GURU CHARAN REDDY MADIREDDY

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EDUCATION

Ph.D., Mechanical Engineering GPA: 3.7 Dec 2021
University of Nebraska-Lincoln
- Dissertation: Understanding anisotropic residual stresses formation by interlayer surface treatments in additive manufacturing
- Advisor: Michael Sealy, Ph.D.

M.S., Mechanical Engineering GPA: 3.5 May 2018
University of Nebraska-Lincoln
- Thesis: Modeling residual stress development in hybrid processing by additive manufacturing and laser shock peening
- Advisor: Michael Sealy, Ph.D.

B.E., Mechanical Engineering (B.E.) Percentage:72% May 2015
Osmania University, Hyderabad, India

TECHNICAL SKILLS

- **Hybrid Additive Manufacturing:** Directed energy deposition (Optomec LENS® + Milling); Powder bed fusion (Matsuura Lumex Avance-25 + Milling) Fused filament fabrication (Stratasys Dimension Elite and Hyrel) Stereolithography (B9 Creator)
- **Characterization:** Scanning electron microscope (SEM), electron backscattered diffraction (EBSD), energy dispersive X-ray spectroscopy (EDS), microhardness, optical microscopy, mechanical polishing, electrochemical polishing, X-ray diffraction
- **Material testing:** Residual stress measurement (hole drilling & XRD), tensile testing, shear testing, fatigue testing, digital image correlation (strain measurement)
- **FEA & Modelling:** Abaqus (static, dynamic, & thermal), Ansys Additive, Ansys, Solidworks, LumexCAM, MasterCAM, AutoCAD, 3D scanning
- **Programming**: Python, Matlab, C, Gcode for AM, Fortran (user subroutines)
- **Surface Treatments:** Laser shock peening, shot peening, ultrasonic peening

PATENTS

- MP Sealy, H. Hadidi, **G. Madireddy,** C. Kanger. Hybrid additive manufacturing method, US Patent application no. 17/126350 (patent-pending)
- MP. Sealy, **G. Madireddy**, M. Negahban. Modeling thermal and mechanical cancellation of residual stress from hybrid additive manufacturing by laser peening, US Patent application no. 62/167436 (patent-pending)

ACHIEVEMENTS/AWARDS

- NSF Innovation Corps – Digital MAYHAM customer discovery for HybridSIM™ ($50,000), 2021
- NSF Graduate Student Travel Award, Solid Freeform Fabrication Symposium (2018, 2019, & 2021)
- 3rd place, Engineering Pitch Competition, University of Nebraska-Lincoln, 2019
- College of Engineering Research Professional Development Fellowship, UNL, 2019
- College of Engineering Graduate Student Travel Award, University of Nebraska-Lincoln, 2017
- 3rd Place, Mechanical and Materials Engineering 2nd Annual Research Fair, University of Nebraska-Lincoln, 2016

PROFESSIONAL EXPERIENCE

- **Postdoctoral research associate,** *Manufacturing Demonstration Facility* Nov 2021 – Present
  Oak Ridge National Lab, Knoxville, TN

  - Developed finite element models to understand the process mechanism in hybrid additive manufacturing (additive+subtractive)
  - Integrated phase transformation models with finite elements methods to determine stress evolution due to phase transformation
  - Working on fast simulation methodology to determine the distortion in big area metal additive manufacturing

- **Graduate Research Assistant**, *Mechanical and Materials Engineering* Jan 2016 – Oct 2021
  University of Nebraska-Lincoln, Lincoln, NE
  Advisor: Dr. Michael Sealy

