

# ROBERT J. WAGNER

## PERSONAL DATA

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Department of Mechanical Engineering  
Thomas J. Watson College of Engineering & Applied Science, Binghamton University  
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## EDUCATION & TRAINING

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**Ph.D., Material Science & Engineering**  
**University of Colorado**, Boulder, CO, August 2017 – August 2022  
**Thesis Advisor:** Professor Franck J. Vernerey

**B.S., Mechanical Engineering** (*Magna cum laude*)  
**Union College**, Schenectady, NY, September 2009 – June 2013.  
**Study Abroad:** Czech Technical University, Prague, Czech Republic, Fall 2012  
**Dean's List:** 2009-2013

## PROFESSIONAL EXPERIENCE

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**Assistant Professor**, Binghamton University, Binghamton, NY  
Mechanical Engineering, January 2024 – Present

**Postdoctoral Researcher**, Cornell University, Ithaca, NY  
Mechanical & Aerospace Engineering, Mech. for Material Design Lab, August 2022 – December 2023  
PI: Professor Meredith N. Silberstein

**Research Assistant**, University of Colorado, Boulder, CO  
Material Science & Engineering, Vernerey Soft Matter Mechanics Group, August 2017 – August 2022  
PI: Professor Franck J. Vernerey

**Application Engineer**, Vetco Gray, GE Oil & Gas, Houston, TX  
Floating Productions Systems, July 2013 – July 2017

**Undergraduate Researcher**, Union College, Schenectady, NY  
Mechanical Engineering, Aerogel Lab, June – August 2012  
PI: Professor Ann M. Anderson

## RESEARCHER INTERESTS

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**Micromechanics of dynamic and active networks:** “Dynamic networks” contain bonds that disconnect and reattach reversibly imparting them with viscoelasticity, enhanced toughness, and self-healing capabilities. The complexity of dynamic networks is exacerbated when their elemental units convert internally stored energy into mechanical work. Such “active networks” may spontaneously morph, locomote or apply traction to their environment. Unsurprisingly, active networks are ubiquitous in biological systems and their exploitation across spatiotemporal scales proves necessary for the development of autonomously adaptive metamaterials. Towards achieving biomimetic counterparts to nature’s functional materials, I employ a combination of observational experimentation and multi-scale modeling, that elucidate the local interaction rules governing global properties of active networks. My aim is to apply what I learn in a first principles engineering approach to bioinspired design.

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### RESEARCHER INTERESTS (CONTINUED)

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**Computational mechanics:** To contend with the complex mechanics of soft materials, I employ a wide range of multi-scale modeling techniques including constitutive modeling and finite element analysis at the continuum scale, and discrete numerical methods (e.g., discrete element method, agent-based models, etc.) at the meso- and microscales. The ability to develop and customize these approaches allows for rapid investigation of both the mechanical and morphological responses of systems ranging from transiently bonded sol-gels to active systems such as clusters of cells or insects.

### FUNDED RESEARCH PROJECTS, HONORS, & AWARDS

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4. **NSF Future Faculty Symposium Travel Award** for SES 2023, A physically motivated mesoscale approach for the mechanical exploration of elastomers and gels. (October 2023), Award Amount: **\$1,000**
3. **Soft Matter GAANN Fellowship**, Mesoscale modeling of transient networks: how does microstructural evolution dictate global mechanical response? (May – August 2022), Award Amount: **\$8,500**.
2. **Summer Research Fellowship**, On the origins of morphogenesis and active contraction in fire ant rafts. (June – August 2021), Award Amount: **\$6,000**.
1. **Academic Merit Scholarship**, Union College. Provided for outstanding high school academic performance. (September 2009 – June 2013), Award Amount: **\$14,000 annually**.

