Virgil Orr Junior Faculty Award – Andrew Peters

Description of Activities that Benefit Students, Faculty, and the University Community

Students:

- Proposed, prepared, and taught a new course (CMEN 435: Polymer Science and Engineering), suitable for both graduate and undergraduate students. I developed various demonstrations and virtual learning tools for this course, including visualizations of the force of polymer chain entropy, visualizations of step and chain growth polymer synthesis, visualization of polymer diffusion, among others.
- Mentored research experiences for 6 undergraduate students in the area of polymer simulation. Students learned a variety of scientific research and simulation skills including: viscosity measurements in simulation, report writing, impact of forcefield parameters on mixing behavior, how to perform a literature search, presentation skills, report writing skills, optimal selection of hardware, how to use and HPC cluster, and the basics of scientific computing.
- Started the "Louisiana Tech Materials Modeling Group" which was intended as a method by which graduate students will transfer simulation and modeling related knowledge between one another before the pandemic. As a student learns new techniques, they will be provided the opportunity to teach that new skill to others at Louisiana Tech in an organized, formal way. This opportunity also serves as a reminder of how far their skills have come, both technically, and in the area of "soft skills" which are required to plan and teach their specified topic.
- Helped run the annual ChemE Camp for incoming CMEN sophomores. This camp is intended to prepare them for CMEN specifically, introducing them to faculty, the curriculum, industry, and what to expect in the next few years.
- Advising ~25 students per quarter on courses selection, minor/major selection, good study habits, internship and job seeking, and preparation for higher studies.
- Advised senior mechanical engineering students on the design project entitled "Active Snack Packaging: A Hands-Free Solution" where the designed a container that is easy to open, keeps dirty hands away from food, be easily manufactured, and be able to pack tightly. Their team finished runner up in the annual Barnwell Memorial Mechanical Engineering Senior Design Conference in 2021.
- Served on multiple thesis committees within Chemical Engineering, Biomedical Engineering, and the PhD Engineering Programs.
- Judged annual graduate symposium.
- Judged annual undergraduate research symposium
- Judged annual 3-minute thesis competition, where graduate students explain their thesis in three minutes.
- Incorporated teaching techniques learned from the "Felder and Brent: Effective Teaching" workshop.
- Provided a presentation on how to make effective scientific plots to all CMEN students.

Faculty:

- Serving on the University Senate.
- Serving on the Senate Executive Committee as a representative of COES.
- Served on the Institute for Micromanufacturing Executive Committee.
- Curate a list of recommended CMEN electives for faculty to discuss with their mentees during advising.

University:

- Helped write and collaborated on the $20,000,000 NSF RII Track-1: Louisiana Materials Design Alliance (LAMDA) grant. In addition to the financial award, this has increased collaboration between Louisiana Tech and in-state universities such as LSU.

- Served on two search committees for IfM associated faculty as well as CMEN associated faculty. Also met with and provided feedback for a number of other faculty candidates within chemical and mechanical engineering.
- As mentioned in the students section, started the "Louisiana Tech Materials Modeling Group" before the pandemic.
- Ran science booth at Ruston Farmer's Market and developed demonstrations for K-12 students.
- Co-PI'd a Departmental Enhancement Grant intended to create a computer lab for the purpose of a modeling and simulation laboratory.

Additional Service to the profession:

- Chair for the AICHE 2021 Polymer Thermodynamics and Self-Assembly Session.
- Reviewer for Macromolecules, RSC Advances, Journal of the American Chemical Society (JACS), Physical Review Letters, Polymer, Optical Engineering, Papers in Physics, Structural Chemistry, and Computational Materials Science.
- Reviewer for the NSF DMR Polymers Program
- Judge at the AICEH Undergraduate Poster Competition
- Judge at the AICHE ChemE Car Competition
- Member of AICHE and APS.

