

Emma D. Betters

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Knoxville, TN 37923

(352) 232-7807
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Education

University of Tennessee Knoxville, Knoxville, TN

August 2019- December 2024

PhD, Mechanical Engineering, GPA: 3.96

University of Tennessee Knoxville, Knoxville, TN

August 2019-May 2022

Master of Science, Mechanical Engineering, GPA: 3.96

University of North Carolina at Charlotte, Charlotte, NC

January 2018- Transferred

Master of Science, Mechanical Engineering; GPA: 4.0

University of Florida, Gainesville, FL

December 2017

Bachelor of Science, Mechanical Engineering; GPA: 3.49

Professional Experience

ORNL Manufacturing Demonstration Facility, Knoxville, TN

R&D Associate Staff Member, Intelligent Machine Tools Group

April 2023- Present

R&D Assistant Staff Member, Intelligent Machine Tools Group

October 2019- April 2023

- Leading cooperative research agreement with Fairmount Technologies for dynamics testing and design consultation for a purpose-built tool for extrusion machining
- Leading project with Caterpillar Inc. to demonstrate capability to produce large components on small machine tools to reduce capital investment for large scale machining
- Co-leading project with machine tool builder Bourn & Koch to investigate new methods of domestic drill press base manufacturing to reduce cost and lead time
- Expanded on existing model for receptance coupling substructure analysis to include effects of helix angle and flute count on tool tip frequency response function. This model allows for the preprocess prediction of stable machining parameters in milling applications.
- Developed curriculum and led on-machine instruction for America's Cutting Edge in-person training.
- Lead design and built a novel CNC milling machine leveraging an additively manufactured mold and concrete filled composite base structure to illustrate alternatives to imported castings
 - Featured at IMTS 2020 and in the IMTS 2022 Emerging Technology Center
 - Accelerated schedule resulted in six-month window from project initiation to first test cut
 - Developed a method for machining large, high-aspect ratio parts on a small format machine, and wrote software to convert toolpaths based on motion of fiducials through the work zone
 - Completed a full-scale demonstration part that was 5x larger than the machine work volume
 - Managed safety, rigging, shipping, and demonstration logistics
- Aided in manufacturing of multiple training aids for Department of Defense sponsors
- Designed and tested standard artifact for comparison of CMM, structured light scanner, laser tracker, and Renishaw touch probe metrology systems
- Authored Standard Operating Procedure (SOPs) for custom built machine tool
- Studied effects of concrete mix parameters on modal damping and compared properties between aluminum, cast iron, and polymer concrete tombstone structures
- Evaluated the effect of captured powder on dynamic response of additively manufactured components with regard to improved damping
- Provided design for manufacturing and assembly input and manufactured a charging device for the domestic production of N95 materials in support of COVID-19 PPE production efforts. The technology was licensed by DemeTECH, generating hundreds of new jobs and production capacity for millions of masks per week.
- Designed a unique joining mechanism for in-oven/autoclave molds produced by big area additive manufacturing. The design allows for the assembly and use of molds larger than the machines used to produce them.
- Collaborated with GKN on fixture design and machining of meter-scale additively deposited titanium part

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ORISE HERE Program Intern, Machining and Machine Tool Research Group **May 2019- October 2019**

- Aided in determining appropriate machining parameters for metal-wire-arc additively manufactured components with complex internal geometry
- Contributed to the successful completion of several high-profile additive manufacturing projects including a multi-week effort to aide in the machining of a challenging hypersonic rocket component
- Reduced the expense of a build plate machining process for the Transformational Challenge Reactor project by two orders of magnitude while delivering a product with improved flatness and surface finish.
- Investigated part geometries that aid the hybrid manufacturing process by altering component dynamics through stiffening or damping, such as sacrificial stiffening structures and dynamic absorbers

