

Student Profile

Daniel Agress – Mathematics PhD Program



Your Time at UCI

What made you decide to pursue a graduate degree?

As an undergraduate, I was very drawn to pure mathematics. I was attracted partly by the sheer difficulty of the subject, and partly by the ability of math to describe and unite so many different aspects of the physical world. Upon graduating, despite having spent several years studying math, the subject still felt mysterious and beyond my grasp, so I decided to study math at a graduate level to get a deeper understanding of the field. In general, I really looked forward to having the opportunity to learn a lot of

new math and to think creatively about solving difficult problems, so I knew that I would relish the graduate school experience.

Why did you choose to come to UCI?

Both my family and my wife's family live in the Los Angeles area, so we wanted to stay in Southern California. Beyond that, Orange County is a really great place for a young family. (I have a young daughter, and we love the abundance of parks and nature areas in Irvine.) When researching universities, I saw that UCI had faculty studying partial differential equations (my chosen research area) from many different perspectives, both pure and applied. I was very satisfied with the range of choices I would find for my research at UCI, so I was excited to come here.

If you are conducting research, how would you explain your research and its significance to your grandparent?

Partial differential equations are the laws that describe how any quantity changes over space and time; many phenomena in biology, physics, and engineering are governed by them. Finding numerical techniques to solve partial differential equations efficiently is one of the central problems of applied mathematics. My research studies one of these techniques, the "fictitious domain method." Essentially, this method tries to solve problems posed on a difficult domain (like a pentagon) by placing the difficult domain within a simpler one, like a rectangle (the "fictitious domain"), and then solving a new, easier equation posed on the simple domain. My research involves both developing new numerical techniques and proving formally that these techniques correctly solve the equations. I am currently studying how to apply the fictitious domain technique to "free boundary problems"—problems where the domain of the problem changes in time. A typical example is the Stefan problem, which studies the changing shape of an ice cube as it melts in water.

What are your hobbies/passions outside of research?

I have an adorable daughter, so many of my current hobbies involve spending time with her. We love going to playgrounds and taking nature walks, as well as doing art projects together. Beyond that, I enjoy playing board games with my wife and friends, and reading popular science books. I am a deeply involved member of my synagogue and spend time daily studying the Bible, the Talmud, and more modern Jewish works.

Reflections

What are you most proud of accomplishing (so far) in your graduate program? What is your most memorable moment/experience at UCI to date?

Several times, I have been stuck on a problem for several months, when suddenly, a solution clicked into place and the problem was fully solved. Those moments, when the many little pieces I have been laboring at fall into perspective, have been truly rewarding for me.

Recently, I posted a paper which describes a new technique for numerically solving partial differential equations. It gives me much pride to think that this technique may be used by other scientists and mathematicians to model and better understand the world around us.

What advice do you have for a new graduate student in your program?

Take your time exploring different options of what areas and problems you would like to research. Make sure that the question you are trying to address in your PhD is something that you would really like to know the answer to, and that you feel that answering it would be an accomplishment that would make you proud. That said, be open to discovering new interests in fields that may not appeal to you when you first begin your program. Don't be frightened by a lack of progress in your research, as long as you are trying and learning new techniques and have a general picture of where you are trying to go.

Career

What do you see yourself doing in five or ten years? How do you hope to make a difference?

I still am not certain whether I will end up in academia or industry. However, I hope that wherever I end up, I will be in a position where I am solving mathematical problems in new and creative ways which rely on the depth of abstract mathematics. We are live in an amazing time period, when new technology is constantly reinventing how we perceive the world. I hope, through my research, to contribute to this transformation in a positive and responsible way.