  - Multi-process asynchronous hybrid additive manufacturing of metals
    - Developed a novel hybrid additive manufacturing (hybrid-AM) process comprising of pre-heating, post-heating to print high-density Al7075 parts
    - Authored first detailed analysis and review of hybrid additive manufacturing processes and the first finite element analysis of hybrid AM paper
    - The effects of laser peening in between the layers of Al7075, SS316, & AlSi10Mg was determined by the changes in microstructure (SEM), micro-hardness, residual stresses (XRD & hole drilling method), & tensile strength of parts
    - Determined optimum process parameters for AlSi10Mg and IN718 on powder bed fusion using melt pool size and density measurements
    - Concluded that laser peening frequency in hybrid-AM depends on the type of additive manufacturing process rather than the material
    - Optimum laser peening frequency was determined in AlSi10Mg based on residual stresses from hole drilling method to reduce the distortion in the parts by 45%
    - The strength of the additive parts (AlSi10Mg, SS316, & SS630) was measured using tensile testing and digital image correlation (DIC) for strain measurement
    - Increased yield strength of additive parts (SS316) by 15% with hybrid-AM and measured using digital image correlation (DIC)
    - Scanned 3d printed parts to measure the distortion from the powder bed fusion process and optimize the print process parameters
    - Characterized the effect of interlayer peening in additive parts using ultrasound surface wave speed measurements
  - Finite element modeling of hybrid additive manufacturing processes
    - Developed finite element models of hybrid additive manufacturing processes (selective laser melting/directed energy deposition, & laser shock peening)
    - Performed static (thermal & structural analysis) and dynamic analyses to determine the effect of surface treatments on residual stresses and distortion of hybrid additive manufactured parts
    - Authored first detailed analysis and review of hybrid-AM and the first finite element analysis of hybrid-AM process
    - Written user subroutines to model moving heatflux and dynamic loading in additive manufacturing simulation using Fortran
    - Successfully identified mechanisms like thermal and mechanical cancellation of residual stresses from hybrid-AM process simulation
    - Discovered that LENS and PBF have different thermal histories & hybrid process parameters for optimizing the strength of parts
    - Developed python scripts to automate the job hybrid-AM process simulation improving the efficiency by 70%**

- Developed finite element models to validate and calibrate hybrid-AM of NIST AMB 2018 bridges
- Successfully validated and calibrated additive manufacturing models based on the experimental data
- Created models for additive manufacturing parts using Solidworks

❖ Hybrid additive manufacturing (hybrid-AM) of polymers

- Analyzed the effect of shot peening on the surface of polymers made using mask image projection Stereolithography and fused filament fabrication
- Testing on the 3d-printed polymers was carried out using the universal testing machine and digital image correlation for strength
- Established that excessive shot peening in between the layers of polymers parts could decrease the strength but with optimized shot peening the strength increases

➢ **Additive Manufacturing Simulation and Validation intern** May 2020 – Aug 2020
Ansys, INC, Park City, UT

- Developed python scripts to visualize and analyze the point cloud data
- Developed visualization tools for melt pool of laser scans
- Worked with the AM validation team to conduct iterative analysis of simulation data
- Run calibration/validation simulations and case studies using Ansys Additive to reduce distortion in the printed parts

➢ **Lab Manager**, *Nebraska Engineering Additive Technologies (NEAT) Lab* Jan 2018 – Mar 2020
Nano-Engineering Research Core Facility, UNL, Lincoln, NE
Supervisor: Dr. Joseph Turner and Dr. Michael Sealy

- Responsible for operating and maintaining $1.5 million facility containing AM equipment which includes two Matsuura Lumex Avance-25 sytems & Optomec LENS Hybrid System
- Developed operating and safety procedures for Matsuura Lumex, Optomec LENS, SINT Technologies MTS3000, and Ruwac Wet Separator Immersion Vacuum
- Print recipe development of metals (Al7075, Ti64, AlSi10Mg, and IN718) and ceramics (Al_2O_3, ZrO_2) on Matsuura and Optomec systems
- Designed and printed wick structures and micro-channels of 100 μm for heat transfer applications
- Trained graduate and undergraduate students on the safety of additive manufacturing practices and operation of Mastuura, Optomec, and MTS3000 systems
- Produced instructional catalog of videos on the operation and safety of Optomec printer

➢ **Commercialization Analyst Intern,** *Office of Technology Transfer* Jun 2016 – Aug 2016
NUtech Ventures, Lincoln, NE

- Screened new technologies developed at UNL through intellectual property analysis, market analysis, and the market potential of the technology
- Interviewed inventors about their technologies
- Performed intellectual property prior art search for patent filing recommendations
- Recommended technologies for intellectual property protection based on the market analysis and prior art search

➢ **Graduate Research Assistant**, *Center for Nontraditional Manufacturing* Dec. 2015
University of Nebraska-Lincoln, Lincoln, NE
Advisor: Dr. K.P. Rajurkar

