

DEVIN J. ROACH, PH.D.

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EDUCATION

Doctor of Philosophy in Mechanical Engineering 05/2016 – 05/2021

Dissertation: Developing Intelligent Structures and Functional Devices Using Novel Smart Materials and Multi-Material Multi-Method (m⁴) 3D Printing
Georgia Institute of Technology, Atlanta, GA

Masters of Science in Mechanical Engineering 05/2016 – 05/2018

Georgia Institute of Technology, Atlanta, GA

Bachelor of Science in Mechanical Engineering 08/2011 – 05/2016

Concentration: Mechanics of Materials
Georgia Institute of Technology, Atlanta, GA

PROFESSIONAL & RESEARCH EXPERIENCE

Senior Member of Technical Staff 08/2022 – Present

Advanced Materials Lab, Sandia National Laboratories, Albuquerque, NM

- Leading PI of research focused on the process monitoring and control of Additive Manufacturing (AM)
- Coordinating research efforts related to the AM of functional composites for use in mission critical Department of Energy applications. Led to publication [6].

Postdoctoral Fellow 06/2021 – 07/2022

Advanced Materials Lab, Sandia National Laboratories, Albuquerque, NM

Advisor: Adam Cook, Principal Member of Technical Staff

- Utilizing computer vision and artificial intelligence (AI) techniques for real-time analysis and optimization of 3D printed components.
- Designing energy absorbent structures using additive manufacturing for use in the nation's stockpile.

Graduate Research Assistant 08/2016 – 05/2021

Active Materials & Additive Manufacturing Lab, Georgia Institute of Technology, Atlanta, GA

Advisor: Dr. H Jerry Qi, Woodruff Fellow

- Designed and built multi-material multi-method 3D printing platforms to print functional structures such as electronics, energy generators, sensors, and soft robotics.
- Developed novel soft-active materials using organic synthesis techniques to generate smart wearable systems, smart robots, and reconfigurable/adaptive radio frequency devices.

Year-Round Graduate Intern 05/2020 – 07/2021

Advanced Materials Lab, Sandia National Laboratories, Albuquerque, NM

Advisor: Adam Cook, Principal Member of Technical Staff

- Applied machine learning and computer vision algorithms to aid in the mechanical characterization and design of 3D printed energy absorbing structures.

Undergraduate Research Assistant 05/2015 – 05/2016

Mechanics of Materials Lab, Georgia Institute of Technology, Atlanta, GA

Advisor: Dr. Laurence Jacobs, Associate Dean

- Performed nonlinear ultrasonic inspections on radiation-embrittlement specimens.
- Helped publish and present the findings at conferences along with a graduate student.

International Science and Engineering Fair 05/2010 – 07/2010

Received numerous awards for project entitled *Design and Use of an Impact Response Device to Assess Structural Integrity*, including:

- Grand Award in Mechanical Engineering among over 5,000 competitors
- First place at the National Academy of Sciences Paper Competition

INDUSTRY EXPERIENCE

Airbus Germany

05/2016 – 08/2016

Testia, GMBH, Non-destructive Inspection Group, Airbus Headquarters, Bremen, Germany

- Helped to determine a new ultrasonic inspection technique's capability within the Airbus fleet
- Collaborated with Senior Engineers to write industry-wide inspection methods for a newly developed nondestructive inspection technique, eventually to be approved by Airbus, Boeing, and other major aircraft manufactures.

Delta Air Lines

01/2012 – 08/2015

Enabling Technologies (R&D) Department, Delta Air Lines Maintenance Headquarters, Atlanta, GA

- Worked on aircraft structural integrity and airworthiness using various structural analysis techniques
- Researched current theoretical structural mechanics techniques used to predict fatigue life of numerous aircraft joint configurations within Delta's fleet
- Designed experiments proving aircraft lap-splice joint strength to the Federal Aviation Administration for an initial, inspection-driven Damage Tolerance Analysis
- Implemented Nasgrow, a NASA-developed crack growth simulation technique, and its relevant equations to aid in the design of an automated crack propagation simulator

TEACHING EXPERIENCE

Adjunct Professor, ME 459 – Mechanical Engineering Design IV

10/2023 – Present

Department of Mechanical Engineering, The University of New Mexico, Albuquerque, NM

- Prepared and delivered lectures based on Budynas & Nisbett's "Shigley's Mechanical Engineering Design".
- Utilized "flipped classroom" techniques for improved student engagement and problem solving.

Teaching Fellow, ME 3001 – Mechanics of Deformable Bodies

08/2016 – 03/2020

GW Woodruff College of Engineering, Georgia Institute of Technology, Atlanta, GA

- Prepared and delivered lectures on all topics, especially focusing on exam review sessions.
- Prepared, administered, and graded exams.

