Northwestern McCormick School of Engineering

Engineering Sciences and Applied Mathematics

FROM THE CHAIR / Spring 2024

Dear friends,

This winter and spring were a particularly eventful time for our department. We are particularly proud of two of our faculty members who received highly recognized awards that celebrate their outstanding work and potential. **Daniel Lecoanet** was named a Sloan Research Fellow and **Petia Vlahovska** was named a Guggenheim Fellow. Details about these awards and their recipients are included in this newsletter.

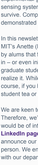
Both faculty members – and others – are featured in our new video, which illustrates how we envision applied mathematics now and in the near future. Our main goal will remain to understand physical, biological, social, and other systems by developing and analyzing models that capture the systems' essential features. However, the spectrum of tools to be used for this purpose will become broader; in many fields of applications, new tools are being added that utilize the ever-increasing quantity of data.

Collaborative research beyond our own department is a prominent feature of our faculty. In this newsletter we highlight recent work by **William Kath**, who collaborates with the experimental group of neurobiology professor Marco Gallio. They investigate the heat-sensing system that tells flies when the temperature is likely to become too hot for them to survive. Complementing the experimental results with a computer model, they demonstrated how a very simple circuit can guide the fly away from dangerous heat.

We are keen to enhance the connections between our students, graduates, and friends. Therefore, we'd be happy to share in this newsletter any professional news of yours that would be of interest to our audience. With this goal in mind, we have now set up a **LinkedIn page** where we post about activities in the department. For instance, we announce our weekly seminars, which you are always welcome to attend virtually or in person. We encourage you to connect with us and stay updated on everything happening with our department.

Finally, we want to recognize and congratulate all the students who graduated during this past year. Their degrees can be found toward the end of this newsletter.

Have a wonderful summer.

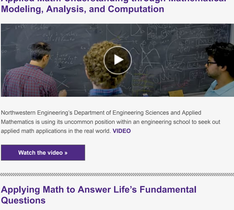


Hermann Riecke
Professor and Chair
Department of Engineering Sciences and Applied Mathematics
McCormick School of Engineering

Stay Connected

For current information on our department, please connect with ESAM and its friends via LinkedIn.

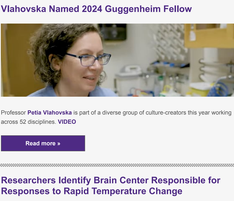
Applied Math: Understanding through Mathematical Modeling, Analysis, and Computation



Northwestern Engineering's Department of Engineering Sciences and Applied Mathematics is using its uncommon position within an engineering school to seek out applied math applications in the real world. **VIDEO**

Watch the video »

Applying Math to Answer Life's Fundamental Questions



In the new National Institute for Theory and Mathematics in Biology, department faculty including Professors **William Kath**, **Madhav Mani**, **Niall Mangan**, and **Hermann Riecke** decode biological findings using the language of mathematics. **VIDEO**

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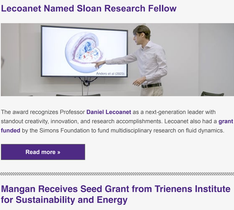
Vlahovska Named 2024 Guggenheim Fellow



Professor **Petia Vlahovska** is part of a diverse group of culture-creators this year working across 52 disciplines. **VIDEO**

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Researchers Identify Brain Center Responsible for Responses to Rapid Temperature Change

A team including Professor **William Kath** found that similar to the tale of the boiling frog, flies are more likely to react to rapid heating.

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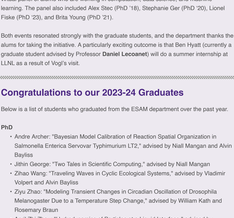
Lecoanet Named Sloan Research Fellow



The award recognizes Professor **Daniel Lecoanet** as a next-generation leader with standout creativity, innovation, and research accomplishments. Lecoanet also had a **grant funded** by the Simons Foundation to fund multidisciplinary research on fluid dynamics.

