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CONTACT INFORMATION

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RESEARCH INTERESTS

Additive manufacturing, composites, control theory, industrial robotics, flexible motion systems, engineering design, mobile robotics, engineering education, machine dynamics, industrial controls, mechatronics

EDUCATION

The Georgia Institute of Technology, Atlanta, Georgia USA

Ph.D., Mechanical Engineering, August 2013
GPA: 4.00/4.00

- Emphasis: Dynamics and Control Systems
- Minor: Robotics for Manufacturing
- Thesis Topic: Robust Estimation for the Control of Flexible Robotic Manipulators

M.S., Mechanical Engineering, August 2010
GPA: 4.00/4.00

- Emphasis: Dynamics and Control Systems
- Minor: Robotics for Manufacturing

Purdue University, West Lafayette, Indiana USA, May 2007

B.S., Mechanical Engineering
GPA: 3.74/4.00

EXPERIENCE

Oak Ridge National Laboratory

- R&D Staff Member: November 2014 - Present, Manufacturing Systems Research Group
- Post Doctoral Research Fellow: August 2013 - November 2014, Manufacturing Systems Research Group
- Robotics Intern: May 2006 - August 2007, Robots and Energetic Systems Group

Georgia Institute of Technology

- Graduate Research Assistant: August 2007 - August 2013, Intelligent Machine Dynamics Laboratory
- Graduate Teaching Assistant: August 2007 - May 2008, Experimental Methodology
- Graduate Teaching Assistant: January 2011 - May 2012, Motion Control Systems
- NSF Student-Teacher Enhancement Partnership Fellow: May 2008 - May 2009, Marrietta High School
- CEISMC Hovercraft Camp Instructor: July 2011

Y-12 National Security Complex

- Mechanical Engineering Intern: May 2005 - August 2005, Oak Ridge Metrology Center

Awards

Oak Ridge National Laboratory

- Early Career Researcher Award 2020 - For distinction as an innovative thought leader in advanced manufacturing
- Technology Transfer Award 2020 - For distinguished innovation and leadership in transferring advanced manufacturing technologies to the private sector
- Technology Commercialization Award - Licensing of BAAM Portfolio to Strangepresse Inc.
- Significant Event Award 2017 - Additively Manufacturing Large Metal Structures Rapidly: printing the boom of an excavator at the April 2017 CONEXPO
- Significant Event Award 2016 - High Temperature Autoclavable Tooling using Large Scale Additive Manufacturing
- Significant Event Award 2015 - Additive Manufacturing and Integrated Energy Systems Demonstration
- Significant Event Award 2015 - ORNL Shelby Cobra
- Directors Award 2014 - Big Area Additive Manufacturing System Development
- Technology Transfer Award 2014 - Cincinnati Incorporated BAAM Development
- Significant Event Award 2014 - Control System for Enabling Large Scale Additive Manufacturing

The Society of Manufacturing Engineers

- Society of Manufacturing Engineers 2020 - Outstanding Young Manufacturing Engineer

Federal Laboratory Consortium

- Technology Focus Award 2018 - Successful Collaboration Accelerates Testing of New Blade Designs
- Excellence in Technology Transfer 2018 - ORNLs Co-Development and Licensing of Large Additive Area Manufacturing Technologies
- Partnership Award 2017 - National Rotor Testbed: Using Large Scale 3D Printing to Test New Wind Blade Designs

R&D Magazine

- R&D 100 Award 2018 - Ambient Reactive Extrusion Additive Manufacturing
- R&D 100 Award 2017 - Additively Manufactured Magnets
- R&D 100 Award 2017 - Large Format Additive Manufacturing Coating Solutions
- R&D 100 Award 2017 - High Temperature Autoclavable Materials for AM
- R&D 100 Award 2015 - Editor's Choice Award Winner: Process/Prototyping
- R&D 100 Award 2015 - GENOA Software

ASM International

- ASM 2016 - Engineering Materials Achievement Award

Society of Manufacturing Engineers (SME)

- Additive Manufacturing Advisor - 2016-2017
- RAPID 2014 - Exhibitor Innovation Award

JEC Group

- JEC Composites Innovation Award - 2016

The Composites and Advanced Materials Expo

- Combined Strength Award - 2015

National Science Foundation

- Student and Teacher Enhancement Parnership - STEP Fellowship, 2008-2009

General Motors
- Manufacturing Education Program - GM Manufacturing Scholar, 2009-2010

Rockwell Automation
- Rockwell Automation Fellowship, 2009

Woodruff School of Mechanical Engineering
- Fluid Power and Motion Control Industry Status Review - Best Poster, 2009
- WSSAC Apprentice Award - Best Teaching Assistant, 2008
- Graduate Teaching Assistantship, 2007-2008
- Graduate Research Assistantship, 2008-2013

Science Applications International Corporation
- Georgia Tech Student Paper Competition - Runner Up, 2009

Summary of ORNL Projects

Sky BAAM - Cable Driven Large Scale AM
- Developing a new, large format 3D printer that uses a cable driven mechanism rather than a Cartesian gantry. Initial scope is to build a test system with a 10'x10'x10' build volume that will enable the study of the dynamic motion capability of this platform and deposition of sonstruction materials at infrastructure scale.
  - Principle Investigator
  - Responsible for meeting all Department of Energy Annual Operating Plan milestones and leading technical development and demonstration of capability
  - Department of Energy Annual Operating Plan $6M 3 Year program