Quarter	Course	Overall Evaluation
F2017	CMEN 413 Unit Operations Design III (Separations)	4.0
W2018	CMEN 432 Chemical Plant Design II	3.6
Sp2018	CMEN 413 Unit Operations Design III (Separations)	4.0
F2018	CMEN 413 Unit Operations Design III (Separations)	3.6
W2019	CMEN 435 Polymer Science and Engineering	3.8
Sp2019	CMEN 413 Unit Operations Design III (Separations)	2.5
F2019	CMEN 413 Unit Operations Design III (Separations)	3.4
Sp2020	CMEN 435 Polymer Science and Engineering	3.3
Sp2020	CMEN 413 Unit Operations Design III (Separations)	3.6
F2020	CMEN 413 Unit Operations Design III (Separations)	3.8
W2021	CMEN 435 Polymer Science and Engineering	4.0
Sp2021	CMEN 213 Unit Operations Design I (Fluids)	3.3
F2021	CMEN 413 Unit Operations Design III (Separations)	3.4
W2022	CMEN 435 Polymer Science and Engineering	3.8

Highlights from student evaluation comments

- "Dr. Peters is one of the best instructors I have ever had. For this being his first quarter he is astounding."
- "I was beyond impressed with Dr. Peters."
- "Dr. Peters is one of the best professors I've had at Tech so far. He takes time to explain the course material thoroughly, doesn't waste class time, and is respectful of the fact that we all have busy schedules.
- "Your in class examples and homework were very beneficial to my success in this class"
- "Your class has helped me realize that I would love to work with distillation"
- "Great Class! Thanks!"
- "Great teacher, always very clear, tests are a perfect reflection of what's taught in class. All goals on the syllabus are accomplished."
- "I really enjoyed the class."

- "Overall, the teacher tries to explain a very complex subject in a way that students understand."
- "Learned a lot."
- The tests were very fair and the homework was perfectly representative of what we see on our exams. I wish every engineering class could be more like this!"
- "He is great teacher"
- "Really enjoyed this class. You are very partial to the Socratic method...frustrating at first (made me feel pretty dumb at times), but definitely led to a better understanding of the material."
- "You were an incredible teacher!"
- "Great professor"

Personal Statement on my beliefs concerning the importance of teaching, research, and other activities.
Teaching: My main goal in teaching is threefold: 1) provide students with the basic skills of the discipline, 2) instill the excitement and curiosity I have for science and engineering in my students, and 3) develop skills in students for life-long learning, curiosity, and making connections between concepts.

The main thing I want to give to my students in teaching beyond the bare subject knowledge, is the ability and desire to lead their own learning through their own curiosity. In order to do this, students have to understand the context of various topics; how they fit into some larger arena of ideas, why they came about, and what they are used for. This creates connections between the specific concept being taught and many other things they know, which in turn leads to more connections that can be made and questions that can be asked.

For example Euler's method could be taught in a vacuum: "here's an ODE, let's solve it using Euler's method". But this leaves little room for critical thinking and curiosity. When this is connected to initial value problems, boundary value problems, and the larger area of applications of this branch of calculus, more areas are available for curious thinking and questions such as "how can this be used for more complex differential equations?"

I use molecular dynamics (MD) methods in much of my research. At their core, these methods are really just one big initial value problem, and could, in principle, be solved with something very like Euler's method. This connects this abstract technique with concrete applications which leads to further curiosity questions. Students sometimes think of their own applications for the methods they are learning, and begin to see other places these might be used, without explicit instruction. For me, this type of thinking is at the core of college level thinking and understanding within the sciences.

To achieve this goal, I make sure topics connect in understandable ways, and tie new concepts explicitly to old ones. At some point, I hope to be able to state a goal and have the students use the previous concepts learned to predict what will come next in the lecture. Providing opportunities for students to think about, investigate, and propose solutions to problems is the core of a active learning which I try to incorporate throughout my courses.