### SCHOLARLY PUBLICATIONS

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10. **Wagner, R.J.**, Lamont, S.C., White, Z.T., Vernerey, F.J. Catch bond kinetics are instrumental to cohesion of fire ant rafts under load. *In revision*. (2024).
9. Abdelrahman, M., **Wagner, R.J.**, Kalairaj, M.S., Zadan, M., Kim, M.H., et al. Material assembly from collective action of shape-changing polymers. *Nature Materials*. (2024).
8. **Wagner, R. J.** & Vernerey, F. J. Coupled bond dynamics alters relaxation in polymers with multiple intrinsic dissociation rates. *Soft Matter* (2023).
7. Xu, L.\* , **Wagner, R. J.\*** , Liu, S.\* , He, Q., Zou, X., Fu, Y., Shi, X., Zhao, D., Ding, J., Vernerey, F. J. Locomotion of an untethered, worm-inspired soft robot driven by a shape-memory alloy skeleton. *Scientific Reports* 12, 12392 (2022).
6. Xu., L.\* , Fu, Y.\* , **Wagner, R. J.\*** , Zou, X., He, Q., Li, T., Ding, J., Vernerey, F. J. Thermosensitive P(AAc-co-NIPAm) hydrogels display enhanced toughness and self-healing via ion-ligand interactions. *Macromolecular Rapid Communications*, 2200320 (2022).
5. **Wagner, R. J.**, Dai, J.\* , Su, X.\* , Vernerey, F. J. A mesoscale model for the micromechanical study of gels. *Journal of the Mechanics and Physics of Solids* 104982 (2022).
4. **Wagner, R. J.** & Vernerey, F. J. Computational exploration of treadmilling and protrusion growth observed in fire ant rafts. *PLOS Computational Biology* 18, e1009869 (2022).
3. **Wagner, R. J.**, Hobbs, E. & Vernerey, F. J. A network model of transient polymers: exploring the micromechanics of nonlinear viscoelasticity. *Soft Matter* (2021).
2. **Wagner, R. J.**, Such, K., Hobbs, E. & Vernerey, F. J. Treadmilling and dynamic protrusions in fire ant rafts. *Journal of The Royal Society Interface* 18, 20210213 (2021).

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\*Denotes equal contribution.

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### SCHOLARLY PUBLICATIONS (CONTINUED)

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1. Vernerey, F. J., Shen, T., Sridhar, S. L. & **Wagner, R. J.** How do fire ants control the rheology of their aggregations? A statistical mechanics approach. *Journal of The Royal Society Interface* 15, 20180642 (2018).

### PATENTS

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4. Rockford D. Lyle, Jesse B. Riha, Daniel L. Havelka, **Robert J. Wagner**. 2020. Wiper seal system and method. 10648566. Filed February 28, 2018. Issued May 12, 2020.
3. Benjamin J. Kubichek, Joseph W. Pallini, Jesse B. Riha, Daniel L. Havelka, **Robert J. Wagner**. 2019. Inverted pull-up riser tensioner. 10174566. Filed February 16, 2017. Issued January 8, 2019.
2. Joseph W. Pallini, Rockford D. Lyle, **Robert J. Wagner**. 2018. Remotely operated external tieback connector. 9938792. Filed November 6, 2015. Issued April 10, 2018.
1. **Robert J. Wagner**, Benjamin J. Kubichek, Daniel L. Havelka. 2017. Tensioner cylinder with internal gas bladder in high pressure chamber. 9816538. Filed August 31, 2016. Issued November 14, 2017.

