In his three years at UNCG, Osena *(left)* **has mentored more than 25 undergraduates, providing them with the opportunity to participate in advanced molecular biotechnology research.** *With support from an NIH MARC U-STAR fellowship, senior Jade Lyons (right) is working to improve the vitamin content of the root vegetable cassava. Sophomore Daniel Staples (center) and senior Russell (previous page) are on projects to develop more heat-tolerant crops, with the help of genes from heat-loving species of red algae and archaea.*

Working with UNCG biologist Dr. Zhenquan Jia and chemist Dr. Nicholas Oberlies, he has found that tef grain extracts have antioxidant properties in human cells, meaning the grains might relieve oxidative stress and impact diseases like diabetes, cardiovascular disease, and cancer. This year, he received $427,800 in National Institutes of Health funding to further investigations of tef grains and tef straw, which could have benefits on human and animal health, respectively.

Osena also is investigating the genetic mechanism by which tef plants acquire minerals from soil and store them in seeds. Findings here could lead to the transfer of tef genes into other more widely consumed grains such as rice, wheat, and corn, to increase their mineral content.

As more people in the United States discover the benefits of tef, Osena hopes it will attract more research funding and growers. "To meet current demands from over 323,000 Ethiopian and Eritrean immigrants in the U.S. – as well as people on gluten-free and low-glycemic index diets – we're importing the grain," he says.

"With recent advances in molecular genetics and genomics opening new avenues for researchers, tef deserves more attention."

by John Newsom • learn more at biology.uncg.edu/osena-lab

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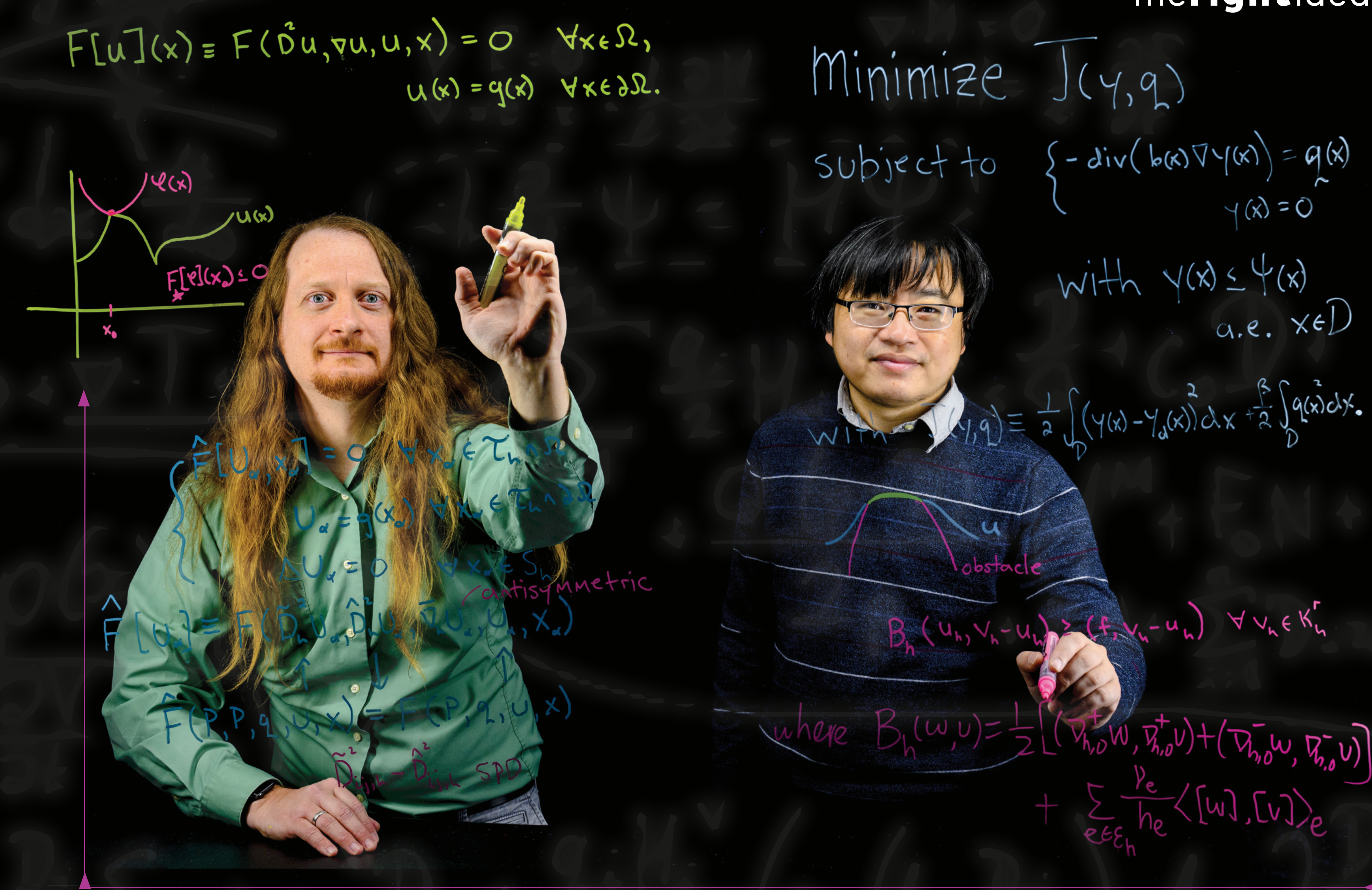