Collegiate Education Research

01/2018 – 08/2021

GW Woodruff College of Engineering, Georgia Institute of Technology, Atlanta, GA

- Collaborated with researchers investigating the "Impact of Active Learning Interventions on Student Outcomes in Core Mechanical Engineering Topics" and will publish the results in early 2021.

Guest Lecturer, ME 7201 – Computational Mechanics of Materials

08/2019 – 12/2019

GW Woodruff College of Engineering, Georgia Institute of Technology, Atlanta, GA

- Prepared and gave lectures on all topics, especially focusing on exam review sessions.

Tutor and Instructor, ME 3322 – Thermodynamics, ME 3340 – Fluid Mechanics

01/2016 – 08/2017

Georgia Tech Athletic Association, Georgia Institute of Technology, Atlanta, GA

- One of three approved teaching assistants for student-athletes in upper-level mechanical engineering classes.
- Led 1-2 hour long review sessions for anywhere from 2 to 6 students.

MENTORSHIP EXPERIENCE

Senior Design Mentor (University of Texas El Paso)

08/2021 – 1/2022

- Mentored 5 students working on a senior design project focused on artificial intelligence (AI) and computer vision – based approaches.

Undergraduate Mentorship Programs Leader

01/2016 – 08/2020

- Mentored five undergraduate students in research projects, three of whom eventually became co-authors on publications. Students went on to work at Tesla, Boeing, Schlumberger, & Northrop.
- Led undergraduate research program by providing all liaison and recruiting for undergraduate students within our laboratory and assigned them graduate students based on targeted skills/career path.
- Led onboarding and training of new Graduate students within our group with items such as how to write papers, facilitate collaboration, and write fellowship applications.

ENGAGES STEM Mentorship Program

05/2019 – 08/2020

- Mentored historically under-represented Atlanta-area high school students in a STEM research projects.
- Mentee's project was selected as one of only three students from Georgia to present his work at the 2020 International Science & Engineering Fair.

Statement of Work (SOW) Writing

08/2016 – 05/2021

- Wrote and prepared SOWs to generate funding for our laboratory resulting in the support of two new PhD students for two years.
- Developed proposals leading to collaboration with Northrop Grumman and Sandia National Labs

PUBLICATIONS

Throughout my career I have focused on publishing high-quality research as a first author multiple times per year. The articles listed below currently have a cumulative citation count of 1270 with an i10-index of 15 and an h-index of 13. The most cited work currently has 467 citations.

Google Scholar link: (<https://scholar.google.com/citations?user=9hlSsrIAAAAJ>)

• JOURNAL ARTICLES (*CORRESPONDING AUTHOR)

- [1] A Rohskopf, L Appelhans, J Cardenas, A Cook, **DJ Roach***, 2022, “Real-Time Process Monitoring and Control of Direct Ink Write using Computer Vision and Inverse Neural Networks” *In preparation*.
- [2] **DJ Roach***, X Sun, X Peng, F Demoly, K Zhou, HJ Qi*, 2022, “4D Printed Multifunctional Composites with Cooling-Rate Mediated Tunable Shape Morphing” *Advanced Functional Materials*, 32 (36), 2203236.
- [3] **DJ Roach**, A Rohskopf, WD Reinholtz, R Bernstein, HJ Qi, A Cook, 2021, “Utilizing computer vision and artificial intelligence algorithms to predict and design the mechanical compression response of direct ink write 3D printed foam replacement structures” *Additive Manufacturing*, 41,101950.
- [4] **DJ Roach**, C Roberts, J Wong, X Kuang, J Kovitz, Q Zhang, TG Spence, HJ Qi, 2020, “Surface Modification of Fused Filament Fabrication (FFF) 3D Printed Substrates by Inkjet Printing Polyimide for Printed Electronics” *Additive Manufacturing*, 36, 101544.
- [5] **DJ Roach**⁺, S Zhang⁺, S Xu, P Wang, W Zhang, HJ Qi, ZL Wang, 2020, “Electromagnetic Pulse Powered by a Triboelectric Nanogenerator with Applications in Accurate Self-Powered Sensing and Security” *Advanced Materials Technologies*, 2000368. [+ Equal first authorship]
- [6] **DJ Roach**, C Yuan, M Romero, I Hamel, C Dunn, K Yu, HJ Qi, 2019, “Long Liquid Crystal Elastomer Fibers for Smart Textiles and Soft Robotics Applications”, *ACS Applied Materials & Interfaces*, 11(21), 19514-19521.
- [7] **DJ Roach**, C Hamel, C Dunn, X Kuang, HJ Qi, 2019, “The m⁴ 3D Printer: A multi-material multi-method additive manufacturing platform for future 3D printed structures” *Additive Manufacturing*, 29, 100819.

