4. **L. Scime**, C. Joslin, R. Duncan, F. Brinkley, C. Ledford, D. Siddel, V. Paquit. *Layer-wise Imaging Dataset from Powder Bed Additive Manufacturing Processes for Machine Learning Applications (v2022-10)*. 11/ 2022.
5. **L. Scime**, A. Singh, V. Paquit. *A Scalable Digital Platform for the use of Digital Twins in Additive Manufacturing*. Manufacturing Letters. 1/2022.
6. W. Halsey, D. Rose, **L. Scime**, R. Dehoff, V. Paquit. *Localized Defect Detection from Spatially Mapped, In-Situ Process Data with Machine Learning*. Frontiers in Mechanical Engineering. 11/2021.
7. S. Taller, **L. Scime**, K. Terrani. *Utilizing a Dynamic Segmentation Convolutional Neural Network for Microstructure Analysis of Additively Manufactured Superalloy 718*. Microscopy and Microanalysis. 8/2021.
8. **L. Scime**, V. Paquit, C. Joslin, D. Richardson, D. Goldsby, L. Lowe. *Layer-wise Imaging Dataset from Powder Bed Additive Manufacturing Processes for Machine Learning Applications (v2021-03)*. 4/2021.
9. **L. Scime**, D. Siddel, S. Baird, V. Paquit. *Layer-Wise Anomaly Detection and Classification for Powder Bed Additive Manufacturing Processes: A Machine-Agnostic Algorithm for Real-Time Pixel-Wise Semantic Segmentation.* AMJ. 12/2020.
10. **L. Scime**, J. Beuth. *Melt Pool Geometry and Morphology Variability for the Inconel 718 Alloy in a Laser Powder Bed Fusion Additive Manufacturing Process*. AMJ. 10/2019.
11. **L. Scime**, J. Beuth. *Using Machine Learning to identify In-Situ Melt Pool Signatures indicative of Flaw Formation in a Laser Powder Bed Fusion Additive Manufacturing Process*. AMJ. 1/2019.
12. **L. Scime**, J. Beuth. *A Multi-scale Convolutional Neural Network for Autonomous Anomaly Detection and Classification in a Laser Powder Bed Fusion Additive Manufacturing Process*. AMJ. 12/2018.
13. S. P. Narra, **L. Scime**, J. Beuth. *Integrated Control of Melt Pool Geometry and Microstructure in Laser Powder Bed Fusion of AlSi10Mg.* Met. Trans. A. 10/2018.
14. **L. Scime**, S. DeVincent Wolf, J. Beuth, S. Mrdjenovich, M. Kelley. *Safety and Workflow Considerations for Modern Metal Additive Manufacturing Facilities*. JOM. 9/2018.
15. **L. Scime**, B. Fisher, J. Beuth. *Using Coordinate Transforms to Improve the Utility of a Fixed Field of View High Speed Camera for Additive Manufacturing Applications*. Manufacturing Letters. 4/2018.
16. **L. Scime**, J. Beuth. *Anomaly Detection and Classification in a Laser Powder Bed Fusion Process using a Trained Computer Vision Algorithm*. AMJ. 1/2018.

In Preparation

- **L. Scime**, C. Joslin, D. Collins, M. Sprayberry, A. Singh, W. Halsey, R. Duncan, Z. Snow, R. Dehoff, V. Paquit. *A Generalizable Data-Driven Framework for Direct Local Tensile Property Prediction of Laser Powder Bed Fusion Parts using an Augmented Intelligence Relay*. Submitted 3/2023.
- Z. Snow, **L. Scime**, A. Ziabari, B. Fisher, and V. Paquit. S*calable Non-Destructive Inspection of Additively Manufactured Components Using In Situ Process Monitoring, Sensor Fusion, and Machine Learning*. Submitted 1/2023.
- G. Knapp, B. Stump, **L. Scime**, A. Rossy, C. Joslin, W. Halsey, A. Plotkowski. *A Physics-based Digital Twin for Microstructure Heterogeneity Prediction in Additively Manufactured Parts*. Submitted 3/2023.