Research: I went into research because I enjoy learning, so my approaches to research end up closely tied to my approach to education. I do this because I love to learn new things. Learning new things has been the impetus for enormous amounts of progress in human history. I want to create students that have to know. They have to figure things out. "I don't know now, but I got to know!" On David Hilbert's grave is written "We must know, we will know." That is what motivates me and what I want to see and instill in students. With this motivation, students and researchers are primed to impact wherever they go. By figuring out why, and understanding how the world and how materials, and technology "ticks", they will create new understanding and new approaches, and new inventions that will change the world.

I have chosen a specialty in polymers (really, macromolecules) and materials. Materials are the tools that enable an enormous variety of technologies. There is a reason human pre-history has been characterized into the stone, bronze, and iron ages. Steel was crucial to the industrial revolution, lightweight structures to

space travel, and carefully controlled materials to biosciences. Materials enable technology. But even today, we do not understand all the fundamentals of polymers and how those properties can be harnessed. For example, a basic property of polymer, the glass transition temperature, is not well understood! Phenomenologically it has been well characterized, but there is great debate about what it fundamentally is. If this secret can be unlocked, then materials can be leveraged in new ways for new purposes. My research aims at gaining fundamental knowledge about polymers (whether it be the glass transition, or how polymer networks form) and using that new knowledge leverage polymers for new purposes, or improve them for existing purposes, thus enabling the technology of tomorrow.

Publications in Peer-Reviewed Journals Since Joining Louisiana Tech

Pouria Nourian, Collin D. Wick, Guoqiang Li, Andrew J. Peters, "Correlation between cyclic topology and shape memory properties of an amine-based thermoset shape memory polymer: A coarse-grained molecular dynamics study" Smart Materials and Structures, Under Review.

Pouria Nourian, Jimmy Lawrence, Andrew J Peters, "Inter-particle interactions of bottlebrush, dendrimer, and linear grafted nanoparticles via molecular dynamics simulations" Macromolecules, In Revision.

Nduka D. Ogbonna, Michael Dearman, Cheng-Ta Cho, Bhuvnesh Bharti, Andrew J. Peters, and Jimmy Lawrence, "Topologically Precise and Discrete Bottlebrush Polymers: Synthesis, Characterization, and Structure-Property Relationships" JACS Au, 2, 898-906 (2022).

Nduka D. Ogbonna, Michael Dearman, Bhuvnesh Bharti, Andrew J. Peters, and Jimmy Lawrence, "Elucidating the impact of side chain dispersity on the assembly of bottlebrush polymers at the air-water interface" Journal of Polymer Science, 1 (2021).

Cheng Yan, Xiaming Feng, Collin Wick, Andrew J. Peters, and Guoqiang Li, "Machine learning assisted discovery of new thermoset shape memory polymers based on a small training dataset" Polymer, 214, 123351 (2021).

Collin Wick, Andrew J. Peters, and Guoqiang Li, "Molecular Dynamics Simulation of Bisphenyl-A Diglycidyl Ether Cured by Isophorone Diamine" Polymer, 213, 123319 (2021).

S.M. Islam Ovy, Joshua Obinwa, and Andrew J. Peters, "The Effect of Graft Density on the Ordering of Block Copolymer Grafted Nanoparticles" Macromolecules, 53, 10655-10663 (2020).

Iman Ahmadian and Andrew J. Peters, "Phase Behavior of AB/CD Diblock Copolymer Blends via Coarse-Grained Simulation" Soft Matter, 16, 3069-3081 (2020).

Andrew J. Peters, "Implementation and Optimization of Protracted Colored Noise Dynamics to Block Copolymer Grafted Nanoparticles" Comp. Mater. Sci., 167, 248-256 (2019).

Andrew J. Peters, Benjamin D. Nation, Daniel Nicoloso, Peter J. Ludovice, Clifford L. Henderson, "Protracted Colored Noise Dynamics in Molecular Dynamics Simulations of Block Copolymers" Macromol. Theory Simul., 1700062 (2018).