- [8] **DJ Roach**, X Kuang, C Yuan, C Dunn, H Jerry Qi, **2018**, “Novel Ink for Ambient Condition Printing of Liquid Crystal Elastomers for 4D Printing”. *Smart Materials and Structures*, 27 (12), 125011.
- [9] **DJ Roach**, C Hamel, J Wu, X Kuang, M Dunn, H Jerry Qi, **2017**, “4-D Printing: Potential Applications of 3-D Printed Active Composite Materials” *HDLAC Journal*, 4, 4.
- [10] E. Linde, **DJ Roach**, L. Appelhans, A. Cook, **2022**, “In Situ Characterization and Monitoring of Material Extrusion Printing of Reactive Resins by Near-Infrared Spectroscopy”. *Additive Manufacturing*, Revisions in progress.
- [11] X Kuang, **DJ Roach**, C Hamel, K Yu, HJ Qi, **2020**, “Materials, Design and Fabrication of Shape Programmable Polymers”. *Multifunctional Materials*, 3 (3), 032002.
- [12] C Hamel, **DJ Roach**, K Long, HJ Qi, **2019**, “Machine-learning based design of active composite structures for 4D printing”, *Smart Materials and Structures*, 28 (6), 065005.
- [13] X Kuang, **DJ Roach**, J Wu, C Hamel, D Zhen, T Wang, M Dunn, HJ Qi, **2019**, “Advances in 4D Printing: Materials and Applications”. *Advanced Functional Materials*, 29 (2), 1805290.
- [14] C Yuan, **DJ Roach**, C Dunn, Q Mu, X Kuang, C Yakacki, TJ Wang, K Yu, H Jerry Qi, **2017**, “3D printed reversible shape changing soft actuators assisted by liquid crystal elastomers”, *Soft Matter*, 13 (33), 5558-5568.
- [15] Q Zhang, **DJ Roach**, L Geng, H Chen, H Qi, and D Fang, **2018**, “Highly stretchable and conductive fibers enabled by liquid metal coating” *Smart Materials and Structures*, 27 (3), 035019.
- [16] C Armstrong, L Yue, X Kuang, **DJ Roach**, HJ Qi, **2022**, “A hybrid additive manufacturing process for production of functional fiber-reinforced polymer composite structures” *Journal of Composite Materials*, 10, 1177.
- [17] X Peng, X Kuang, **DJ Roach**, Y Wang, CM Hamel, C Lu, HJ Qi, **2021**, “Integrating digital light processing with direct ink writing for hybrid 3D printing of functional structures and devices” *Additive Manufacturing*, 40, 101911.
- [18] Q Zhang, X Kuang, S Weng, L Yue, **DJ Roach**, D Fang, HJ Qi, **2021**, “Shape-Memory Balloon Structures by Pneumatic Multi-material 4D Printing”, *Advanced Functional Materials*, 2010872.
- [19] S Weng, X Kuang, Q Zhang, CM Hamel, **DJ Roach**, N Hu, HJ Qi, **2020**, “4D Printing of Glass Fiber-Regulated Shape Shifting Structures with High Stiffness”, *ACS Applied Materials & Interfaces*, 13 (11), 12797-12804.
- [20] X Kuang, Q Mu, **DJ Roach**, HJ Qi, **2020**, “Shape-programmable and healable materials and devices using thermo-and photo-responsive vitrimer”, *Multifunctional Materials*, October **2020**.
- [21] V Li, X Kuang, C Hamel, **DJ Roach**, HJ Qi, **2019**, “Cellulose nanocrystals support material for 3D printing complexly shaped structures via multi-materials-multi-methods printing” *Additive Manufacturing*, 28, 14-22.
- [22] Q Mu, M Lei., **DJ Roach**, C Dunn, X Kuang, C Yuan, T Wang, Qi, HJ Qi, **2018**, “Intense pulsed light sintering of thick conductive wires on elastomeric dark substrate for hybrid 3D printing applications” *Smart Materials and Structures*, 27 (11), 115007.

- **BOOK CHAPTERS & EDITORIALS**

- [23] Z Wang, J Boothby, **DJ Roach***, Q He*, **2022**, “Editorial: Soft robotics based on liquid crystal elastomers (LCE)”, *Frontiers in Robotics and AI*, 9, 1018819.
- [24] **DJ Roach**, X Kuang, HJ Qi. “4D Printing Based on Multi-Material Design” Edited Volume on Additive Manufacturing for Multifunctional Materials and Structures, Manufacturing in the Era of 4th Industrial Revolution, **2020**.