Machine Tool Research Center, Charlotte, NC
Knoxville, TN

January 2018 – May 2019
May 2019- Present

Graduate Research Assistant

Advisor: Dr. Tony Schmitz

- Measured connection stiffness for pre-process prediction of stable machining parameters for a library of tools
- Analyzed and modeled the drilling process, including thrust force and torque, and determined cutting force coefficients for aluminum, titanium, and carbon fiber reinforced polymers in conjunction with the Korea Institute of Machinery and Materials
- Designed and machined an additively manufactured dynamic absorber demonstration in collaboration with Oak Ridge National Laboratory
- Analyzed methods for modeling of indexable endmills with equivalent diameters for use in machining stability analysis
- Implemented structured light scanning for measurement of dynamic repeatability of additively manufactured structures for machining stability in hybrid applications

Design and Manufacturing Laboratory, Gainesville, FL

January 2015 – January 2018

Teaching Assistant

- Taught mechanical design and manufacturing to fellow engineering students and assisted with detail-oriented problem solving
- Taught traditional and geometric dimensioning and tolerancing (GD&T)
- Taught application of design for manufacturability and assembly protocols (DFMA)
- Developed skills in CAD, design, and manufacturing through use of facility equipment such as lathes, milling machines, welding equipment (GMAW/GTAW), and sheet metal machinery while working on laboratory projects
- Improved personal teaching and technical aptitude through training of future laboratory teaching assistants
- Helped author advanced design guides for traditional manufacturing and assembly processes
- Designed and manufactured shop improvement projects using advanced manual and CNC machine processes and welding. Examples include thin parallel sets, a cart to store and move lathe chucks, and caliper storage boxes.

University of Florida Student Machine Shop, Gainesville, FL

May 2015 – January 2018

Teaching Assistant

- Supervised and assisted students manufacturing parts of various complexity for research and design projects
- Provided consultation on designs and drawings for target function, tolerancing, and design for manufacturability
- Performed equipment maintenance and troubleshooting

MIT Lincoln Laboratory, Lexington, MA

June 2016 - August 2016

Mechanical Engineering Intern

June 2017 - August 2017

- Designed, analyzed, and prototyped a deployment system for phased array satellite
- Conducted dynamic strain analysis of system prototype using digital image correlation software

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- Developed concept for concussion prevention on an interdisciplinary engineering team
- Completed technical disclosure for patent application of concussion prevention design
- Conducted FEA and modal analysis of additively manufactured components to determine flight readiness and material property variation between bulk material and additively manufactured parts
- Ran trade study for acquisition of torque analysis systems for laboratory wide use

Honors and Awards

SME 30 Under 30	2023
▪ See links #1 and 2 under Media	
UT-Battelle Special Event Award	2022
▪ Design, development, and demonstration of a concrete base machine tool in the Emerging Technology Center at IMTS 2022.	
▪ See links #6, 7, 10, and 14 under Media	
UT-Battelle Director's Award	2020
▪ Rapid development and deployment of melt blowing and charging technology to enable domestic production of N95 media	
UT-Battelle Technology Transfer Award	2020
▪ The charging technology enabling the domestic production of N95 media was licensed to DemeTECH whose plant created over 500 new jobs and produced millions of masks.	
ASPE Student Scholarship Award	2019

Professional Affiliations

Precision Engineering Journal- Associate Editor	2024- Present
American Society of Mechanical Engineers	2019- Present
SME	2019- Present
American Society of Precision Engineering	2018- Present

Technical Skills

Software

- SolidWorks, Fusion 360, MATLAB, MetalMax, GOM Inspect, Microsoft Project, Abaqus, LMS Test Lab, HyperMILL

Manufacturing

- CNC milling, CNC turning, manual milling, manual turning, MIG welding, wet and prepreg composite layups (carbon fiber and Kevlar), sheet metal equipment and fabrication, design for manufacturing and assembly, drafting and evaluation of technical drawings using traditional tolerancing and GD&T