### CONFERENCE PROCEEDINGS & COLLOQUIA

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9. **Computation for dynamic soft matter design**. Poster. SES2023, Minneapolis, MN, October 10<sup>th</sup>, 2023.
8. **A physically motivated mesoscale approach for the mechanical exploration of dynamic elastomers and gels**. Talk. SES 2023, Minneapolis, MN, October 10<sup>th</sup>, 2023.
7. **Agent-Based Modeling of Fire Ant Rafts Reproduces Spontaneous Collective Exploration**. Talk. USNC/CM 2023, Albuquerque, NM, July 26<sup>th</sup>, 2023.
6. **Rate-dependent fracture of vitrimers**. Talk. USNC/TAM 2022, Austin, TX. June 24<sup>th</sup>, 2022.
5. **A mesoscale model for the micromechanical investigation of transient polymers**. Talk. USNC/TAM 2022. Austin, TX. June 22<sup>nd</sup>, 2022.
4. **Ab initio discrete numerical modeling of gels for predictive design**. Talk. USNC/TAM 2022. Austin, TX. June 21<sup>st</sup>, 2022.
3. **Exploring cooperative treadmilling and protrusion growth in fire ant rafts**. Talk. APS March Meeting 2022. Chicago, IL. March 18<sup>th</sup>, 2022.
2. **Design of a Wood Core Flax Fiber-Reinforced Composite I-Beam**. 2013 SAMPE Natural Fiber Composite Bridge Competition. Poster. Long Beach, CA. May 8<sup>th</sup>, 2013.
1. **ASME Old Guard Oral Presentation Competition**. Talk. New York Institute of Technology. Hicksville, NY. April 27<sup>th</sup>, 2013.

### TEACHING

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- Guest Lecturer: Polymer Mechanics (MAE 4671, Cornell University), Spring 2023
- Guest Lecturer: State Variable Modeling (MAE 6140, Cornell University), Fall 2022
- Guest Lecturer: Mech. of Soft Matter (MCEN 4228/5228, CU Boulder), Fall 2021
- Teaching Assistant: Mech. of Soft Matter (MCEN 4228/5228, CU Boulder), Fall 2020
- Teaching Assistant: Mech. of Soft Matter (MCEN 4228/5228, CU Boulder), Spring 2019
- Teaching Assistant: Fundamentals of Material Sci. & Eng. (MSEN 5000, CU Boulder), Summer 2018

## ROBERT J. WAGNER

### MENTORSHIP TO UNDERGRADUATE RESEARCHERS & M.S. STUDENTS

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- Rahul Ghosh (August 2022 – 2023): M.S. Student in Silberstein Mechanics for Materials Design Lab: Exploring the use of non-Newtonian resins for the reduction of dry spots in fiber composites.
- Tianke Chen (August 2022 – 2023): M.S. Student in Silberstein Mechanics for Materials Design Lab: Mitigation of fiber composite residual stress using dynamic polymer resins.
- Vara Tummala (January 2022 – March 2022): YOU'RE@CU Undergraduate Research Program: Numerical investigation of transient, hybrid network mechanics.
- Jinyue Dai (September 2020 – May 2021): CU Boulder Mechanical Engineering Senior Project: Numerical modeling of 2D dynamic networks for simulated mechanical experimentation on polymers.
- Xinfu Su (September 2020 – May 2021): CU Boulder Mechanical Engineering Senior Project: Numerical modeling of 2D dynamic networks for simulated mechanical experimentation on polymers.
- Madison M. Davis (September 2018 – May 2019): Vernerey Soft Matter Mechanics Lab: Design of a biomimetic active network for the study of local-to-global mechanics.

### ENGINEERING SOCIETIES

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- Member, **American Society of Mechanical Engineers**. September 2023 – Present
- Member, **American Physical Society**. November 2019 – Present
- Member, **New York Mu Chapter, Tau Beta Pi Honorary Engineering Society**. Union College, May 2013 – Present
- Member, **Alpha Alpha Chapter, Pi Tau Sigma Honorary Mechanical Engineering Society**. Union College, May 2012 – Present

