



## Thomas Grandine Interview



After obtaining his PhD in numerical analysis at the University of Wisconsin, Thomas Grandine went to work for the Boeing Company, where he is senior technical fellow. His areas of expertise include advanced geometric design, curve and surface modeling, numerical approximation, splines, and multidisciplinary design optimization. He has extensive experience in computational methods for both design and manufacturing applications. His e-mail address is [thomas.a.grandine@boeing.com](mailto:thomas.a.grandine@boeing.com).

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

**Grandine:** Although I had been an above-average mathematics student throughout most of grade school and middle school, I became a great one when I learned algebra in ninth grade. At the time, learning algebra felt like being handed the keys to a magical world in which really interesting knowledge could be extracted from limited information, and I was spellbound by the possibilities that offered. I don't think I ever seriously considered doing anything else after that.

*Diaz-Lopez:* Who encouraged or inspired you (mathematically or otherwise)?

**Grandine:** I was really lucky to have a great collection of teachers at every turn, from a truly amazing second grade teacher to incredible professors in graduate school and at every other level along the way. I learned so much from all of them, both about math and about having the confidence to tackle such a difficult subject, explore its possibilities, and leverage it to solve many of life's problems.

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

**Grandine:** The Boeing Company has 35,000 engineers, and they have an uncanny ability to generate large numbers of very interesting math problems, all of which need to be solved to design, build, and maintain airplanes. Although many of these problems can be solved by the engineers themselves, there are always a few that require more mathematical training and skill than engineers are typically equipped with. That's where we mathematicians come in. Our most successful contributions result when we partner with our engineering colleagues to produce

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# THE GRADUATE STUDENT SECTION

the solution to some hard mathematical problem that we would have been unable to formulate and solve on our own.

Design optimization is one recurring example. When formulating a numerical optimization problem to perform design optimization, Boeing mathematicians do not possess the domain knowledge necessary to properly specify the objective function and constraints. By partnering with the design engineers who possess that knowledge, the optimization problem whose solutions represent realistic optimal designs can be mathematically formulated.

**Diaz-Lopez:** *You finished your PhD and shortly after you started working for Boeing. What message would you give to those doctoral students and professional mathematicians thinking about having a career in industry?*

**Grandine:** I was really fortunate to be equipped with excellent (at least at that time) computing skills, and they came in handy right away. Because the most effective means of transitioning mathematical technologies into engineering processes is via software, the importance of this skill cannot be overstated, but there are many other important skills that are needed as well. One is the ability to work effectively on teams, something that mathematicians often struggle with because of a culture that promotes individual work starting at a very young age. Also important are the ability to communicate mathematical material to a non-mathematical audience, a willingness to dive in and tackle problems that don't necessarily satisfy all the preconditions of the relevant theory, and a tolerance for solving problems that aren't always mathematically pretty.

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

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*Enjoy the rich, energetic campus atmosphere that graduate school offers.*

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**Grandine:** Enjoy the rich, energetic campus atmosphere that graduate school in a university environment offers. Outside of academia, the atmosphere is often less enthusiastic and energetic.

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

**Grandine:** One of the most effective strategies for dealing with discouragement I have ever found is to engage in professional activities beyond my job. Being able to discuss what I do with

graduate students in a professional society setting or engage with company interns or participate in mentoring and coaching activities all serve to remind me that I have one of the coolest jobs in the world and that I really enjoy what I do and am grateful to have found such a rewarding and fulfilling career.

**Diaz-Lopez:** *If you were not a mathematician, what would you be?*

**Grandine:** If I were starting over, I think it would be very exciting to get into the clean energy field. The opportunity to participate in something as exciting as a near complete rebuild of the energy production and distribution system for the world for the second half of the twenty-first century is very exciting to me.

**Diaz-Lopez:** *If you could recommend one lecture (book, paper, article, etc.) to graduate students, what would it be?*

**Grandine:** It's now an older book, but I found *Winning the PhD Game* by Richard W. Moore to be thoroughly outstanding. It offers a comprehensive discussion of all the issues facing graduate students, from academic disputes to family and emotional issues. It was a great comfort and help to me during my last two years in graduate school.

## Photo Credit

Photo courtesy of Thomas Grandine.



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