Media

1. [Rising Stars in Manufacturing: A 30 Under 30 Conversation](#)
Jake Volcsko, Casey Ross, Emma Betters, Hasnaa Ouidadi, Michael Gomez, SME, 2024
2. [SME 30 Under 30](#)
SME, 2023
3. [Metalworking Innovation – AeroDef](#)
Jake Volcsko, Nat Frampton, Brendt Holden, Emma Betters, SME, 2023
4. [Pathway to Technology Adoption – Eastec](#)
Jane Arnold, Bryan Bauw, Michael Gomez, Emma Betters, SME, 2023
5. [Pathway to Technology Adoption – Houstex](#)
Jane Arnold, Nat Frampton, Michael Gomez, Emma Betters, SME, 2023
6. [IMTS+ Creators Lounge - Day 6 LIVE](#)
Emma Betters, Meaghan Ziembra, James Soto, AMT/Industrial, 2022
7. [IMTS 2022 AMT Emerging Technology Center Annex](#)
Justin West, Emma Betters, Scott Smith, AMT, 2022

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8. [Mavens of Manufacturing Ep. 61: Next Generation Training](#)
Emma Betters, Meaghan Ziemba, Mavens of Manufacturing, 2022
9. [America's Cutting Edge CNC Training Testimonials – Emma Betters – MFG Day 2021](#)
Emma Betters, MSC, 2021
10. [Inside Oak Ridge's 3D-Printed Machine Tool Moonshot](#)
Brent Donaldson, Modern Machine Shop, 2020
11. [Chasing Gold in A&D Manufacturing](#)
Ed Sinkora, SME Media, 2021
12. [The Building Blocks of Directed Energy Deposition Design](#)
Laura Ely, Metal 3D Printing, 2021
13. [Emma Betters: Advancing machining and revitalizing industry](#)
Jennifer J Burke, Energy Science and Technology Directorate, 2021
14. [ETC Talks – Moonshot](#)
IMTS 2020, Tony Schmitz, Scott Smith, Justin West, Emma Betters

Publications (Updated 6/12/2024)

Citations: 122

h-index: 6

i10-index: 4

Journal Articles

1. West, Justin, Emma Betters, and Tony Schmitz. "Limited-constraint WAAM fixture for hybrid manufacturing." *Manufacturing Letters* 37 (2023): 66-69.
2. Schmitz, T., Betters, E., Budak, E., Yüksel, E., Park, S., & Altintas, Y. Review and status of tool tip frequency response function prediction using receptance coupling. *Precision Engineering*, 79 (September 2022), 60–77.
3. Schmitz, T., Cornelius, A., Dvorak, J., Nazario, J., Betters, E., Corson, G., Smith, S., Blue, C., Harmon, J., Morrison, M. and Blevins, T., 2022, America's Cutting Edge CNC Machining and Metrology Training, *Manufacturing Letters*, 33: 927-934.
4. Hassen, A.A., Betters, E., Tsiamis, N., West, J., Smith, T., Billah, K.M.M., Nuttall, D., Kumar, V., Smith, S. and Kunc, V., 2022. Joining technique for in-oven/autoclave molds manufactured by large scale polymer additive manufacturing. *Manufacturing Letters*, 32, pp.77-82.
5. West, J., Betters, E.D., Schmitz, T.L., Smith, S., Roschli, A., Nuttall, D., Lindahl, J., Love, L., 2021, Rethinking production of machine tool bases: Polymer additive manufacturing and concrete, *Manufacturing Letters*
6. Larsen, G. S., Cheng, Y., Daemen, L. L., Lamichhane, T. N., Hensley, D. K., Hong, K., ... & Paranthaman, M. P. (2021). Polymer, additives, and processing effects on N95 filter performance. *ACS Applied Polymer Materials*, 3(2), 1022-1031.
7. Betters, E., West, J., Noakes, M., Nycz, A., Smith, S., and Schmitz, T., 2020, Dynamic Stiffness Modification by Internal Features in Additive Manufacturing, *Precision Engineering*, 66: 125-134.
8. Schmitz, T., Betters, E., and West, J., 2020, Increased Damping through Captured Powder in Additive Manufacturing, *Manufacturing Letters*, 25: 1-5.
9. Gibson, BT, Mhatre, P, Borish, MC, West, JL, Betters, ED, Smith, SS, Richardson, BS, Love, LJ, Sundermann, TW, Potter, JT, Vetland, EJ, Henry, WC, & Allison, CP, Accelerating Large-Format Metal Additive Manufacturing: How Controls R&D Is Driving Speed, Scale, and Efficiency, Proceedings of the ASME 2020 International Mechanical Engineering Congress and Exposition

