College of Engineering News Room

MENTORING THE NEXT GENERATION OF DIVERSE ENGINEERS AND FOSTERING INCLUSION IN STEM

by Russell Nay

One USF engineering senior and two alums were awarded National Science Foundation Graduate Research Fellowships.

The oldest graduate fellowship of its kind, the National Science Foundation (NSF) **Graduate Research Fellowship Program** aims to support the vitality and diversity of the human resource base of science and engineering in the U.S.

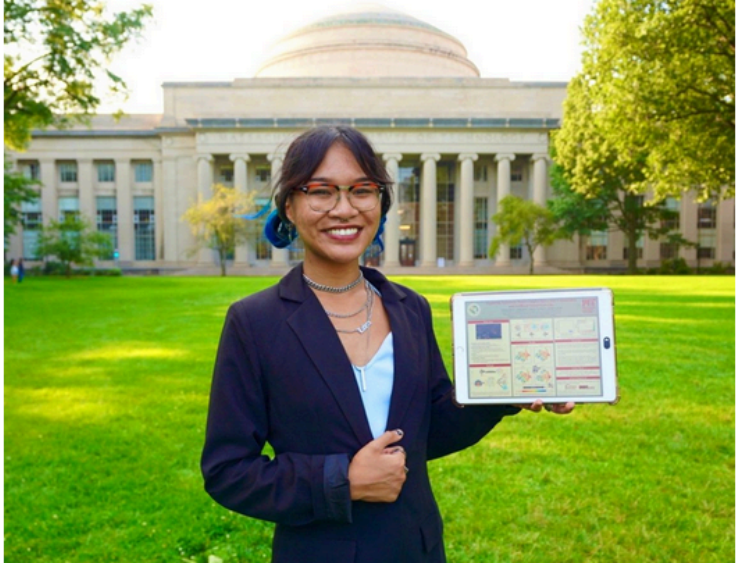
The program recognizes outstanding graduate students in NSF-supported STEM disciplines who are pursuing research-based master's and doctoral degrees at accredited US institutions. Of the 60,000 fellows selected since 1952, 42 became Nobel Prize laureates, and more than 450 became National Academy of Sciences members.

The five-year fellowship includes three years of an annual $34,000 stipend, opportunities for professional development, and a $12,000 cost of education allowance for tuition and fees paid directly to the institution the awardee attends.

NSF states that fellows are expected to "become knowledge experts who can contribute significantly to research, teaching, and innovations in science and engineering" and that they're an important part of the nation's technological infrastructure, national security, and economic well-being. "So that the nation can build fully upon the strength and creativity of a diverse society," NSF writes, people from backgrounds and in communities underrepresented in STEM academia are encouraged to apply.

This year, USF Department of Computer Science and Engineering senior Adriana Ladera, Department of Chemical, Biological and Materials Engineering alum Harry Tuazon, and Department of Computer Science and Engineering alum Tyler Hanks were among the nearly 2,200 students from around the U.S. who were awarded fellowships from the program.

Adriana Ladera



An incoming graduate student in the Massachusetts Institute of Technology (MIT) Doctoral Program in Computational Science and Engineering, USF computer science senior Adriana Ladera first came to the institution as an **MIT Summer Research Program** intern in 2021. While her faculty mentor was MIT Department of Chemical Engineering Associate Professor Heather Kulik, Ladera's work using neural networks and scientific computing to analyze physical systems will continue when she begins her graduate research with MIT Electrical Engineering & Computer Science Department Assistant Professor Tess Smidt.

Though Ladera's past research used products of computer science as tools to investigate the properties of materials like **thin films**, **relaxor ferroelectrics**, and **molecular systems**, her future work at MIT will focus directly on the development of simulations, algorithms, and neural networks that can be used by researchers in a variety of STEM fields.

"Rather than the focal point being the science itself, and then computation is kind of in the background, now I want to search more into the computers and the algorithms of simulations with applications that can broadly be applied to different sciences," she said.