Big Area Additive Manufacturing (BAAM) Systems Research
- Thrust lead for large scale polymer additive manufacturing systems
- Responsible for meeting all Department of Energy Annual Operating Plan milestones
- Led the development of control systems and process tools that enable deposition rates 1000x faster and orders of magnitude larger than traditional additive manufacturing systems
- 20+ Active industrial partnerships aimed at improving the utility of and expanding the application space of BAAM

Active Projects

Big Area Additive Manufacturing (BAAM) - Polymer Systems
- Developing and helping commercialize large scale, high speed additive manufacturing. The goals include: industrialize additive manufacturing and develop systems that can produce large parts (in excess of 20 ft on a major dimension) at rates exceeding 100 lbs/hr with low cost feedstocks (less than $10/lb). Partnered with Local Motors and Cincinnati Incorporated on the first 3D printed car. Currently working with approximately 20+ industrial partners exploring the use of technology for low cost tooling and advancing technologies that enable multi-resolution, hybrid materials, and 5-axis out-of-plane printing.
  - Role: Principle Investigator (FY17 - Present)
  - Type: Department of Energy Annual Operating Plan
  - Funding Agency: Department of Energy's Advanced Manufacturing Office
  - Amount (FY14 - Present): $12M

Additive Manufacturing in Wind Energy Systems

- Performing an extensive search of applications for additive manufacturing in wind turbine applications including utility scale and distributed wind applications. Published a report for DOE outlining opportunities, risks, and long-term applications in wind turbine production using additive manufacturing. Partnering with Vestas, the worlds largest wind turbine manufacturer, to target nacelle components, which could be impacted by additive manufacturing.
  - Role: Principle Investigator
  - Type: Department of Energy's Annual Operating Plan
  - Funding Agency: Department of Energy's Wind Energy Technologies Office
  - Amount (FY14 - Present): $700K

Strangepresse - Extruder Technology

- Large scale polymer AM systems differ from traditional small scale AM systems in a few significant areas. The primary distinction is the use of a polymer extruder that uses pellets rather than a hot-end that melts filament. Most polymer extruders are stationary and designed to operate at steady state conditions. Servo driven extruders are now being developed by Strangepress, specifically tailored to this process. ORNL is working with Strangepress to evaluate their extruder designs for this new application.
  - Role: Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $40K

Large Scale Metal AM Systems Research (Metal BAAM)

- Implemented GKN titanium laser welding additive manufacturing process control
- Developed active compensation strategy that enables high speed deposition of titanium near-net shape parts

Selected Completed Projects

Whirlpool Inc. - Refrigerator Cabinet Foaming Process Tooling

- Evaluating the potential of using additively manufactured polymer tools to replace conventional tooling in the refrigerator cabinet foaming process. The target is to reduce the cost of tooling by an order of magnitude without impacting tooling longevity or the quality of the manufactured components.
  - Role: Principle Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $240K

ORNL Omnidirectional Autonomous Shuttle

- Developing a novel platform for multi-person, high-mobility autonomous vehicle research. The base vehicle allows for modular/replaceable cab designs that can be manufactured rapidly through large scale additive manufacturing.
  - Role: Investigator
  - Type: ORNL Seed Money
  - Funding Agency: Internal
  - Amount: $200K

Gate Precast Company: Concrete Mold Inserts

- Collaborating with Gate Precast Company to develop a process that enables rapid construction of molds for concrete fascia components. The target is to enable extreme duty mold inserts (more than 100 pulls) for a high rise building installation.

To date, additive manufacturing reduces the mold production time from 2 weeks to 2 days and inserts have been tested successfully to 50 pulls without failure.
- Role: Investigator
- Type: DOE AMO Technical Collaboration (CRADA)
- Funding Agency: Department of Energy
- Amount: $240K

GKN Aerospace - Large Scale Titanium Laser Wirefeed AM
- Developing the control systems necessary to enable large scale titanium additive manufacturing. Project target is to produce aerospace relevant near-net-shape parts with material properties that meet design specifications. Ultimately, building near-net-shape components at high deposition rates will enable significant cost reduction verses conventional manufacturing of lightweight aircraft components.
  - Role: Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $16M (5 Years)

Army Corps of Engineers Printed Concrete Barrack Hut
- The target of this program is to enable the Army to quickly produce infrastructure in forward deployments without burdening the supply chain or putting soldiers at risk. The goal is to develop the technology and techniques necessary to print concrete barracks using locally sourced materials. Polymer BAAM is being used to make emplaced elements in the structure including HVAC pass-throughs and door lentils.
  - Role: Investigator
  - Type: Work For Others
  - Funding Agency: Army Corp of Engineers
  - Amount: $300K

US Navy Development and Demonstration of 3D Printed Submersible Vehicles
- Seal delivery vehicles (SDV) are small submersible vehicles that are used to transport gear and personnel from one underwater location to another. Current SDVs are expensive to manufacture and the design cycles are measured in years. BAAM is an enabling technology that is being applied to develop new autonomous and manned wet sub designs rapidly and for significant cost reductions.
  - Role: Investigator
  - Type: Work For Others
  - Funding Agency: Department of Defense
  - Amount: $1M

