

# Luke Scime

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## EDUCATION

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### Doctor of Philosophy in Mechanical Engineering

*Dissertation on Additive Manufacturing Process Optimization and Monitoring*  
Carnegie Mellon University (GPA: 3.97/4.00)

May 2018

Pittsburgh, PA

### Master of Science in Mechanical Engineering

*Qualifying topic in Advanced Heat Transfer*  
Carnegie Mellon University (GPA: 3.96/4.00)

May 2016

Pittsburgh, PA

### Bachelor of Science in Mechanical Engineering

*Minor in Electrical Engineering*  
The University of Florida (GPA: 4.00/4.00)

May 2014

Gainesville, FL

## CAREER FOCUS

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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

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### R&D Associate Staff Scientist

Oak Ridge National Laboratory

May 2019 – 2022

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 14 different platforms, with 12+ active ORNL users and licenses assigned to 7 companies and 7 government entities.
- Leading a multi-year effort to integrate 15+ 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 \$240k in funding for a CRADA with RTX on training neural networks to detect porosity.
- Assisting with roadmap and proposal documents for multi-year DOE EERE and DOE NE programs.
- Participating in CRADAs with Cummins, GE, and EOS on AM process monitoring.
- Engaging with 40+ visiting companies, government agencies, and universities each year.
- Curating and publicly releasing powder bed printing datasets accessed by 10+ 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

Oak Ridge National Laboratory

June 2018 – April 2019

Oak Ridge, TN

- Invented the Dynamic Segmentation Convolutional Neural Network (DSCNN) architecture for analysis of multi-modal in-process layer-wise imagery from powder bed printing processes.
- 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.

May 2018 – December 2021

**Founder**

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**

Carnegie Mellon University

**August 2014 – May 2018**

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**

Carnegie Mellon University

**January 2016 – May 2018**

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**

DEKA Research and Development

**Summer 2013**

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**

NASA Independent Verification &amp; Validation Facility

**Summer 2011 and 2012**

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**

Intelligent Machines Design Lab

**Spring 2014**

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**

Integrated Product and Process Design

**Fall 2013 – Spring 2014**

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

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### Secret City Wildbots FIRST Robotics Team 2018 – 2022

- 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 – 2022

- Mentoring an ORNL staff member working on their master's degree at UT-Knoxville.
- Mentored one postdoctoral researcher.
- Mentored two 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

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### FIRST Robotics Competition

- Lead controls systems mentor for the Secret City Wildbots (FRC 4265) 2018 – 2022
- 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 9 local, regional, and national competitions 2008 – 2022

## HONORS AND AWARDS

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- 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

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- **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. Under Review (16/950,484).

## JOURNAL PUBLICATIONS AND DATASETS

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Citations: 839

H-index: 8

- 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. Submitted July 2022.
- **L. Scime**, A. Singh, V. Paquit. *A Scalable Digital Platform for the use of Digital Twins in Additive Manufacturing*. Manufacturing Letters. January 2022.
- 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. November 2021.
- **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)*. OSTI. April 2021.
- **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. December 2020.
- **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. October 2019.
- **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. January 2019.
- **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. December 2018.
- 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. October 2018.
- **L. Scime**, S. DeVincent Wolf, J. Beuth, S. Mrdjenovich, M. Kelley. *Safety and Workflow Considerations for Modern Metal Additive Manufacturing Facilities*. JOM. September 2018.
- **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. April 2018.
- **L. Scime**, J. Beuth. *Anomaly Detection and Classification in a Laser Powder Bed Fusion Process using a Trained Computer Vision Algorithm*. AMJ. January 2018.

### In Preparation

- **L. Scime**, D. Goldsby, V. Paquit. *Methods for Rapid Identification of Anomalous Layers in Laser Powder Bed Fusion*. Manufacturing Letters.
- **L. Scime**, C. Joslin, D. Collins, M. Sprayberry, A. Singh, W. Halsey, R. Duncan, Z. Snow, R. Dehoff, V. Paquit. *Direct Local Tensile Property Prediction for Laser Powder Bed Fusion Parts using an Augmented Intelligence Relay*. AMJ.

## INVITED PRESENTATIONS

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- *Scalable Part Qualification for Powder Bed Additive Manufacturing*. NASA/ASTM. Huntsville, AL. June 2022.
- *A Comprehensive Digital Platform for AM*. ASTM 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.

## PROFESSIONAL SERVICE, MEMBERSHIPS, AND CERTIFICATIONS

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- 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 – 2022. 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 *Journal of Machine Tools and Manufacturing*.
- Proposal reviewer since 2020 for programs including DOE NE, NSF CMMI, and DOE NEUP.
- Member of Pi Tau Sigma honors society as of 2013.
- PADI Open Water SCUBA certified in 2011.

## RESEARCH IN THE MEDIA

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- *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>.
- *Looking through the eyes of a 3-D printer*. CIT. November 2017.  
<https://engineering.cmu.edu/news-events/news/2017/11/06-scime-3d-printer.html>.

## UNIQUE COURSEWORK AND TECHNICAL SKILLS

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- 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

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