Ladera said that being awarded an NSF Graduate Research Fellowship will allow her to spend more time pursuing other initiatives while working in a research assistantship with Smidt, which was originally going to be her main way of paying tuition at MIT. She said she'd like to hold mentoring classes for other students applying for the NSF Graduate Research Fellowship or graduate school, especially students who are from backgrounds underrepresented in STEM.

"I do want to advance knowledge in computational science, but there's also a diversity aspect that I do think is pretty important," she said. "I know I'm not fully qualified to give advice, but I can always give my experience and see what they can take from that. I'd also like to work with organizations that push for more inclusivity in STEM, especially for women and the LGBTQ+ community."

A teaching assistant for Program Design - COP 3514 since Fall 2020, Ladera said that she made it a goal to make the course better than when she took it by being a mentor for current students. She added a peer leading system to the course and interactive components like trivia to make the course more engaging and immersive. She also uses her role to introduce students to a variety of the opportunities and futures they can pursue in the wide fields of computer science and engineering.

"When they tell you, 'The peer leading sessions helped a lot.' it makes you realize you're actually helping shape the next generation of cool computer scientists or engineers," Ladera said. "That also made me realize I wanted to be a professor. The same way I had really good role models to guide me through my undergraduate career and through research, I would be so happy to teach the next generations of scientists and computer scientists."

In her first year at USF after trying several majors and deciding she wanted to be a computer science and engineering major with a physics minor, Ladera applied to a number of summer industry internships as well as NSF-funded Research Experiences for Undergraduates (REU)

summer programs. Penn State University accepted her application, and after working with a lab group there for the summer, she continued working through the fall semester with Berlin-based science and technology research center Leibniz-Institut für Kristallzüchtung. This led to her first research publication — Temperature dependence of three-dimensional domain wall arrangement in ferroelectric K0.9Na0.1NbO3 epitaxial thin films — published in the Journal of Applied Physics.

"I ended up getting really infatuated with computational science after I realized you can use code and mathematical models to simulate experiments that could be in the real world — but it's all in the computer," Ladera said. "I had to find something just like that back at USF, and that's how I started working with the Department of Physics Computational Nanoscience Group."

The group consists of members of USF Department of Physics Professor Inna Ponomareva's research lab, and Ladera's work there resulted in her second research publication — Ba(Ti1−x,Zrx)O3 relaxors: Dynamic ferroelectrics in the gigahertz frequency range — published in American Physical Society's Physical Review B.

"I'm still working with them and have been on the same project since I joined," she said. "We're only just now wrapping up the project and writing a draft for it. I hope it gets submitted soon — that's been my baby for the past two years. And Dr. Ponomareva has been the greatest professor ever."

Ladera's application for her NSF Graduate Research Fellowship focused on improving high-performance and numerical simulations of turbulent flow — a pattern of movement in fluids where the fluid constantly undergoes irregular changes. She said that because any small change in the initial conditions of the flow can have a dramatic effect on its results, it's difficult and computationally expensive to simulate turbulence. Investigating improvements meant reviewing a variety of lengthy research papers on turbulence, existing simulations of turbulence, and current techniques for speeding up data transfer in turbulence simulations.

USF Office of National Scholars Director Sayandeb Basu also reviewed Ladera's application and worked with her over much of the Fall 2021 semester as she continued to refine it.

"I had to figure out if my topic was actually possible and then how I could make suggestions for improvement," she said. "Then I had more literature review and finally started writing. There were so many drafts that I went through with Dr. Basu where he said 'This doesn't sound good;' or 'This doesn't sound technical;' or 'You should change this and this.' It took a long time and lots and lots of reading."

Basu also worked with USF computer science and engineering alum Willie McClinton on his Barry Goldwater Scholarship application, and McClinton is also in a doctoral program at MIT. Ladera said that MIT was one of the schools with a strong computer science program that she applied for summer research at after finishing her Penn State REU, which gave her an edge in applying for a graduate program there.