Residual Stress Modeling for Large Scale Polymer AM
- Residual stress formation limits the utility of large scale additive manufacturing constraining the types of geometry and size of parts that can be manufactured. This program is in partnership with the Office of Naval Research and is targeted at building fundamental models of the thermophysical properties of the BAAM process. These models will be used to influence the tool path generation and design tools that drive the BAAM process.
  - Role: Investigator
  - Type: Work For Others
  - Funding Agency: Department of Defense
  - Amount: $1M

Diversified Tooling - Automotive Tooling

- Automotive tooling consists of numerous types of molds and patterns, three of which are being evaluated for BAAM and metal BAAM processes (check fixtures, foundry patterns, and stamping dies). Quick turn tooling has the ability to revolutionize the automobile manufacturing process, which enables rapid innovation and drives down the cost of production.
  - Role: Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $40K

Ingersoll Machine Tools - Wide and High Additive Manufacturing (WHAM)

- Traditional AM processes are limited by the size of their oven and their deposition rate. A typical 3D printer can make parts the size of a shoe box. The Ingersoll WHAM, which is being developed in partnership with ORNL, will have a build envelope of 4m x 3m x 20m and deposit material at a rate greater than 1000lb/hr.
  - Role: Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $40K

Hybrid Manufacturing Technologies

- In contrast to subtractive manufacturing technologies where material is removed successively to form the final geometry, additive manufactured components are grown layer by layer. Emerging "hybrid" processes combine additive and subtractive capability allowing for high quality surfaces in an AM component. The target of this project is to work with Hybrid Manufacturing Technologies to develop a small pellet polymer extruder that is tool-changeable to become a standard, subtractive CNC machine.
  - Role: Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $40K

Raytheon - Full Scale Directly Printed Boat Feasibility

- The goal of this project is to evaluate the feasibility of full scale, autonomous, and manned military watercraft for specialized missions. The first phase of this project focuses on the evaluation of material properties to inform the design of these vessels, and the second phase will focus on the construction of a full scale 40+ft boat.
  - Role: Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $40K

Bell Helicopter - AM Tooling for Helicopter Windshields

- Developed a process using AM for creating production tooling, which is used to make windshields for Bell Helicopters. This process requires high quality surface finish as any defects will transfer directly to the windshield and cause optical distortions.
  - Role: Principle Investigator
  - Type: TN Rev Program
  - Funding Agency: State of Tennessee
  - Amount: $100K

AMG: Catamaran Boat Hull Mold

- Designed and manufactured a 35ft catamaran hull mold using a novel, BAAM-enabled approach. All mold surfaces were measured within 0.05" from the nominal model and experienced a minimal 0.020" deflection with an external load applied at the center of the span. This project is the first MDF user program application, and the user, AMG, is now evaluating the mold set for making production hulls.
  - Role: Investigator
  - Type: DOE AMO User Program
  - Funding Agency: Department of Energy
  - Amount: $40K

Hover Energy, LLC - Vertical Axis Wind Turbines

- New vertical axis wind turbines take up a significantly smaller footprint then traditional horizontal axis wind turbines, making them ideal for urban installations. However, their efficiency's are limited by the ability to manufacture complex, low-drag airfoils. This project aims to use large scale additive manufacturing to produce components that enable a new vertical axis wind turbine technology.
  - Role: Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $40K

TPI Composites - Additive Manufacturing of Wind Turbine Molds

- Developed the process and produced a full scale mold set for making 47ft long wind turbine blades. Key developments include the direct print of conformal HVAC passageways and composite laminated AM sections to eliminate anisotropy.
  - Role: Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $500K

Association of Equipment Manufacturers - Additively Manufactured Excavator

- Designed and printed the stick (part of the arm) of an excavator using the Wolf Robotics metal Big Area Additive Manufacturing process. Additionally, mentored a student team to design and manufacture the excavator cab using the composite BAAM process.
  - Role: Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $240K

ORNL Additive Manufacturing and Integrated Energy Systems (AMIE)

- Enabled a demonstration of energy sharing between a hybrid vehicle and a high-efficiency and solar-equipped small home through large scale 3D printing. Partnered with SOM architects to design and manufacture the home (30,000+ lbs of composite) and the NTRC on the design of the printed utility vehicle. Both systems were manufactured and integrated to enable bilateral wireless energy sharing.
  - Role: Investigator
  - Type: ORNL LDRD
  - Funding Agency: Internal
  - Amount: $2M

Design Miami - Bio-Derived Material Pavilion

- Worked to develop a new bio-derived material capable of good performance in large scale 3D printing. Partnered with ShoP Architects and Branch Technology to design and manufacture an award winning pavilion for Design Miami using the biomaterial.
  - Role: Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $240K

ORNL - 3D Printed Shelby Cobra

- Traditional concept car manufacturing takes 2 years. The team leveraged AM to build a fully functional, electric vehicle in just six weeks. From a downloaded CAD model, the structural components were designed to support the vehicle systems and the printed body. New surface finishing techniques were developed, which made the vehicle virtually indistinguishable from a conventionally manufactured car.
  - Role: Investigator
  - Type: AOP
  - Funding Agency: Department of Energy (AMO + VTO)
  - Amount: $250K