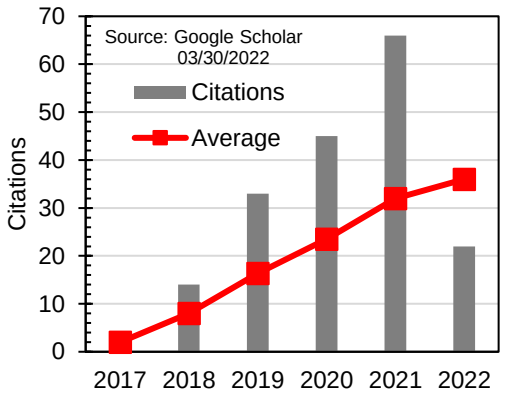
❖ Sustainability in Electric Discharge Machining

- Investigated sustainability of electric discharge machining (EDM) and micro-EDM by addressing energy efficiency and green dielectrics in EDM
- Co-authored first literature review on the sustainability of Non-Traditional manufacturing processes

- **Research Statistics**
  Source: Google Scholar
  Date: 03/30/2022

	All	Since 2017
Citations:	185	185
h-index:	5	5
*i*10-index:	4	4

Note:
- h-index is the largest number *h* such that *h* publications have at least *h* citations
- *i*10-index is the number of publications with at least 10 citations



TEACHING EXPERIENCE

- **Graduate Teaching Assistant**, *Mechanical and Materials Engineering* Aug 2018 – Dec 2019
  University of Nebraska-Lincoln, Lincoln, NE
  - MECH 370: Manufacturing Methods and Processes
    - Provided lectures on machining, rolling, and extrusion to 100+ students
    - Graded homework
  - MECH 343: Machine Design
    - Held recitation sessions
    - Held weekly office hours to assist students with homework
  - MECH 200: Engineering Thermodynamics
    - Graded homework
    - Held weekly office hours to assist students with homework

ENTREPRENEURSHIP

- Conducted over 100 interviews with the experts in the industry for Digital MAYHAM during NSF I-Corps
- Developed a business hypothesis and business modal canvas
- Identified customer problems from the interviews and developed a business model
- Won 3rd prize in Engineering Pitch Competition at the College of Engineering, UNL

SERVICE/LEADERSHIP

- Mentored undergraduate research teams working on surface treatments of hybrid additive manufactured polymer and metal parts (2017, 2018, 2020)
- Taught junior high school students on fatigue, corrosion, and polishing at Culler Middle school (Lincoln, NE) through the Nebraska Center for Materials and Nanoscience (NCMN) Outreach Program
- Trained sophomore students on 3d modeling using AutoCAD and Solidworks (2014)

PEER REVIEWED JOURNAL PUBLICATIONS

[1] A.K. Both, J.A. Linderman, **G. Madireddy**, M.A. Helle, C.L. Cheung, 2022, Valorization of coco coir into biocomposite material throough water-based chemistry, Industrial Crops and Products. Volume 178, 114563

[2] A.K. Both, M.A. Helle, **G. Madireddy**, C.L. Cheung, 2021, Green chemical approach to fabricate hemp composites for making sustainable hydroponic growth media, ACS Agricultural Science and Technology.

[3] K.L.M. Avegnon, P.Noll, M.R. Uddin, **G. Madireddy**, R.E. Williams, A. Achuthan, M.P. Sealy, 2021, Use of energy consumption during milling to fill a measurement gap in hybrid additive manufacturing, Additive Manufacturing. Volume 46, pages 1-9.

[4] M.P. Sealy, R. Karunakaran, S. Ortgies, **G. Madireddy,** A.P. Malshe, K.P. Rajurkar, 2021, Reducing corrosion of additive manufactured magnesium alloys by interlayer ultrasonic peening, CIRP Annals. Volume 70(1), pages 1-4.

[5] **G. Madireddy,** C. Li, J. Liu, M.P. Sealy, 2019, Modeling thermal and mechanical cancellation of residual stress from hybrid additive manufacturing by laser peening, *Nanotechnology and Precision Engineering.* Volume 2(2), pages 49-60.

[6] M.P. Sealy, **G. Madireddy,** R. Williams, P. Rao, M. Toursangsaraki, 2018, Hybrid processes in additive manufacturing, *ASME Journal of Manufacturing Science and Engineering*. Volume 140(6), pages 060801-13.

