Ryan Hynd Interview

Conducted by Alexander Diaz-Lopez

Ryan Hynd is associate professor of mathematics at the University of Pennsylvania (Penn). He works on partial differential equations and likes problems involving optimization, geometry, and probability. Ryan is an NSF CAREER grant recipient and is co-founder of the Bridge to PhD program at Penn.

Diaz-Lopez: *When did you know you wanted to be a mathematician?*

Hynd: I started my college education as a basketball player at my local community college in Florida. At some point I got serious about school and thought about transferring to a university to major in computer engineering. My best friend's older brother was a computer technician, and I thought maybe I could do that, too.

One of the math prerequisites I needed for computer engineering was differential equations; I took this course over the summer at Florida Atlantic University from Tomas Schonbek. He was the first mathematician I had ever met. I really liked his lecturing style and the way he told stories in class. During office hours, I prodded him for details in one of his stories and he lent me a copy of E. T. Bell's *Men of Mathematics*. I made up my mind that I would be a mathematician after reading a few chapters.

Diaz-Lopez: *Who else encouraged or inspired you?*

Hynd: The summer after I took Tomas Schonbek's class, I did an REU with John McCuan at Georgia Tech. This was my first experience doing research. We didn't have much success initially, but we kept chipping away at a few problems during the school year. I think I eventually impressed him with my commitment to research. John was the first person who told me that I had the ability to become a research mathematician and who encouraged me to go to graduate school in mathematics. I'll never forget him for that.

Not long after I arrived at Berkeley to begin graduate school, I started attending Craig Evans' partial differential equations (PDE) seminar. It was eye-opening to learn about the variety of topics people were doing research on related to PDE. I was really inspired by how much Craig cared about the theory of PDE. He seemed to be conversant in everything going on in PDE theory, and he had a great sense of when the audience needed perspective during a lecture. He would often interrupt the speakers to give commentary for the students in the audience. This is how I got my research foundation.

Ted Hill also became my mentor when I was in graduate school. I met him when I was an undergraduate at Georgia Tech, but I really got to know him during his many visits to Berkeley to meet with his advisor Lester Dubins. We bonded as we both have nontraditional backgrounds for mathematicians (he started college at West Point). Ted told me a lot of stories about his career and really taught me

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about how great life could be as an academic. Ted and I are still very close to this day.

Diaz-Lopez: *How would you describe your work to a graduate student?*

Hynd: In 1757, the first partial differential equations were written down by Euler in his seminal work on fluid mechanics. Since then, these types of equations have found their way into seemingly countless mathematical models. PDE theorists such as myself use real and functional analysis to understand properties of solutions of equations that we usually have no chance of solving explicitly.

We ask questions such as: Are there solutions? Are solutions unique? What do they look like globally and locally? Do they have distinctive properties? Are they stable in some sense? Ironically, the answers to most of these basic questions for Euler's equations are still unknown.

Diaz-Lopez: *What theorem are you most proud of?*

Hynd: Probably the main result I obtained in my PhD dissertation. It involved the solution of a nonlinear eigenvalue PDE problem that had an application in financial modeling with transaction costs. I had come up with a problem related to the eigenvalue problem that I could solve for any given approximation parameter, but I was unable to justify sending that parameter to zero to get a solution of my original problem. I needed certain estimates to get control of these approximate solutions.

Fortunately, I ran into Scott Armstrong at a cafe in Berkeley one afternoon and explained one of the inequalities that I suspected to be true for the approximate solutions but couldn't prove. He saw how to verify the inequality with a clever trick: he put an epsilon somewhere I hadn't thought to try. It turned out that my discussion with Scott opened up a new way of looking at the approximate solutions, and a few weeks later I essentially had all the estimates I needed to solve the original eigenvalue problem.

I'm most proud of this result, as I was about halfway through my last year in grad school with no results to show. Moreover, I had failed pretty miserably at analyzing two other PDEs and was starting to wonder if I was cut out for this line of work. I'm glad that I didn't give up, and I'm lucky my persistence paid off.

Diaz-Lopez: *What advice do you have for graduate students?*

Hynd: Keep an open mind and be opportunistic.

Diaz-Lopez: All mathematicians feel discouraged occasionally. How do you deal with discouragement?

Hynd: With the amount of failure that is typical in research, it is hard not to get discouraged. I try to remember this harsh reality and see failure as an opportunity to be more inventive. Unfortunately, neither option solves the problem of being discouraged from time to time.

Diaz-Lopez: *As part of your CAREER grant, you created the Bridge to PhD program in the math department at the University of Pennsylvania. What are your objectives and goals for the program?*

Hynd: I was on the graduate admissions committee one of my first few years at Penn. The chair instructed us to be on the lookout for applicants from underrepresented groups. When we met to discuss applications, I presented a few very promising minority applicants. However, I encountered hesitancy because their GRE math subject test scores were a bit too low and because they were coming from institutions not known for having strong math departments.

So I spoke with Shaun Harper, who was in our education school at the time, and he suggested the idea of creating a bridge program. We could accept students at the master's level and groom them for our PhD program. It also turned out that a program like this already existed between Fisk and Vanderbilt Universities in physics, biology, and chemistry. I learned a lot from speaking with Keivan Stassun, who started that program, and from using the "toolkit" material they have posted online.

To answer your question, our goal is the same as it was before—more diversity at the PhD level, especially from students from underrepresented groups. We are hoping that the Bridge to PhD program will make a difference.

Diaz-Lopez: *If you could recommend one book to graduate students, what would it be?*

Hynd: Tough question! There are so many good books to choose from. One little book that really inspired me, that perhaps isn't so well known, is Robert Osserman's *Poetry of the Universe: A Mathematical Exploration of the Cosmos*. I think it's special in the way it emphasizes how powerful mathematical thinking can be.

Diaz-Lopez: *Any final comment or advice?*

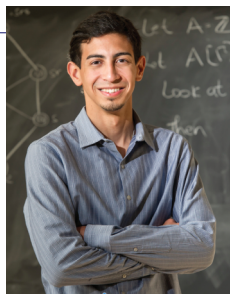
Hynd: Enjoy your time in graduate school! Make some friends outside of the mathematics department, pick up a hobby, travel during the summers, learn another language. I believe that activities such as these, done with appropriate balance, will only serve to enhance your experience.

Photo Credit

Photo of Ryan Hynd by Felice Macera.

ABOUT THE INTERVIEWER

Alexander Diaz-Lopez, having earned his PhD at the University of Notre Dame, is now assistant professor at Villanova University. Diaz-Lopez was the first graduate student member of the *Notices* Editorial Board.



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