Local Motors - 3D Printed Automobile

- Collaborated with Local Motors and Cincinatti Inc. to print the Strati, the worlds first 3D printed car. Over a 6 month development process, the Strati resulted in the development of a commercializeable large scale AM system (CI BAAM), build support structures, and lights out operation. The Strati took 48 hours to print and was printed live at the International Manufacturing Technology Show in Chicago.
  - Role: Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $240K

US Army - Direct Print of Army Vehicle Components

- The US Army maintains fleets of legacy vehicles for periods in excess of 40 years. Tooling used to make the vehicles is often lost or destroyed, making the production of replacement parts impossible. The target of this program was to look at and evaluate the potential of BAAM to make replacement parts for military vehicles. A 1943 Willys Jeep was reverse engineered and a new body and interior was printed and retrofitted to the existing vehicle chassis to create a fully functional 3D printed Jeep.
  - Role: Investigator
  - Type: WFO
  - Funding Agency: Department of Defense
  - Amount: $200K

Kawaneer - 3D Printed Custom Store Front Window Frames

- Industrial window systems are often custom sizes and manufactured primarily by hand resulting in expensive and long lead time products. The goal of this project was to develop a process for directly printing custom window frame/glass systems to enable rapid development.
  - Role: Investigator
  - Type: DOE AMO Technical Collaboration (CRADA)
  - Funding Agency: Department of Energy
  - Amount: $40K

Journal Publications

Christine Ajinjeru, Vidya Kishore, John Lindahl, Thomas Sudbury, Ahmed Hassen, Brian Post, Lonnie Love, Vlastimil Kunc, Chad Duty, "The influence of dynamic rheological properties on carbon fiber-reinforced polyetherimide for large-scale extrusion-based additive manufacturing", *International Journal of Advanced Manufacturing Technology* , vol. 99, issue 1-4, 2018

Clayton Greer, Andrzej Nycz, Mark Noakes, Brad Richardson, Brian Post, Thomas Kurfess, Lonnie Love, "Introduction to the design rules for Metal Big Area Additive Manufacturing", *Additive Manufacturing* , vol. 27, issue N/A, 2019

Michael Borish, Brian Post, Alex Roschli, Phillip Chesser, Lonnie Love, Katherine Gaul, "Defect Identification and Mitigation Via Visual Inspection in Large-Scale Additive Manufacturing", *Journal of the Minerals Metals & Materials Society (JOM)* , vol. TBD, issue Special, 2018

Alex Roschli, Katherine Gaul, Alex Boulger, Brian Post, Phillip Chesser, Lonnie Love, Fletcher Blue, Michael Borish, "Designing for Big Area Additive Manufacturing", *Additive Manufacturing* , vol. 25, issue n/a, 2018

Phillip Chesser, Brian Post, Alex Roschli, Charles Carnal, Randy Lind, Michael Borish, Lonnie Love, "Extrusion control for high quality printing on Big Area Additive Manufacturing (BAAM) systems", *Additive Manufacturing* , vol. 28, issue n/a, 2019

Kinjal Gandha, Ling Li, I.C. Nlebedim, Brian Post, Vlastimil Kunc, Brian Sales, James Bell, Parans Paranthaman, "Additive manufacturing of anisotropic hybrid NdFeB-SmFeN nylon composite bonded magnets", *Journal of Magnetism and Magnetic Materials* , vol. 467, issue n/a, 2018

Brian Post, Phillip Chesser, Randy Lind, Alex Roschli, Lonnie Love, Katherine Gaul, Matthew Sallas, Fletcher Blue, Stephen Wu, "Using Big Area Additive Manufacturing to directly manufacture a boat hull mould", *Virtual and Physical Prototyping* , vol. TBD, issue TBD, 2018

Ling Li, Kodey Jones, Brian Sales, Jason Pries, I.C. Nlebedim, Ke Jin, Hongbin Bei, Brian Post, Michael Kesler, Orlando Rios, Vlastimil Kunc, Robert Fredette, John Ormerod, Aaron Williams, Thomas Lograsso, Parans Paranthaman, "Fabrication of highly dense isotropic Nd-Fe-B nylon bonded magnets via extrusion-based additive manufacturing", *Additive Manufacturing* , vol. 21, issue n/a, 2018

Brad Richardson, Randy Lind, Peter Lloyd, Mark Noakes, Lonnie Love, Brian Post, "The Design of an Additive Manufactured Dual Arm Manipulator System", *Additive Manufacturing* , vol. 24, issue 2214-8604, 2018

Orlando Rios, William Carter, Brian Post, Peter Lloyd, David Fenn, Cindy Kutchko, Reza Rock, Kurt Olson, Brett Compton, "3D printing via ambient reactive extrusion", *Materials Today Communications* , vol. 15, issue , 2018

Maged Guerguis, Leif Eikevik, Andrew Obendorf, Lucas Tryggestad, Philip Enquist, Brian Lee, Benton Johnson, Brian Post, Kaushik Biswas, "Algorithmic Design for 3D Printing at Building Scale", *International Journal of Modern Research in Engineering and Technology* , vol. 2, issue 1, 2017

Ling Li, Brian Post, Vlastimil Kunc, Amy Elliott, Parans Paranthaman, "Additive manufacturing of near-net-shape bonded magnets: prospects and challenges", *Scripta Materialia* , vol. 135, issue 7, 2017