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10. Atkins, C, Betters, E, Boulger, A, Chesser, P, Heineman, J, Hun, D, Lapsa, M, Loy, A, Roschli, A, Vaughan, J, Wang, P, & Post, B. Construction-Scale Concrete Additive Manufacturing and its Application in Infrastructure Energy Storage, Proceedings of the ASME 2020 International Mechanical Engineering Congress and Exposition
11. Schmitz, T., Honeycutt, A., Gomez, M., Stokes, T.M., and Betters, E., 2019, Multi-point Coupling for Tool Point Receptance Prediction, Procedia Manufacturing
12. Schmitz, T., Honeycutt, A., Gomez, M., Stokes, T.M., and Betters, E., 2019, Multi-point Coupling for Tool Point Receptance Prediction, Journal of Manufacturing Processes

Non- Refereed Proceedings

1. Betters, Emma D., "A TWO-DIAMETER HELICAL ENDMILL BEAM MODEL FOR TOOL TIP DYNAMICS PREDICTION WITH APPLICATION TO MILLING. " PhD diss., University of Tennessee, 2023. https://trace.tennessee.edu/utk_graddiss/9177
2. Poon, T., West, J., Betters, E., Smith, S., Tyler, C., and Schmitz, T., 2022, Design considerations for additive manufacturing of machine tool structural components, American Society for Precision Engineering Annual Meeting, October 10-14, Bellevue, WA.
3. Schmitz, T., Cornelius, A., Dvorak, J., Nazario, J., Betters, E., Smith, S., Blue, C., Harmon, J., Morrison, M., Blevins, T., and Hopkins, J., 2021, CNC machining and metrology training: ACE program update, American Society for Precision Engineering Annual Meeting, November 1-5, Minneapolis, MN.
4. Betters, E., West, J., and Schmitz, T., 2020, Comparison of Dynamic Stiffness In Tombstone Materials, American Society for Precision Engineering Annual Meeting, October 12-23, Virtual
5. West, J., Betters, E., and Schmitz, T., 2020, Captured powder damping in additive manufacturing, American Society for Precision Engineering Annual Meeting, October 20-22 (virtual).
6. Betters, E., West, J., Noakes, M., Nycz, A., Smith, K.S., Schmitz, T.L., 2019, Additive Manufacturing of Internal Features for Manipulation of Structural Dynamics, American Society for Precision Engineering Annual Meeting, October 28- November 1, Pittsburg, PA
7. West, J., Betters, E., Schmitz, T.L., 2019, Platform for Affordable Hybrid Manufacturing of Light Metals, American Society for Precision Engineering Annual Meeting, October 28- November 1, Pittsburg, PA

Presentations

1. Betters, E., West, J., Schmitz, T.L., 2019, Additive Manufacturing of Internal Features for Manipulation of Structural Dynamics, Pittsburg, PA.
2. Betters, E., West, J., Noakes, M., Nycz, A., Smith, K.S., Schmitz, T.L., 2019, Dynamic absorber applications in wire arc additive manufacturing, Metallic 4-D Printing Current Challenges and Next Generation Paradigms Symposium, April 12, 2019, Philadelphia, PA.