While she knows that her PhD thesis will stay within the realm of computer science, Ladera said she's still choosing from one of the many paths her past and future research experience could take her. They include topics in aerospace engineering, topics explored in Smidt's **Atomic Architects lab**, or newer topics like machine learning plus biomolecules and using computer science to improve solar cells.

One part of her academic career that's certain is her promotion of diversity in STEM. A member of the **Women in Computer Science and Engineering (WICSE) chapter at USF**, Ladera said she'd like to work with both **oSTEM** and **Girls Who Code** once she's achieved her PhD and become a professor.

"I think it's important to push for diversity and inclusivity in STEM because that means we are opening the doors of possibility to include all scientists across a spectrum of backgrounds, which certainly includes historically underrepresented but brilliant candidates," she said. "Diversity and inclusivity fosters collaboration and allows one to see perspectives that they might not be able to see alone. I also feel that it's important to have a role model to look up to.

When you see someone just like you making great strides, you start to think that you can do that too."

Harry Tuazon

A Georgia Institute of Technology President's Fellow and BioE Graduate Program doctoral student, USF chemical engineering alum **Harry Tuazon** has spent two years researching how the dynamics of entangled California Blackworms — behaving and moving as a collective "worm blob" — **can be applied to swarm robotics**.

Tuazon said that winning the NSF Graduate Research Fellowship will fund his travel to a variety of international conferences like this year's **15th International Symposium on Aquatic Oligochaetes** in Brussels, Belgium. It's focused on the broad improvement of knowledge of many types of aquatic and terrestrial worms, including the ones Tuazon researches.

Because his research is highly collaborative, attending this and similar conferences around the world will help Tuazon branch out and find potential collaborators that can lend their expertise on worm physiology, respiration, mathematical theory — and other related specializations — to help advance the understanding of how worm blobs work and to apply what he learns to the field of swarm robotics.

"It gave me a confidence boost knowing that NSF has vouched for my professional achievements, as well as the intellectual merit and broader impact of my project," he said. "The freedom to go to different countries for conferences is also extremely helpful."

Tuazon first spoke to his current principal investigator and program adviser, Georgia Tech biomolecular engineering assistant professor Saad Bhamla, after working with one of his mentors at the time — USF chemical engineering doctoral alum Edikan Archibong Ogunnaike — to find a suitable graduate research topic. Tuazon was in a transition period at the Pentagon and had a choice to make. He could continue to serve in the U.S. Navy or become a reservist and pursue a graduate program.

"Throughout my time in the Navy, Dr. Archibong was checking up on me to see how I was doing, and she asked me if I thought about doing a PhD," he said. "I really did enjoy my time in the USF research world. It was something I think I clicked with, but I had to serve my time in the Navy."

A native of Manila, Philippines, Tuazon said that when his mother and stepfather — a World War II veteran from the U.S. — married, his stepfather offered to move his mother, him, and his three older siblings to the U.S. on two conditions. One was that she — a nurse — take care of him until he died, and the second was that her children serve in the armed forces.

While some of his siblings served in different branches for four years and stopped, Tuazon received offers for both Air Force and Navy scholarships and said that he joined the Navy

because he wanted to see the world. He attended USF to be closer to his mom in Melbourne, Florida, and joined **USF's NROTC program**.

"In the ROTC program itself, it's mandatory that the unit sends one student to go and interview for submarines," he said. "For my class that was me. What I heard about the submarine community is that, yes, it is difficult and somebody has to do it, but the opportunities afterward are phenomenal. I'm a nuclear engineer and have experience with operations and maintenance, so that translated pretty well into a civilian lifestyle once I finished the military."

After commissioning from USF's NROTC unit and going through a two-year training pipeline in Charleston, South Carolina, Tuazon served in the guided missile nuclear submarine USS Florida where he was a division officer and worked as the electrical assistant, main propulsion assistant, Lan division officer, navigation division officer, intelligence officer, and assistant operations officer.