Paul Chambon, Scott Curran, Shean Huff, Lonnie Love, Brian Post, Robert Wagner, Roderick Jackson, Johney Green Jr, "Development of a Range-Extended Electric Vehicle Powertrain for an Integrated Energy Systems Research Printed Utility Vehicle", *Applied Energy* , vol. 191, issue N/A, 2017

Ling Li, Angelica Tirado, Cajetan Nlebedim, Orlando Rios, Brian Post, Vlastimil Kunc, Rick Lowden, Edgar Lara-Curzio, Robert Fredette, John Ormerod, Thomas Lograsso, Parans Paranthaman, "Big Area Additive Manufacturing of High Performance Bonded NdFeB Magnets", *Scientific Reports* , vol. 6, issue 36212, 2016

Vidya Kishore, Christine Ajinjeru, Andrzej Nycz, Brian Post, John Lindahl, Vlastimil Kunc, Chad Duty, "Infrared Preheating to Improve Interlayer Strength of Big Area Additive Manufacturing (BAAM) Components", *Journal of Manufacturing Science and Engineering* , vol. 14, issue N/A, 2017

Gregory Dreifus, Kyle Goodrick, Scott Giles, Milan Patel, Reed Foster, Cody Williams, John Lindahl, Brian Post, Alex Roschli, Lonnie Love, Vlastimil Kunc, "Path Optimization Along Lattices in Additive Manufacturing Using the Chinese Postman Problem", *3D Printing and Additive Manufacturing* , vol. 4, issue 2, 2017

Chad Duty, Vlastimil Kunc, Brett Compton, Brian Post, DONALD Erdman III, Rachel Smith, Randy Lind, Peter Lloyd, Lonnie Love, "Structure and Mechanical Behavior of Big Area Additive Manufacturing (BAAM) Materials", *Rapid Prototyping Journal* , vol. 23, issue 1, 2016

Farid Talagani, Saber DorMohammadi, Renly Dutton, Cody Godines, Harsh Baid, Frank Abdi, Vlastimil Kunc, Brett Compton, Srdjan Simunovic, Chad Duty, Lonnie Love, Brian Post, Craig Blue, "Numerical Simulation of Big Area Additive Manufacturing (3D Printing) of a Full Size Car", *SAMPE Journal* , vol. 51, issue 4, 2015

Lonnie Love, Vlastimil Kunc, Orlando Rios, Chad Duty, Brian Post, Craig Blue, "The Importance of Carbon Fiber to Polymer Additive Manufacturing", *Journal of Materials Research* , vol. 29, issue 17, 2014

Dreifus, Gregory, Brian K. Post, Kyle Goodrick, Scott Giles, Milan Patel, Reed Foster, Cody Williams, Vlastimil Kunc, John Lindahl, Alex Roschli, and Lonnie Love. Path Optimization in Additive Manufacturing Using the Chinese Postman Problem. *3D Printing and Additive Manufacturing.* (Awaiting Publication)

Riechert, Susan E. and Brian K. Post. From Skeletons to Bridges and Other STEM Enrichment Exercises for High School Biology. In: *The American Biology Teacher:* vol. 72, issue 1, pg 20−22, January, 2010.

Conference Publications

Celeste Atkins, Jesse Heineman, Phillip Chesser, Alex Roschli, Brian Post, Peter Lloyd, Lonnie Love, Randy Lind, "Wire Co-Extrusion with Big Area Additive Manufacturing", , Solid Freeform Fabrication Symposium, Austin, Texas, Texas, United States of America, 2019

Alex Roschli, Brian Post, Phillip Chesser, Michael Borish, Lonnie Love, Pum Kim, "CREATING TOOLPATHS WITHOUT STARTS AND STOPS FOR EXTRUSION-BASED SYSTEMS", *Solid Freeform Fabrication Proceedings* , Solid Freeform Fabrication, Austin, Texas, United States of America, 2019

Brian Gibson, Yashwanth Kumar Bandari, Brad Richardson, Alex Roschli, Brian Post, Michael Borish, Aaron Thornton, William Henry, Matthew Lamsey, Lonnie Love, "MELT POOL MONITORING FOR CONTROL AND DATA ANALYTICS IN LARGE-SCALE METAL ADDITIVE MANUFACTURING", , International Solid Freeform Fabrication Symposium (SFF 2019), Austin, Texas, United States of America, 2019

Michael Borish, Brian Post, Alex Roschli, Phillip Chesser, Lonnie Love, Katherine Gaul, Matthew Sallas, Nikolaos Tsiamis, "In-Situ Thermal Imaging for Single Layer Build Time Alteration in Large-Scale Polymer Additive Manufacturing", *Procedia Manufacturing* , North American Manufacturing Research Conference, Erie, Pennsylvania, United States of America, 2019

Phillip Chesser, Brian Post, Randy Lind, Alex Roschli, Celeste Atkins, Alex Boulger, Paritosh Mhatre, Peter Lloyd, "SkyBAAM Large-Scale Fieldable Deposition Platform System Architecture", *Solid Freeform Fabrication Proceedings* , 30th Annual International Solid Freeform Fabrication Symposium - An Additive Manufacturing Conference, Austin, Texas, United States of America, 2019

Alex Roschli, Chad Duty, John Lindahl, Brian Post, Phillip Chesser, Lonnie Love, Katherine Gaul, "Increasing Interlaminar Strength in Large Scale Additive Manufacturing", *Solid Freeform Fabrication Proceedings* , 29th International Solid Freeform Fabrication Symposium, Austin, Texas, United States of America, 2018