PEER REVIEWED CONFERENCE PROCEEDINGS

[1] M. Borumand, S.E. Borujeni, S. Nannapaneni, M. Ausherman, **G. Madiraddy**, M.P. Sealy, G. Hwang, Process mapping of additively manufactured metallic wicks through surrogate modeling, International Mechanical Engineering Congress and Exposition (IMECE), November 2021.

[2] **G. Madireddy**, J.F. Liu, M.P. Sealy, 2020, Distortion mitigation in additive manufacturing of AlSi10Mg by multilayer laser peening, Procedia CIRP, 20th CIRP Conference on Electro Physical and Chemical Machining (ISEM), Jan. 19-21, 2021, Zurich, Switzerland, pp. 133-137. (5 pages) (reviewed)

[3] H. Hadidi, B. Mailand, T. Sundermann, E. Johnson, **G. Madireddy,** M. Negahbhan, L. Delbreilh, M.P. Sealy, 2019, Low velocity impact of ABS after shot peening predefined layers during additive manufacturing, *Procedia Manufacturing.* Volume 34, pages 594-602. (reviewed)

[4] **G. Madireddy**, M. Montazeri, E. Curtis, J. Berger, N. Underwood, Y. Khayari, B. Marth, B. Smith, S. Christy, K. Krueger, M.P. Sealy, P. Rao, 2017, Effect of process parameters and shot peening on the tensile strength and deflection of polymer parts made using mask image projection stereolithography (MIP-SLA), Proc. 28th Annual International Solid Freeform Fabrication Symposium, August 7-9, 2017, Austin, TX, pp. 1761-1770. (reviewed)

[5] K.P. Rajurkar, H. Hadidi, J. Pariti; **G. Madireddy,** 2017, Review of sustainability in non-traditional machining processes, *Procedia of Manufacturing*, Volume 7, pages 714-720. (reviewed)

[6] M.P. Sealy, **G. Madireddy**, C. Li, Y.B. Guo, 2016, Finite element modeling of hybrid additive manufacturing by laser shock peening, Proc. 27th Annual International Solid Freeform Fabrication Symposium, Aug. 8-10, 2016, Austin, TX, pp. 306-316. (reviewed)

CONFERENCE PRESENTATIONS (*speaker)

[1] **G. Madireddy***, J.F. Liu, M.P. Sealy, 2020, Distortion mitigation in additive manufacturing of AlSi10Mg by multilayer laser peening, 20th CIRP Conference on Electro Physical and Chemical Machining (ISEM), Jan. 19-21, 2021, Zurich, Switzerland.

[2] **G. Madireddy***, M.P. Sealy, 2019, "Residual Stresses Measurements in Hybrid Additive Manufacturing," Solid Freeform Fabrication Symposium, Aug. 12-14, 2019, Austin, TX. (invited)

[3] H. Hadidi, **G. Madireddy***, R. Karunakaran, M.P. Sealy, 2019, "Glocal Integrity Formation in Hybrid Additive Manufacturing," Solid Freeform Fabrication Symposium, Aug. 12-14, 2019, Austin, TX. (invited)

[4] H. Hadidi, B. Mailand, T. Sundermann, E. Johnson, **G. Madireddy***, M. Negahbhan, L. Delbreilh, M.P. Sealy, 2019, Low velocity impact of ABS after shot peening predefined layers during additive manufacturing, North American Manufacturing Research Conference (NAMRC), Jun. 10-14, 2019, Erie, PA.

[5] M.P. Sealy*, H. Hadidi, **G. Madireddy**, R. Karunakaran, K.P. Rajurkar, 2019, "Defining Structural Glocal Integrity Enabled by Hybrid Additive Manufacturing," Intl. Academy for Production Engineering (CIRP) Winter Meeting, STC E: Electro-Physical and Chemical Processes, Sponsor: K.P. Rajurkar (CIRP Fellow), Feb. 20-22, 2019, Paris, France. (invited)

[6] H. Hadidi, **G. Madireddy**, C. Kanger, M.P. Sealy*, 2018, "Hybrid Processing in Additive Manufacturing by LENS and Laser Peening," Optomec LENS User Group Meeting, Sponsor: Tom Cobbs (Director of LENS Technology), Aug. 14, 2018, Austin, TX.