INVITED PRESENTATIONS

- *A Scalable In-Situ Process Monitoring Software Stack using Artificial Intelligence*. ICAM. D.C. October 2023.
- *AM Digital Thread & Materials Data Generation* panel discussion. RAPID. Chicago, IL. May 2023.
- *Scalable Part Qualification for Powder Bed Additive Manufacturing*. NASA/ASTM. Huntsville, AL. June 2022.
- *A Comprehensive Digital Platform for AM*. ICAM. Virtual. November 2020.
- *Peregrine: A Machine-Agnostic Approach to Layer-Wise Process Monitoring and Control of Powder Bed Additive Manufacturing Technologies*. TMS. San Diego, CA. February 2020.
- *Applications of Data Analytics and ML for Additive Manufacturing*. WVU. Morgantown, WV. October 2019.

CLEARANCES, PROFESSIONAL SERVICE, MEMBERSHIPS, AND CERTIFICATIONS

- University of Tennessee Oak Ridge Innovation Institute (UT-ORII) fellow as of 2022.
- Recurring author of the Wohlers Report's chapter on *process monitoring in metal powder bed fusion* from 2020 – 2023. Wohlers is the leading additive manufacturing industry publication.
- Manuscript reviewer since 2018 for journals including *Additive Manufacturing*, *Scripta Materialia*, *Journal of Intelligent Manufacturing*, *ASME Journal of Manufacturing Science and Engineering*, *IEEE*, and J*ournal of Machine Tools and Manufacturing.*
- Proposal reviewer since 2020 for programs including NSF CMMI and DOE NE / NEUP / SBIR / STTR.
- Organizing committee member for a symposium at the 2023 ASTM ICAM conference in Washington D.C.

RESEARCH IN THE MEDIA

- *AI software enables real-time 3D printing quality assessment.* ORNL. August 2020. https://www.ornl.gov/news/ai-software-enables-real-time-3d-printing-quality-assessment.
- *As ORNL builds novel reactor, nuclear industry benefits from technology.* ORNL. May 2020. https://www.ornl.gov/news/ornl-builds-novel-reactor-nuclear-industry-benefits-technology.
- *The intersection of 3-D printing and machine learning*. CIT. June 2018. https://engineering.cmu.edu/news-events/news/2018/06/01-intersection-scime.html.

UNIQUE COURSEWORK AND TECHNICAL SKILLS

- Courses in Computer Vision, Solidification Processing, Control Theory, Finite Element Modeling, Inverse Kinematics, Digital Logic, Microprocessor Applications, Modern Physics, and Climate Change Mitigation.
- Advanced experience programming with Python, TensorFlow, LabVIEW, and MATLAB.
- Some experience programming with C++ and assembly code.
- Significant experience designing with SolidWorks, Autodesk Inventor, and Magics.
- Advanced experience operating EOS M290, ExOne Innovent, and Concept Laser M2 metal printers.
- Experience using polishing and metallurgical sample preparation equipment and optical microscopes.
- Experience with high temperature furnaces, wire EDMs, manual mills, manual lathes, soldering, FDM and SLA polymer printers, laser cutters, and hand tools.
- Experience with National Instruments DAQs and a broad range of microcontrollers and microprocessors.
- Experience with visible-light cameras, high speed visible-light cameras, infrared cameras, near infrared cameras, pyrometers, thermocouples, photodiodes, accelerometers, inertial measurement units, encoders, potentiometers, Hall effect sensors, pressure transducers, ultrasonic range finders, infrared range finders, laser range finders, beam breaks, and strain gauges.

OTHER INTERESTS

- I am an avid wildlife and landscape photographer with an online portfolio https://lrscime.myportfolio.com/.