Chad Duty, Jordan Failla, Pum Kim, Tyler Smith, John Lindahl, Alex Roschli, Brian Post, Lonnie Love, Vlastimil Kunc, "Z-Pinning Approach for Reducing Mechanical Anisotropy of 3D Printed Parts", , Solid Freeform Fabrication Symposium (SFF Symposium 2018), Austin, Texas, United States of America, 2018

Phillip Chesser, Brian Post, Alex Roschli, Randy Lind, Alex Boulger, Lonnie Love, Katherine Gaul, "Fieldable Platform for Large-Scale Deposition of Concrete Structures", *Solid Freeform Fabrication Proceedings* , 29th Annual International Solid Freeform Fabrication Symposium, Austin, Texas, United States of America, 2018

Alex Roschli, Brian Post, Phillip Chesser, Matthew Sallas, Lonnie Love, Katherine Gaul, "Precast Concrete Molds Fabricated with Big Area Additive Manufacturing", *Solid Freeform Fabrication Proceedings* , 29th Annual International Solid Freeform Fabrication Symposium, Austin, Texas, United States of America, 2018

Alex Boulger, Phillip Chesser, Brian Post, Alex Roschli, Joshua Hilton, Connor Welcome, Nikolaos Tsiamis, Lonnie Love, Katherine Gaul, Breanna Rhyne, "Pick and Place Robotic Actuator for Big Area Additive Manufacturing", *Solid Freeform Fabrication Proceedings* , 29th Annual International Solid Freeform Fabrication Symposium, Austin, Texas, United States of America, 2018

Phillip Chesser, Randy Lind, Brian Post, Alex Roschli, Lonnie Love, Katherine Gaul, "Using Post-tensioning in Large Scale Additive Parts for Load Bearing Structures", *Solid Freeform Fabrication Proceedings* , 29th Annual International Solid Freeform Fabrication Symposium, Austin, Texas, United States of America, 2018

John Lindahl, Ahmed Hassen, Stian Romberg, Ben Hedger, Peter Hedger Jr, Mike Walch, Tim DeLuca, Wes Morrison, Pum Kim, Alex Roschli, David Nuttall, John Czachowski, Brian Post, Lonnie Love, Vlastimil Kunc, "Large-scale additive manufacturing with reactive polymers", *CAMX Conference Proceedings* , CAMX - The Composites and Advanced Materials Expo, Dallas, Texas, United States of America, 2018

Pum Kim, Gregory Dreifus, Bentley Beard, Andrew Glick, Andrew Messing, Ahmed Hassen, John Lindahl, Peng Liu, Tyler Smith, Jordan Failla, Brian Post, John Bowers, Kenneth Stephenson, Lonnie Love, Vlastimil Kunc, "Graded Infill Structure of Wind Turbine Blade Accounting for Internal Stress in Big Area Additive Manufacturing", *CAMX Conference Proceedings* , CAMX 2018, Dallas, Texas, United States of America, 2018

Chad Duty, Jordan Failla, Pum Kim, John Lindahl, Brian Post, Lonnie Love, Vlastimil Kunc, "REDUCING MECHANICAL ANISOTROPY IN EXTRUSION-BASED PRINTED PARTS", *Solid Freeform Fabrication Proceedings* , Solid Freeform Fabrication Symposium, Austin, Texas, United States of America, 2017

Andrzej Nycz, Mark Noakes, Brad Richardson, Andrew Messing, Brian Post, Jonathan Paul, Jason Flamm, Lonnie Love, "Challenges in Making Metal Large-scale Complex Parts for Additive Manufacturing: A Case Study Based on the Additive Manufacturing Excavator (AME)", , Solid Freeform Fabrication, Austin, Texas, United States of America, 2017

Christine Ajinjeru, Vidya Kishore, Thomas Sudbury, Chad Duty, John Lindahl, Ahmed Hassen, Brian Post, Lonnie Love, Vlastimil Kunc, "The Influence of Rheology on Melt Processing Conditions of Carbon Fiber Reinforced Polyetherimide for Big Area Additive Manufacturing", , SAMPE 2017 Seattle, Seattle, Washington, United States of America, 2017

Vlastimil Kunc, John Lindahl, Ralph Dinwiddie, Brian Post, Lonnie Love, Chad Duty, Mike Matlack, Richard Fahey Jr., Ahmed Hassen, "INVESTIGATION OF IN-AUTOCLAVE ADDITIVE MANUFACTURING COMPOSITE TOOLING", , CAMX, Anaheim, California, United States of America, 2016

Kaushik Biswas, Randy Lind, Brian Post, Roderick Jackson, Lonnie Love, Johney Green, Lucas Tryggestad, Andrew Obendorf, Leif Eikevik, Maged Guerguis, "Big Area Additive Manufacturing Applied To Buildings", , Thermal Performance of the Exterior Envelopes of Whole Buildings XIII International Conference, Clearwater, Florida, United States of America, 2016

Gregory Dreifus, Nadya Ally, Brian Post, Yuan Jin, "APPROACHES TO GEOMETRIC DATA ANALYSIS ON BIG AREA ADDITIVELY MANUFACTURED (BAAM) PARTS", , 2016 Annual International Solid Freeform Fabrication Symposium - An Additive Manufacturing Conference, Austin, Texas, United States of America, 2016

