Graduate Profile

JD Walsh

by Alan Diaz

JD Walsh is a third-year PhD student in the School of Mathematics. He won an NSF Graduate Research Fellowship in 2014 and studies numerical approaches to optimal transport with his advisor, Professor Luca Dieci. He is making contributions to the SoM's undergraduate curriculum and has led a regional outreach program as president of Georgia Tech's graduate student AMS chapter. The SoM recently awarded JD a Festa Fellowship in recognition of his academic accomplishments and leadership. He spoke with ProofReader at the end of spring 2015.

Q. So what is optimal transport?

Put simply, we want to move stuff from point A to point B, and we want to know the most efficient way to do it. In mathematical terms it becomes much more complex than that. It has all sorts of applications, from as obvious as "How do we move these shipping containers?" to as subtle as "How do we resolve economic conflicts?"

Q. How did you become interested in this area?

Professor Dieci and I started off two years ago looking at an algorithm of Michael Muskulus of the Norwegian University of Science and Technology, and Sjoerd Verdyun-Lunel of Utrecht University. They were using optimal transport to compare time series data from two dynamical systems, to see if the systems have similar structures. Verdyun-Lunel had visited Georgia Tech in the spring of 2012 and had given a couple of lectures. Professor Dieci said, "Let's look at this paper and see what's interesting."

We thought it could be used for other things besides time series data. What if we applied the same approach to image comparisons? We were trying to compare fingerprint images, because it's pretty clear if you look at the whorls that there's some kind of dynamical system in those lines.

Q. One theme of your recent work is to try to utilize information that is usually disregarded. Can you talk about that?

When you compute optimal transport, you end up with a number, a cost. But in the process of getting that cost, you have to construct a transportation network that then gets thrown away. However, it's important because it has geometric properties: it tells you not just how two systems differ, but where they differ and where they don't.

We began looking at pairs of brain scans from a research paper by a group at Los Alamos: one scan before a brain tumor has developed, and the other one afterward. I was able to replicate the results, and to pull out of it a gradient vector that shows you how it has changed.

Q. You were awarded an NSF Graduate Research Fellowship last year, which gave you the freedom to work full time on research. Yet you have also opted to teach during this time. Can you talk about that decision?

Teaching is what I love doing, and if I can end up in an academic position, I will. Even though we are a research institution, people here care about teaching, and I do too.

Q. Tell us about some of your teaching efforts.

Last semester I was a lead instructor for Survey of Calculus, a course for business and liberal arts majors. By the end of the term I felt that I should have done it completely differently, and I volunteered to write down ideas on how to change the course. Most of the textbooks include a lot of theory that these students likely won't need, and are light on applications that they might find much more useful.

Over the summer I'm scheduled to help Professor Dan Margalit with writing online homework for some of our courses. We're exploring an open source online homework system called WebWork. We want to see if it scales well to large groups, and whether we can make it user-friendly for the faculty.

Q. What do you like to do when you're not working on math?

I volunteer with my wife for Lost and Found Youth, a local homeless shelter. We teach financial management to 18-25-year-olds: how to budget, how to find an apartment, how to grocery shop and how to further their education.

A lot of people aren't aware of how many homeless kids there are in Atlanta; there are 700-800 in that age group. This particular shelter focuses on LGBT youth, who are the fastest growing and largest group of homeless youth. Somewhere between 45 and 50 percent of them have been kicked out of their homes.

Q. This year you were president of our AMS graduate student chapter. Tell us about the outreach program you started.

It is geared toward female and minority math majors in colleges that are located within a day's ride from us. We felt those students didn't hear enough about how great math is and all the things you're able to do with math. Rarely were they told, "Hey, going to grad school and going into an advanced career in math is a great opportunity! It's something you're qualified for. It's something that would be great for you and great for mathematics."

So we got funding from the Provost's fund for Excellence in Graduate Studies (PEGS) to take trips to these colleges and speak about these issues. Math is all about looking at problems from a different perspective. When we have a lot of people with different backgrounds coming into math, we're solving more problems and learning more about the structure of the universe, and that helps everybody.

Alan Diaz