After four years as a division officer, he spent about two years as a manpower requirements officer at the Pentagon before transitioning to the Navy Reserve as a staff planning officer in 2020. Since moving to Atlanta to attend Georgia Tech, he's supported the communications efforts of a submarine group in Europe and a group of submarines in the Kings Bay naval base in Georgia that are sometimes equipped with nuclear warheads. His awards include the Navy and Marine Corp Commendation medals, the Navy and Marine Corp Achievement medal, Navy Unit Commendation medal, and four Battle "E" awards.

Before commissioning from USF's NROTC unit, Tuazon worked on research projects with USF Department of Chemical, Biological and Materials Engineering Associate Professor Anna Pyayt, who was Tuazon's undergraduate research adviser. They included a project to detect hemolysis using a pen-sized, point-of-care device to address the expensive and time-consuming methods of centrifugation. Throughout his undergraduate research, he presented in eight conferences, received two awards, and co-authored three peer-reviewed publications, including **one patent, which he, Ogunnaike and Pyayt recently attained**.

"When I was working with Dr. Pyayt, our subject matter was in biomedical sensors," he said. "I wanted to learn more about the biomedical world, so I got a minor in biomedical physics."

Tuazon said that the skills and techniques he learned as an undergrad at USF are still serving him in his doctoral program, including CAD modeling, 3D printing, and making custom setups for microscope photography during experiments.

"When I was given a microscope and tasked with doing experiments, I really enjoyed that, and it translated over at Georgia Tech," he said. "I applied the same method of using a webcam and a photo box to photograph most of my experiments, and we've gotten some publications out of it."

The creative thinking Tuazon learned in his undergrad program would prove to be at odds with his responsibilities while on submarine deployments though, as he said that most submariner tasks require memorizing and executing a strict set of protocol. This is compounded by the nature of a submarine deployment, which means spending four months many hundreds of feet below water with no sunlight other than what can be seen through a periscope camera. He said that the least repetitive time he spent during his four deployments in the submarine community was as an assistant operations officer, as his work was more open-ended, and he planned part of a deployment that took the submarine crew across the Atlantic, through the Strait of Gibraltar and through the Suez Canal.

"I really enjoyed that, and I think that creative thinking came from being an undergrad research assistant," Tuazon said.

This freedom to solve new problems with fresh mindsets was a big reason why he ended up on the worm blob project. While he was originally interested in tissue engineering and wanted to investigate how human healing processes can be accelerated in low-oxygen environments — like in submarines — nothing clicked with the professors he talked to before starting his doctoral program. Bhamla, however, introduced him to worm blobs and said that the current postdoc running their research project was about to leave.

“He said that it’s a brand-new project and that not many people have done anything with it,” Tuazon said. “He said, ‘You’re free to take this project and run as far as you can with it and take it in whatever direction you want.’ and that sold me pretty much instantaneously.”

In addition to finding collaborators at international conferences, Tuazon said he’s also reaching out to researchers in professional chapters of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers and the American Institute of Chemical Engineers. Tuazon was in the USF chapters of both organizations as an undergrad and said he still contacts his connections in each.

He’s also mentoring a student for a summer NSF Research Experiences for Undergraduates program for the project this year and said he learned at USF that mentoring goes a long way for both graduate and undergraduate students. He’s mentored two students so far, and one will soon become a graduate student.

“Trying to drive mentees to becoming independent researchers is one of my main goals,” Tuazon said. “I try to give undergrads room to do their own thing and be part of the work I’m doing so they can get some publications. I know publications are extremely important if you’re trying to get into a good grad school. I ended up with one co-authored one at USF, and that took me a long way.”

In addition to getting the **worm blob research project featured in the New York Times**, Tuazon recently submitted a first author publication, is named on a pending patent, and is collaborating with other researchers to submit an additional five papers related to the project.