Ahmed Hassen, Robert Springfield, John Lindahl, Brian Post, Lonnie Love, Chad Duty, Uday Vaidya, R. Byron Pipes, Vlastimil Kunc, "THE DURABILITY OF LARGE-SCALE ADDITIVE MANUFACTURING COMPOSITE MOLDS", , CAMX 2016, Anaheim, California, United States of America, 2016

Brian Post, Peter Lloyd, John Lindahl, Randy Lind, Lonnie Love, Vlastimil Kunc, "The Economics of Big Area Addtiive Manufacturing", , Solid Freeform Fabrication Conference, Austin, Texas, United States of America, 2016

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Brian Post, Phillip Chesser, Alex Roschli, Lonnie Love, Katherine Gaul, "Large-Scale Additive Manufacturing for Low Cost Small-Scale Wind Turbine Manufacturing", *ORNL Report* , 2020

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Patents and Invention Disclosures

US Patent US9884444B2, Enhanced Additive Manufacturing with a Reciprocating Leveling and Force Sensing Platen. C. A. Blue, R. F. Lind, L. J. Love and B. K. Post

US Patent US10105876B2, Apparatus for generating and dispensing a powdered release agent Lind, Randall F; Post, Brian K; Chesser, Philip C; Reis, Andrew P; Roschli, Alex C

US Patent US9821502B2, Multi-orifice deposition nozzle for additive manufacturing Lind, Randall F; Post, Brian K; Cini, Colin L

Patent Pending S-161,959, "Novel method to align anisotropic bonded permanent magnets during printing" M Parans Paranthaman, Brian C Sales, Brian K Post

Patent Pending "Increased material flow throughput in large scale additive manufacturing through movable segmented build platform." Vlastamil Kunc, Ahmed A Hassen, John M Lindahl, Lonnie J Love, David Nuttall, Brian K Post

Patent Pending S-138,483, Z layer Improvement using Liquid Nails Method Chad Duty, Jordan Failla, Seokpum Kim, John Lindahl, Brian Post, Lonnie Love, Vlastimil Kunc

Patent Pending S-138,585, Highly Dense Isotropic Bonded Magnets via Additive Manufacturing, Kunc, Vlastimil, Li, Ling, Paranthaman, M Parans, Post, Brian, Sales, Brian

Patent Pending S-138,57, Polymer Exhaust for Eliminating Extruder Transients Love, Lonnie J, Post, Brian K, Sallas, Matthew R, Lind, Randall F., Roschli, Alex C, Chesser, Philip C

Patent Pending S-138,489, "Method for Printing Low Density and Varying Density in Large Scale Additively Manufactured Polymer Structures," Ahmed Hassen, Vlastimil Kunc, John M. Lindahl, Peng Liu, Lonnie J. Love, and Brian K. Post

Patent Pending S-124,914, Additive Manufacturing of Bonded Permanent Magnets using a Novel Polymer Matrix. V. Kunc, B. M. Monono, M. P. Paranthaman, B. K. Post, O. Rios and H. Ucar

Patent Pending S-124,872, Hybrid Continuous Fiber Composite Additive Manufacturing. Blue, Craig A; Kunc, Vlastimil; Lind, Randall F; Love, Lonnie J; Post, Brian

Patent Pending S-124,994, "Removable Support Approaches for Large Scale Additive Manufacturing." C. A. Blue, C. L. Carnal, P. C. Chesser, C. E. Duty, V. Kunc, R. F. Lind, P. D. Lloyd, L. J. Love, A. K. Messing, B. K. Post, A. P. Reis, A. C. Roschli, O. Rios, R. J. Smith and A. R. Young

Invention Disclosure "Precision bead forming 3D printhead for cementitious materials" Randall Lind, Brian Post

Invention Disclosure "Manufacturing of Overmolded Composite Structures using Optimized Additively Manufactured Skeletons" Craig A Blue, Ahmed A Hassen, Seokpum Kim, Michael M Kirka, Vlastimil Kunc, Lonnie J Love, Brian K Post

Invention Disclosure "Electrostatic Powder-Bed Layer Recoating for High-speed and High-Resolution Additive Manufacturing" Ryan R Dehoff, Peter D Lloyd, Alexander J Plotkowski, Philip C Chesser, Jesse Heineman

Invention Disclosure "Wire Co-Extrusion System for Large Scale Additive Manufacturing Systems" Ahmed A Hassen, Phillip C Chesser, Christopher J Hershey, Seokpum Kim, Vlastimil Kunc, John M Lindahl, Lonnie J Love, Brian K Post, Alex C Roschli, Jesse Heineman

Invention Disclosure "Single Layer Build-Time Alteration via Thermal Imaging for Large-Scale Polymer Additive Manufacturing" Michael C Borish, Phillip C Chesser, Brian K Post, Alex C Roschli

Invention Disclosure S-138,853, "Additive Manufacturing Extrudate Flow Measuring and Calibration System" Charles Carnal, Phillip Chesser, Randy Lind, Peter Lloyd, Lonnie Love, Brian Post, Alex Roschli

Invention Disclosure S-138,599, Cable Driven Big Area Additive Manufacturing System (CDBAAM) Post, Brian K, Love, Lonnie J Lind, Randall Chesser, Philip C., Roschli, Alex C., Randall Lind

