BRADLEY DARRALL

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EDUCATION

University at Buffalo, State University of New York
- Ph.D., Mechanical Engineering, June 2016
- M.S., Mechanical Engineering, June 2015
- B.S., Mechanical Engineering, June 2011

PROFESSIONAL EXPERIENCE

Mechanical and Aerospace Engineering Department, University at Buffalo
- Associate Professor of Teaching (2023-Present)
- Assistant Professor of Teaching (2016-2023)
- Instructor (2014-2016)
- Teaching Assistant (2013-2016)

Sprung-brett RDI, Buffalo, NY
- Research Assistant (2012)

AWARDS

SEAS Teaching Faculty of the Year, UB (2022)
Vanderhoef Faculty Award for Excellence in Mentorship, UB (2021)
Tau Beta Pi "Professor of the Year", UB (2017)
National Science Foundation Graduate Research Fellowship (2011-2015)
UB Presidential Fellowship (2011-2015)
Senior Scholar Award, UB (2011)
Zimmer Undergraduate Research Scholarship, UB (2010)
UB Provost Scholarship (2007-2011)
Buffalo Engineering Society Scholarship (2007-2011)
NYS Regents Scholarship (2007-2011)

RESEARCH SUMMARY

Primary research fields

- Computational and applied mechanics
- Numerical methods (primarily finite element methods)
- Variational approaches to classical, continuum, and quantum mechanics
- Multi-physics and small-scale continuum mechanics

Recent research projects

- Least energy variational principle for heat diffusion and development of novel time-dependent Ritz method
- Finite element methods and variational methods for three dimensional and anisotropic micro-scale elasticity (couple-stress elasticity)
- Finite element methods and variational methods for micro-scale incompressible flow (couple-stress fluids)
- Finite element methods and variational methods for size-dependent piezoelectricity (flexoelectricity) and thermoelasticity
- Least action variational principles for dissipative continuum dynamics (thermoelastodynamics, dynamic poroelasticity, heat diffusion etc)
- Least action principles for quantum mechanics

PUBLICATIONS

Many publication preprints are available as pdfs at buffalo.edu/~bdarrall/

JOURNAL PAPERS

1. **Darrall, B.T.**, Dargush, G.F. "Convolved energy variational principle in heat diffusion", *Int. J. Heat Mass Transf*, **175**, 121315 (2021).

2. Pedgaonkar, A., **Darrall, B.T.**, Dargush, G.F. "Mixed displacement and couple stress finite element method for anisotropic centrosymmetric materials", *Eur. J. Mech. A-Solids*, **85,** 104074 (2021).

3. **Darrall, B.T.**, Dargush, G.F. "Variational principle and time-space finite element method for dynamic thermoelasticity based on mixed convolved action". *Eur. J. Mech. A-Solids*, **71**, 351-364 (2018).

4. **Darrall, B.T.**, Dargush, G.F. "Mixed convolved action variational methods for poroelasticity", *ASME J. App. Mech*, **83**, 091011 (2016).

5. Dargush, G.F., Apostolakis, G., **Darrall, B.T.**, Kim, J. "Mixed convolved action variational principles in heat diffusion", *Int. J. Heat & Mass Transfer*, **100**, 790-799 (2016).

6. Dargush, G.F., **Darrall, B.T.**, Kim, J., Apostolakis, G. "Mixed convolved action principles in linear continuum dynamics", *Acta Mech.*, **226**, 4111-4137 (2015).

7. **Darrall, B.T.**, Hadjesfandiari, A.R., Dargush, G.F. "Size-dependent piezoelectricity: A 2D finite element formulation for electric field-mean curvature coupling in dielectrics", *Eur. J. Mech. A-Solids*, **49**, 308-320 (2015).

8. **Darrall, B.T.**, Dargush, G.F., Hadjesfandiari, A.R. "Finite element Lagrange multiplier formulation for size-dependent skew-symmetric couple-stress planar elasticity", *Acta Mech.*, **225**, 195-212 (2014).

CONFERENCE PAPERS

1. **Darrall, B.T.**, Dargush, G.F. "Mixed convolved action principles for dynamics of linear poroelastic conitinua", ASME, IMECE2015-53163, Houston, TX, November 2015.

THESES

1. **Darrall, B.T.** "True variational principles and time-space finite element methods for classical and quantum mechanics", *Ph. D Dissertation*, University at Buffalo, The State University of New York (2016).

2. **Darrall, B.T.** "Variational and 2D finite element formulations for size-dependent elasticity and piezoelectricity", *M.S. Thesis*, University at Buffalo, The State University of New York (2015).

SUBMITTED / IN-PREPERATION

1. **Darrall, B.T.**, Dargush, G.F. "Finite element method for size-dependent thermoelastic analysis", in preperation.

2. **Darrall, B.T.**, Dargush, G.F. "Finite element method for 3d couple stress analysis using mixed edge elements ", in preparation.

3. **Darrall, B.T.**, Bambrah, H.E., Dargush, G.F. "Three-dimensional finite element formulation for size-dependent couple stress elasticity", in preparation.

4. **Darrall, B.T.**, Tan, J. "2D Finite element method for size-dependent linear incompressible fluid mechanics", in preparation.

5. **Darrall, B.T.**, Dargush, G.F. "Mixed convolved action principle for the time-dependent Schrodinger's equation and corresponding time-space finite element method", in preparation.

6. **Darrall, B.T.**, Dargush, G.F. "A least convolved action principle for quantum mechanics", in preparation.

7. Pedgaonkar, A., **Darrall, B.T.**, Dargush, G.F., "2d analysis and finite element method for non-centrosymmetric couple stress materials", in preparation.