- **CONFERENCE PROCEEDINGS (ONLY FIRST-AUTHOR SHOWN)**

- [25] **DJ Roach**, D Reinholdtz, A Cook, L. Appelhans, “Real-Time Process Optimization of Direct Ink Write 3D Printing Using Computer Vision and Machine Learning”, MRS Spring, Honolulu, HI, **2022**.
- [26] **DJ Roach**, A Cook “Utilizing Computer Vision and Artificial Intelligence Algorithms to Predict and Design the Mechanical Compression Response of Direct Ink Write 3D Printed Foam Replacement Structures”. JOWOG 28, Virtual Meeting, **2021**.
- [27] **DJ Roach**, J Wong, HJ Qi “Leveraging Multi-Material Multi-Method (m4) 3D Printing for Printable Electronics and Soft Robotics”. SES Annual Meeting, St. Louis, MO, **2019**.
- [28] **DJ Roach**, J Wong, X Kuang, HJ Qi “Developing Intelligent Structures and Devices using Novel Smart Materials and Multi-Material Multi-Method (m4) 3D Printing”. IWSHM, Stanford, CA, **2019**.
- [29] **DJ Roach**, C Yuan, X Kuang, HJ Qi “Novel Ink for Ambient Condition Printing of Liquid Crystal Elastomers for 4D Printing”. ASME IMECE, Pittsburgh, Pennsylvania, **2018**.
- [30] **DJ Roach**, C Yuan, M Romero, C Dunn, K Yu, HJ Qi, “4D Printing of Liquid Crystal Elastomer Fibers for Use in Smart Textiles and Soft Robotics”, Southeast Polymer Forum, Blacksburg, Virginia, May **2017**.

● **PATENTS & COPYRIGHTS**

- [31] “**Real-time process monitoring for direct ink write additive manufacturing**” Patent Applied for. Application Serial No. SD15860.1/S170827. **2022**.
- [32] “**Slice-Write**” Commercial Software Copyright Assertion SCR 2753. **2022**.
- [33] “**Artificial Intelligence to Predict the Mechanical Response of 3D Printed Foam Replacement Structures**” Patent Applied for. Application Serial No. 17/548,746. **2022**.
- [34] “**System of Foldable Box Kites to Harness High Altitude Wind Energy for Electricity Generation**” Provisional Serial No: 62/844,822. **2019**.
- [35] “**Fabrication of Long Liquid Crystal Elastomer Fibers for Smart Textile and Smart Fiber Applications**” Patent under internal Georgia Tech review. **2019**.

PROPOSALS AND GRANTS

FY 23 Laboratory Directed Research & Development (LDRD) Exploratory Express, “Digital Light Processing (DLP) of Aligned Liquid Crystal Elastomer (LCE) Foams for High Frequency Shock and Vibration Applications”, \$125k **10/2022 – 10/2023**

HONORS AND RECOGNITIONS

- Early Career Leadership Award**, New Mexico EPSCoR, 2021.
- Invited Editor for Frontiers in Robotics and AI**, Special Topic on Liquid Crystal Elastomers for Soft Robots, 2021.
- HDIAC Subject Matter Expert (SME) for 4D Printing**, 2019.
- Invited Tech Talk**, Homeland Defense & Security Information Analysis Center (HDIAC), 2018.
- NSF Innovation Corps Grant Award**, 2017.
- Grand Award in Mechanical Engineering**, ISEF International Science and Engineering Fair, Reno, Nevada, 2010.
- First Place at the National Academy of Sciences Paper Competition**, ISEF International Science and Engineering Fair, Reno, Nevada, 2010.

SERVICE

New Mexico Regional Science and Engineering Fair Topic Chair

01/2022 – 04/2022

APPLICABLE SKILLS AND INTERESTS

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|---------------------------|---|
| Journal Editor | Frontiers in Robotics and AI – Special Topic on Liquid Crystal Elastomers |
| Journal Article Reviewer: | Advanced Functional Materials, Additive Manufacturing, Multifunctional Materials, full list on Publons |
| Certifications/Trainings | CETL Education, Cleanroom, Machine Shop, SEM, FTIR, DMA, DSC |
| Software: | Abaqus, Ansys, and NASTRAN finite element modeling solvers, Visual Studio, Microsoft Office, AutoCAD, SolidWorks, Adobe Suite |
| Programming Languages: | Python, LabView, Matlab, Visual Basic, C++, Java |
| Languages: | English (Native), Spanish (Fluent), German (Conversational) |