### PROFESSIONAL SERVICE ACTIVITIES & OUTREACH

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- **Tutor for Cornell Prison Education Program**. August 28<sup>th</sup>, 2023 – Present. Tutor incarcerated students pursuing their Associate's Degrees at Cayuga Correctional Facility in topics ranging from mathematics to history.
- **Volunteer at 4-H Career Explorations 2023 "Mechanical Metamaterials"**. July 28<sup>th</sup>, 2023. A hands-on workshop on the fundamentals of stress-strain relations, and how highly structured topologies can be used to impart special mechanical properties such as negative Poisson's ratio. Ages 15-18.
- **Organizer and Lead of "Solids, fluids, and everything between: 'Viscoelasticity' and the curious case of fire ants"**. Dryden Elementary School. March 3<sup>rd</sup>, 2023. An interactive lesson on viscoelastic solids' and condensed active matter's mechanical properties, to showcase and provide access to STEM research for students ages 7-9.
- **Volunteer at Greater Ithaca Activities Center** to teach students (ages 9-10) the principles of engineering and promote access to and interest in STEM for young women.
  - November 30<sup>th</sup>, 2023. Lesson on potential and kinetic energy.
  - March 29<sup>th</sup>, 2023. Mechanics of bridge building workshop.
  - February 1<sup>st</sup>, 2023. Continuation of mousetrap cars and energy storage workshop.
  - December 7<sup>th</sup>, 2022. Mousetrap cars and energy storage workshop.
  - November 2<sup>nd</sup>, 2022. Catapults, kinematics, and levers workshop.
  - October 19<sup>th</sup>, 2022. Science of sound workshop.

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### PROFESSIONAL SERVICE ACTIVITIES & OUTREACH (CONTINUED)

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- **Volunteer** for the **Families Learning Science Together** program at **Tompkins County Public Library** to lead students (ages 5-9) through active learning activities and promote open-access STEM education in the Ithaca community.
  - May 13<sup>th</sup>, 2023. Mechanics of bridge building workshop.
  - March 11<sup>th</sup>, 2023. Bernoulli's principle workshop.
  - January 14<sup>th</sup>, 2023. Electrostatics workshop.
  - December 10<sup>th</sup>, 2022. Circuits workshop.
  - November 5<sup>th</sup>, 2022. Chemistry workshop.
  - October 8<sup>th</sup>, 2022. Science of Sound workshop.
- **Co-lead** of Lego Car build activity at **GAANN Engineering Field Day** for middle school students. May 11<sup>th</sup>, 2022. Active learning activity in which students from Denver, CO were taught about the design principles that improve thrust-driven vehicle performance.
- **Event organizer and moderator** for the **2<sup>nd</sup> Annual Non-equilibrium Networks & Active Matter Workshop**, August 13-14<sup>th</sup>, 2019. Two-day, open-to-public symposium that gathered experts in active matter mechanics to present their research and educate the Boulder community. 14 invited faculty speakers and 12 graduate student poster presenters.
- **Event organizer and teacher** of **Introduction to Material Science: 3D Printing** for a group of Brownie Scouts, ages 4-9 years old. March 2018. Lecture for young students about the various states of matter, followed by a demonstration of how transition between these states allows engineers to achieve things like additive manufacturing. The lecture involved coloring exercises that mimic 2D additive manufacturing, and then gave a live demonstration of 3D printing.
- **Co-founder and administrator** of the **Prospects of Soft Matter Student Club**, Fall 2018 – August 2022. Student club that brings faculty, post doctorates, graduate, and undergraduate researchers together to facilitate discussion, learning, and collaboration. The club focuses on polymer chemistry, biomaterials, soft mechanics, and other disciplines centered on state-of-the-art soft matter research.

### COMMUNITY SERVICE & OUTREACH

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- **Volunteer** functional fitness instructor for **The Phoenix**. December 2022 – Present. Lead functional fitness classes and local outdoor activities to promote a healthy and active lifestyle while fostering a supportive allied community for those recovering from substance abuse issues.
- **Founder** of the **Functional Fitness Club at University of Colorado Boulder**. Chief Executive Officer: Fall 2018 – Spring 2021. Advisor: Summer 2021 – 2022. A student club committed to promoting easy-access well-being in the Boulder community as achieved through physical activity and participation in the sport of competitive functional fitness.
- **Lead organizer** of the **2021 Collegiate CrossFit® Championship**, a remotely hosted, not-for-profit intercollegiate functional fitness competition licensed by CrossFit® with the specific aim of providing quarantined college students across the country a safe, yet competitive outlet in the sport of functional fitness, during the time of COVID-19.