PROFESSIONAL SERVICE

REVIEWER

International Journal of Solids and Structures

Engineering Analysis with Boundary Elements

AIP Advances

Special Topics and Reviews in Porous Media

Reports on Mathematical Physics

CONSULTING

TTARP Industries (FEA consulting, 2020, 2021)

TEACHING SUMMARY

RECENT QUANTITATIVE EVALUATIONS *(Most recent 3 year average)*

Course	Overall Instructor Rating
MAE Lab II (MAE338)	**4.9 /5**
Intermediate Dynamics (MAE345)	**4.8 /5**
Applied Math for MAE (MAE376)	**4.5 /5**
Analysis of Structures (MAE315)	**4.5 /5**
Dynamics (EAS208)	**4.7 /5**

INSTRUCTOR

Applied Mathematics for MAE (MAE376)

Fall 2022, 2 sections, enrollment: 170
Fall 2021, 2 sections, enrollment: 160
Fall 2020, 2 sections, enrollment: 160
Fall 2019, 2 sections, enrollment: 200

Dynamics (EAS208)

Spring 2019, 1 section, enrollment: 65
Spring 2018, 1 section, enrollment: 100
Spring 2017, 2 sections, enrollment: 130
Spring 2015, 2 sections, enrollment: 130
Fall 2014, 1 section, enrollment: 65
Spring 2014, 2 sections, enrollment: 130

MAE Lab II (Fluids and thermal) (MAE338)

Summer 2022, 1 section, enrollment: 30
Summer 2021, 1 section, enrollment: 30
Summer 2020, 1 section, enrollment: 20
Summer 2019, 1 section, enrollment: 18
Fall 2018, 8 sections, enrollment: 200
Summer 2018, 1 section, enrollment: 15
Fall 2017, 8 sections, enrollment: 200
Summer 2017, 1 sections, enrollment: 10
Fall 2016, 10 sections, enrollment: 250
Winter 2016, 1 section, enrollment: 10

Analysis of Structures (MAE315)

Fall 2022, 1 section, enrollment: 60
Fall 2021, 2 sections, enrollment: 140
Fall 2020, 1 section, enrollment: 90
Fall 2019, 1 section, enrollment: 100
Fall 2018, 1 section, enrollment: 80
Fall 2017, 1 section, enrollment: 65
Fall 2016, 1 section, enrollment: 60

Intermediate Dynamics (MAE345)

Spring 2022, 2 sections, enrollment: 150
Spring 2021, 2 sections, enrollment: 160
Spring 2020, 2 sections, enrollment: 190
Spring 2019, 2 sections, enrollment: 160
Spring 2018, 2 sections, enrollment: 135
Spring 2017, 1 section, enrollment: 75

Engineering Computations (EAS230)

Summer 2016, 1 section, enrollment: 40

TEACHING ASSISTANT

Dynamics (EAS208)

Spring 2016, 4 sections, enrollment: 220

Fluids and Thermal Lab (MAE338)
Fall 2015, 7 sections, enrollment: 200

Statics (EAS207)
Spring 2013, 3 sections, enrollment: 150

ADVISEMENT

UNDERGRADUATE RESEARCH ADVISEMENT

Student(s)	Project Description	Timeline
Thomas Scully	*FEA for size-dependent wave propagation in couple-stress materials*	Summer 2022 – Present
Matteo Pellegrini	*Convolved action principles for non-linear dynamic systems*	Spring 2022 – Fall 2022
Brendan Donovan Max Magee Evan Allen	*MDOF vibration simulation and physical demonstrations*	Spring 2022 – Summer 2022
Herman Bambrah	*Applications of 3d couple-stress FEM*	Summer 2020 – Summer 2021
Jingye Tan	*FEA of incompressible couple-stress fluids*	Spring 2018 – Spring 2019
Seth Messer	*Design of 2D conduction experiment: comparing infrared thermal maps to FEA*	Summer 2018
Paul Leoniak	*Couple-stress contact mechanics finite element algorithm*	Summer 2017
William Abt	*Acoustic analysis and design of composite drum shells using FEM*	Summer 2016
Lim Yi Ang	*Experimental analysis of size-dependent flow through micro-needles*	Spring 2016

UNIVERSITY SERVICE ACTIVITES

DEPARTMENT

MAE Matlab Online Video Crash Course (Creator)	Summer 2022
MAE Undergraduate Advisement Faculty Coordinator	Fall 2021-Present
MAE Undergraduate Faculty Advisor *(roster of 80+ students)*	Spring 2021-Present
MAE Undergraduate Studies Committee	Spring 2018-Present
MAE Department Undergraduate Advisement	Fall 2016-Present
MAE UG Student Excellence and Diversity Committee	Fall 2016-Present
MAE Graduate Poster Competition Judge	Spring 2019-2020
MAE Undergraduate Lab Upgrades Committee	Fall 2017-2019
MAE Open House Volunteer	Spring 2016-2019
MAE Orientation Speaker	Summer 2018-2019
MAE Teaching Faculty Search Committee	Fall 2017

SCHOOL

EAS Undergraduate Mentor Program	Spring 2017-Present
"Science is Elementary" Teaching Volunteer	Spring 2016-Present
SEAS Graduation Marshall	Spring 2019

OUTREACH

Guest STEM teacher at Westminster Elementary School (Spring 2016, 2017, 2018, 2019)

Tours of UB fluids and thermal lab and lesson/experiment for (K-8) classes (Winter 2016)

SOFTWARE and PROGRAMMING

Programming: Matlab, Fortran, Maple, HTML, c++, MPI, OpenMP
CAD/Graphics: AutoCAD, Pro Engineer, Adobe Photoshop, Adobe Illustrator
Finite Element: Abaqus, ANSYS *Other:* Microsoft Office Suite