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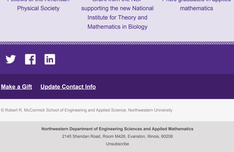
Mangan Receives Seed Grant from Trienens Institute for Sustainability and Energy



Working with Northwestern Engineering colleague **Linsey Seitz**, Professor **Niall Mangan** will experimentally validate and theoretically enhance their model of electrocatalytic production of hydrogen peroxide.

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Hosoi Delivers Reiss Lectures

The annual Edward L. Reiss Memorial Lectures were given this year by MIT professor Anette (Peko) Hosoi. Reflecting her broad interests, Hosoi gave lectures on two very different topics.

In her talk, "A Few Short Stories about Probability and Sports" aimed at a more general audience, she described how she and her research group have used advanced mathematical methods to extract from data answers to questions such as: What is the relative role of skill and chance in various types of sports and fantasy sports? Did football games held in stadiums with fans present enhance or reduce the spreading of COVID-19? How can one measure the ability of basketball players to make good split-second decisions during a game?

Her more technical talk, "Filtration and Fluid Mechanics Inspired by the Manta Ray," presented elegant fluid dynamics research inspired by the way manta rays feed on zooplankton by filtering them out of the water without their filters getting clogged. Using mathematical perturbation theory and asymptotics, the group developed filtration tools that are resistant to clogging and that can filter out particles that are substantially smaller than the pore size of the filters.

Recordings of both talks, along with all ESAM colloquia, are available on the **ESAM website**.

Alumni Connect with Graduate Students

This year, two ESAM department alumni initiated exciting events with graduate students.

Chris Vogl (PhD '13) visited and delivered a presentation on opportunities and his work at the Lawrence Livermore National Laboratory (LLNL) and previous stations in his career, which also involved industry experience with the Aerospace Corporation. His research interests have been in the area of numerical methods and their application to computational fluid dynamics. At LLNL, he has worked on earth system modeling, power grid cyber resilience, tokamak plasma simulation, tsunami generation and propagation, non-destructive testing, and vesicle deformation.

Now at Johns Hopkins University's applied physics lab, Noah Ford (PhD '20) initiated a virtual panel of alums who are working in computation, data science, and machine learning. The panel also included Alex Rose (PhD '18), Stephanie Ger (PhD '20), Lionel Fiske (PhD '23), and Brita Young (PhD '21).

Both events resonated strongly with the graduate students, and the department thanks the alums for taking the initiative. A particularly exciting outcome is that Ben Hyatt (currently a graduate student advised by Professor **Daniel Lecoanet**) will do a summer internship at LLNL as a result of Vogl's visit.

Congratulations to our 2023-24 Graduates

Below is a list of students who graduated from the ESAM department over the past year.

PhD

- Andre Archer: "Bayesian Model Calibration of Reaction Spatial Organization in Salmonella Enterica Serovar Typhimurium LT2," advised by Niall Mangan and Alvin Bayliss
- Jithin George: "Two Tales in Scientific Computing," advised by Niall Mangan
- Zihao Wang: "Traveling Waves in Cyclic Ecological Systems," advised by Vladimir Volpert and Alvin Bayliss
- Ziyu Zhao: "Modeling Transient Changes in Circadian Oscillation of Drosophila Melanogaster Due to a Temperature Step Change," advised by William Kath and Rosemary Braun
- April Zhi Zhou: "Hydrodynamics of Particles at a Liquid Interface," advised by Michael Miksis and Petia Vlahovska

MS

Yash Deodhar, Ting Dong, Noah Igram, Olga Lew-Kiedrowska, Junior Ndaylengurukiye, Muhammad Rabbani, Xiaofeng Xiao

BS

Tej Bahri, Teal Coil-Otto, Ria D'Souza, Shungo Fukaya, Adam Golcan, Derek Guo, Marina Hutzler, Brooke Leber, Olga Lew-Kiedrowska, Carol Liu, Cindy Yong

FACTS & FIGURES

6
Fellows of the American Physical Society

$50 million
Grant from the NSF supporting the new National Institute for Theory and Mathematics in Biology

200+
PhDs graduated in applied mathematics

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