[7] M.P. Sealy, H. Hadidi, R. Eddins, C. Buel, X.T. Wang, **G. Madireddy***, W.L. Li, M. Negahban, 2018, Tensile and shear strength of ABS from hybrid additive manufacturing by fused filament fabrication (FFF) and shot peening (SP), Solid Freeform Fabrication Symposium, Aug. 13-15, 2018, Austin, TX. (invited)

[8] M.P. Sealy, **G. Madireddy***, C. Li, 2018, Modeling residual stresses evolution in steel from hybrid processing by directed energy deposition and laser shock peening, Solid Freeform Fabrication Symposium, Aug. 13-15, 2018, Austin, TX. (invited)

[9] M.P. Sealy*, **G. Madireddy**, C. Kanger, H. Hadidi, K.P. Rajurkar, 2018, "Hybrid Processes in Additive Manufacturing," Intl. Academy for Production Engineering (CIRP) Winter Meeting, STC E: Electro-Physical and Chemical Processes, Sponsor: Kamlakar Rajurkar (CIRP Fellow), Feb. 21-23, 2018, Paris, France. (invited)

[10] M.P. Sealy*, **G. Madireddy**, C. Kanger, H. Hadidi, 2017, "Hybrid Processes in Additive Manufacturing," Indian Institute of Technology (IIT) - Bombay, Sponsor: K.P. Karunakaran (IIT-Bombay), Dec. 21, 2017, Mumbai, India. (invited)

[11] M.P. Sealy*, **G. Madireddy**, C. Kanger, H. Hadidi, 2017, "Hybrid Additive Manufacturing by Peening," Intl. Conf. on Advanced Materials and Processes (ADMAT 2017 SkyMat), Sponsor: Narayana Murty (Indian Space Research Organization), Dec. 14-16, 2017, Kovalam, Thiruvananthapuram, India. (invited)

[12] M.P. Sealy*, T. Patil, **G. Madireddy**, C. Kanger, H. Hadidi, 2017, "Hybrid Additive Manufacturing of Biodegradable Medical Devices," Vishwakarma Institute of Technology, Sponsor: Rahul Waikar (VIT-Pune), Dec. 8, 2017, Pune, India.

[13] **G. Madireddy***, M.P. Sealy, 2017, Modeling residual stresses in hybrid additive manufacturing by laser peening, Mechanical and Materials Engineering 3rd annual research fair, University of Nebraska-Lincoln. (poster)

[14] C. Kanger, **G. Madireddy***, D. Sokol, M.P. Sealy, 2017, Hybrid additive manufacturing of steel by LENS and laser shock peening, Solid Freeform Fabrication Symposium, Aug. 7-9, 2017, Austin, TX.

[15] **G. Madireddy***, M. Montazeri, E. Curtis, J. Berger, N. Underwood, Y. Khayari, B. Marth, B. Smith, S. Christy, K. Krueger, M.P. Sealy, P. Rao, 2017, Effect of process parameters and shot peening on the tensile strength and deflection of polymer parts made using mask image projection stereolithography (MIP-SLA), Solid Freeform Fabrication Symposium, Aug. 7-9, 2017, Austin, TX.

[16] **G. Madireddy***, E. Curtis, J. Berger, N. Underwood, Y.A. Khayari, M.P. Sealy, P. Rao, 2017, Influence of shot peening on tensile strength and deflection of polymer parts made using mask image projection stereolithography (MIP-SLA), 28th Annual Solid Freeform Fabrication Symposium, Austin, TX, Aug. 7-9, 2017. (poster)

[17] **G. Madireddy***, M.P. Sealy, C. Li, Y.B. Guo, 2017, Finite element analysis of hybrid additive manufacturing to print location specific mechanical properties by sequential laser shock peening TMS 2017 additive manufacturing of metals San Diego, CA, Feb. 27, 2017. (poster)

[18] **G. Madireddy***, M.P. Sealy, 2016, Hybrid additive manufacturing by laser shock peening, Mechanical and Materials Engineering 2nd annual research fair, University of Nebraska-Lincoln. (3rd place) (poster)

[19] M.P. Sealy, **G. Madireddy***, C. Li, Y.B. Guo, 2016, Finite element modeling of hybrid additive manufacturing by laser shock peening, Solid Freeform Fabrication Symposium, Aug. 8-10, 2016. Austin, TX.

REFERENCES

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