Invention Disclosure S-138,458, Corresponding Extruder Tip Force to Surface Geometry in BAAM. Alex M. Boulger, Philip C. Chesser, Randall F. Lind and Brian K. Post

Invention Disclosure S-138,421, Big Area Additive Manufacturing of High Performance Bonded Magnets. Vlastimil Kunc, Ling Li, M. Parans Paranthaman, Brian K. Post and Orlando Rios

Invention Disclosure S-138,083, Method for Additive Manufacturing of Prosthetic Devices. Post, Brian K; Love, Lonnie J; Lloyd, Peter D; Lind, Randall F

Invited Talks

- NSF Workshop on Additive Manufacturing for Civil Infrastructure Design and Construction - Breaking Barriers with BAAM: Large Scale Additive Manufacturing Applications in Infrastructure
- Solid Freeform Fabrication Conference 2017 - ***Keynote*** Big Area Additive Manufacturing Application in Wind Turbine Molds
- CONEXPO/CONAGG 2017 Pop Up Talk - Large Scale AM Applications
- South Eastern Institute for Manufacturing Technology Additie Manufacturing Conference - ***Keynote*** Bringing Science to Manufacturing

- Lincoln Laboratory Mechanical Engineering Technology Seminar Series - Breaking Barriers in 3D Printing at ORNLs Manufacturing Demonstration Facility
- United Technologies Corporation Additive Manufacturing Conference - Large Scale Additive Manufacturing
- Knoxville JEC Composites Conference - Large Scale AM With Applications in Composite Tooling
- INNOVATE Hawaii - Breaking Barriers in 3D Printing at ORNLs Manufacturing Demonstration Facility
- 3D Printing State of the Industry Panel: 3DP and AM Industry Trends and Opportunities on the Horizon - Breaking Barriers in 3D Printing at ORNLs Manufacturing Demonstration Facility
- ETSU Math Spring Banquet - ***Keynote*** Breaking Barriers in 3D Printing at ORNLs Manufacturing Demonstration Facility
- Altrusa International - Bringing robotics to life - Enabling the future of American manufacturing through robotics, additive manufacturing and STEM education
- Ashville, NC 3D Printing Summit - 3D Printing Applications and Ongoing Research at the Oak Ridge National Laboratory Manufacturing Demonstration Facility

Service and Students

Service

- Society of Manufacturing Engineers - Additive Manufacturing Advisory Group Content Committee Chair 2016-Present
- ORNL SULI Intern Seminar Series (tri-yearly since 2015) - Robotics and Large Scale Additive Manufacturing at ORNL's MDF

Mentored Students

- **PostDoc**: Michael Borish
- **PostMasters**: Alex Roschli, Breanna Rhyne, Greg Dreifus, Yuan Jin, Adiola Adediran, Prashant Gupta, Abigale Barnes
- **PostBachelors**: Phillip Chesser, Katherine Gaul, Daniel Shyles, Morgan Jenkins
- **Undergraduate**: Gregory Kurfess, Morgan Usher, Alex Boulger, Amiee Jackson, Derek Vaughn, Elizabeth Yeoh-Wang, Ethan Grahm, Gavin St. Pierre, Harini Selvaraj, Harry Hughes, Kaylee Kiefaber, Alex Riedel, Rowan Palmer, Sierra Palmer, Georgiana Blue, James Earle, Rachel Smith, Zeke Sudury, Luke Meyer, Aaron Young, Kyle Goodrich, Patrick Jung, Fletcher Blue, Lauren Heinrich, Jesse Goodwin
- **Community College**: Nickolas Tsamis, Matt Sallas, Dakota Gentry

Technical Skills **Extensive hardware and software experience in robotics, motion control, and mechatronic systems**

- **Matlab experience:** linear algebra, Fourier transforms, numerical methods, control system design, polynomials, visualization, machine vision

  - **Matlab toolboxes:** control systems, filter design, neural networks, machine vision, system identification, Simulink, xPC Target

- **LabVIEW experience:** linear algebra, UDP/TCP communication, real time control, control system design, machine vision, data acquisition, serial communication, GUI Design, system identification, nonlinear control
  - **LabVIEW modules:** control design and simulation, vision development, LabVIEW RealTime, mathscript RT, data logging, and supervisory control

- **Experience with embedded systems for control and simulation:** xPC Target, NI CompactRIO, NI PXI, NI RealtimeDesktop, Freescale HCS12, Arduino,

- **Programming Languages:** C, C++, LabVIEW, Matlab, html, BASIC, Ladder Logic, Maple

- **Other Engineering Software:** SolidWorks, Catia, AutoCad, RSLogix5000

- **Computer Applications:** TEX (LATEX, BibTEX), most common productivity packages (for Windows, OS X, and Linux platforms)

- **Operating Systems:** Microsoft Windows family, Apple OS X, Linux, Unix

ENGINEERING EXPERTISE

Subjects: Additive Manufacturing, Linear and Nonlinear Systems Theory, Feedback, Variable Structure Systems and Sliding Modes, Autonomous Control, Dynamics and Vibrations, System Dynamics, Engineering Design, Machine Design and Fabrication, Mechatronics, Mechanics of Materials, Heat Transfer, Fluid Power Systems, Haptics

REFERENCES

Available upon request