Benjamin D. Nation, Andrew J. Peters, Richard A. Lawson, Peter J. Ludovice, Clifford L. Henderson, "Effect of chemoepitaxial guiding underlayer design on the pattern quality and shape of aligned lamellae for fabrication of line-space patterns" J. Micro-Nanolith. Mem., 16, 043502 (2017).

Plus 8 articles before joining LaTech, and **14** conferences proceedings, **9** invited research talks and **39** contributed talks.

Grants Received Since Joining Louisiana Tech

Title	**Role**	**Funding Agency**	**Total Award**	**Period Covered**
Enhancement of IfM Innovation via Purchase of a Temperature Modulated Differential Scanning Calorimeter	PI	LaTech IfM (Internal)	$ 20,731.89	1/2022

Improving the compatibility of waste plastic and asphalt binder via theoretically justified identification of compatible blends	PI	Federal Highway Administration	$461,641	10/2020-9/2023
RII Track-1: Louisiana Materials Design Alliance (LAMDA)	Senior Investigator	NSF	$20,000,000 (My portion is ~$290,000)	7/2020-6/2025
Precise Arrangement of Nanoparticles via Block Copolymer Grafts	PI	LA-BOR	$129,160	7/2020-6/2023
Improving Asphalt Binder Properties Using Recycled Plastics and Crosslinking Agents/Additives	PI	Louisiana Department of Transportation	$30,000	7/2020-6/2021
Enhancement of IfM Innovation via AFM Wet Cell Capabilities and Studies of Nanoscale Hydrogel Swelling	PI	LaTech IfM (Internal)	$4,800	4/2020
Coarse Grained Molecular Dynamics Simulations of Raster Solvent Annealing	PI	Louisiana Space Grant Consortium (LaSPACE)	$6,000	9/2018-8/2019
Nanoscale Arrangement of Metal Nanoparticles via Grafted Block Copolymers for Improved Manufacturing Materials	PI	NSF/LA BOR	$10,000	6/2018-12/2019
Travel to the 2018 GSFC TIM	Travel Award	Louisiana Space Consortium (LaSPACE)	$1,500	6/2019
Protracted Colored Noise Dynamics for Polymer Systems	PI	NVIDIA	$1,500	9/2017

Endorsement of Supervisor (Daniela Mainardi, CMEN Director)

"Since he joined Louisiana Tech University in Fall 2017, Dr. Peters has demonstrated high levels of competence in the three main areas of faculty activity: teaching, research & scholarly activities, and service and collegiality.

Teaching is the foundation of excellence at Louisiana Tech University and Dr. Peters not only has established a level of performance that results in a high level of student learning, but also stimulated the interest of students to ensure that instructional objectives are achieved. Dr. Peters have taught Chemical Engineering courses from sophmores through seniors and graduate students, and his enthusiasm and dedication as a teacher are admirable; evidenced by his very good student-to-teacher evaluations. He has made improvements in the teaching of his courses to incorporate active learning, in-class demonstrations, and short group activities in order to improve the student learning experiences.

As a tenure-track faculty, Dr. Peters has been diligent in seeking outside funding for research to national competitive peer-reviewed programs. Research proposal preparation is an indication of effort, but funded research is a necessity for scholarship that Dr. Peters did not take lightly. He is the PI on Federal Highway Administration (FHWA) and Louisiana Board of Regents Research Competitiveness Subprogram (RCS) grants, and a major contributor to the statewide NSF-RII Track-1: Louisiana Materials Design Alliance (LAMDA) multi-million dollar grant. University and public service are important components of a university's mission and responsibilities.

Dr. Peters not only has been serving his Program, College, and University, but also he has engaged with the community and delivered educational tutorials and demonstrations at the local farmer's market, where he helped K-12 students understand the principles of hydrogels. These are all evidences of his commitment to the profession, the community, and this Institution overall. As an assistant professor devoted to LA Tech's enhancement and excellence, I have no doubts Dr. Peters is an appropriate recipient for the Virgil Orr award."