Numerical analysis is hitting its stride at UNCG.

Two researchers dedicated to the subfield recently won two prestigious NSF grants in support of their work. The three-year grants, won by less than one-third of mathematics applicants, are a particularly unusual accomplishment for more "pure" research in an applied field.

Dr. Tom Lewis and Dr. Yi Zhang work in computational applied math, a branch of mathematics that uses computers to attack all kinds of scientific problems, from how fast cancer cells can spread and how populations grow and decay, to how metals conduct heat and how gravitational fields affect objects in space.

Such problems can be described with partial differential equations, which show how changing variables relate to each other. Usually partial differential equations describing real phenomena do not have known solutions, so numerical analysts like Lewis and Zhang generate approximate solutions under specific sets of conditions.

Many applied mathematicians spend their careers working closely with engineers – writing code to find approximate solutions to partial differential equations for specific applications. But Lewis and Zhang go deeper: They're hoping to change the methods applied mathematicians use.

Analysts and engineers often use something called monotone methods to handle a particularly challenging class of partial differential equations. These methods require a lot of heavy lifting to find solutions, with complicated code required for each specific problem. Lewis is working to replace monotone methods with "narrow-stencil methods," using an idea that began with Lewis' PhD advisor, who was later also Zhang's postdoctoral supervisor.

While the 1991 proof that monotone methods would work was relatively straightforward, Lewis and his advisor's 2021 paper for their new narrow-stencil method took 39 pages in a top journal where papers are usually capped at 20 pages. Basically, they trade onerous coding and an 'easy' proof for an onerous proof with 'easy' coding.

This approach could completely change the field. Lewis says just about "anyone can code" narrow-stencil methods, including undergraduate students.

"We basically broke analytic barriers that've been around since the '90s," Lewis says. "There's top research that implies what we're doing is not feasible, and we proved that it was."

Lewis and Zhang (above) are also creating new versions of methods that analysts have used since the 1970s to address so-called optimization problems. Think: minimizing cost or energy or maximizing a certain outcome in a complex system.

With their new funding, Lewis and Zhang will further develop these "penalty-free" methods and work to demonstrate their reliability and efficiency in solving industry problems. They'll also apply both narrow-stencil and penalty-free methods to expanding classes of partial differential equations – with the potential to impact areas ranging from optics to economics.

The grants are another feather in the cap of UNCG's unique computational math program, which now offers applied-math doctoral students rigorous training in both partial differential equations theory and numerical computing, preparing them for both academic and industrial work.

"Yi and I are basically the numerical group in the computational math program, which means we're honored to be pioneering and growing that reputation," Lewis says.

Adds Zhang, "It helps our graduates compete and our department continue to make a name for itself."

by Yen Duong • learn more at go.uncg.edu/yi-zhang & go.uncg.edu/lewis