My Story with MCM

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It has been more than 10 years since I participated in the Mathematical Contest in Modeling (MCM®) as an undergraduate student back in Sichuan University (China). I was very fortunate to meet many great friends who shared with me their passion about mathematics at that time and finally teamed up with Yongxian Long and Cuifen Bai to compete in the MCM in 2007. I especially want to thank the advisors from the College of Mathematics in Sichuan University who guided us through our preparation for this competition. Without their inspiration and help, it would have been impossible for our team to be a Meritorious Winner Award in MCM 2007.

When I look back to my experience with MCM, I find that it is much more than a reward for my curiosity in mathematics; it had a lasting impact on my pursuit of scientific research and professional career in the last 10 years, and it is going to keep encouraging me to further explore into the future.

In the first two years of my undergraduate study, I was like a little kid who walked into a big park and got amazed by all kinds of creatures that he had never seen before. Many subjects (mathematics, physics, biology, history) interested me, but I was not very clear what I really wanted to study and what profession could fit me best in the future. I was enrolled in the Dept. of Biomedical Engineering simply because I had heard that biomedical science will embrace some ground-breaking breakthroughs and make a huge impact on healthcare soon. I had an intuitive intention to do research; but I asked myself, "What do you really want to research about?"

I did not have an answer until the MCM. In our preparation for the contest, I read some books on operation research, optimization, graph theory, etc. I noticed that I was always fascinated by the mathematical theories and the ways that they describe the complex real world. For the first time, I heard about "artificial neural networks" and "genetic algorithms," which greatly expanded my imagination about how far we can go with the power of computers, even starting from some basic ideas.

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I enjoyed programming. I had taken some programming classes in my sophomore year (C language, data structures), and MCM was a real proof to myself that I can write code to solve real problems.

Another unique challenge brought by MCM was that it required the three team members to collaborate closely to solve the problem and finish the report in a limited time, which would otherwise have been impossible. The experience of working with other students toward a tough challenge and relying on each other to succeed really helped me established a simple but strong belief that team spirit is key to any success.

Working on a problem for three consecutive days was intense but also pleasing when the report was finally submitted. My MCM experience in 2007 finally convinced me that there is something special for me and I should go for it.

So later I applied for graduate school and was admitted to the Ph.D. program in Engineering Science at Louisiana State University (LSU) with a full scholarship. I chose the interdisciplinary program in Engineering Science over others because I wanted to explore further the science of mathematics and computation while not limiting myself to a particular application. At LSU, I finished a sequence of courses in computation, ranging from functional analysis, differential equations, to finite difference methods, and more.

In graduate school, I also became aware of the environmental crises that Louisiana is facing in its coastal area, not just hurricane flooding in New Orleans, but especially the serious erosion of the country's largest coastal wetlands. In my dissertation, therefore, I decided to use numerical methods to develop a modeling system for Louisiana's coastal protection and restoration. I simulated storm surge, hurricane waves, and sediment transport on the Louisiana coast using supercomputers. The results provided important guidance for planning and designing coastal projects across the state. Without solid training in mathematics and computation, I cannot imagine finishing a Ph.D. on a subject (Coastal Engineering) about which I knew nothing before I went to graduate school. It is mathematical modeling and quantitative thinking that helped me bridge the distance between different disciplines and solve those realistic problems in a quantitative way.

After graduating from LSU, I joined NASA's Jet Propulsion Laboratory at California Institute of Technology as a postdoc, and I now work for JP Morgan as a Quantitative Researcher. Every step seems a big change from the previous one, but I remain relatively confident because the skills that I developed through education and research—especially mathematical analysis and modeling—have far-reaching applications in data- and quantitative analysis-related fields, from remote sensing to finance.

Looking back, I am very grateful for having been a part of MCM and starting a long journey in scientific research 12 years ago. MCM helped me open a door to a very broad field where I can enjoy the beauty of

mathematics and apply modeling and computational skills to a variety of scientific and engineering problems. In the future, I hope I can pass to younger students my passion in mathematical modeling and the lessons that I learned through the years, by promoting the awareness of mathematics not only as an abstract subject in classrooms but also as a practical and powerful "technology" to explore the unknown and make the real world a better place.

About the Author

Ke Liu has a bachelor's degree from Sichuan University and a Ph.D. in Engineering Science from Louisiana State University, where he developed a modeling system on supercomputers for storm surge, waves, and sediment transport. As a coastal modeler, he also applied numerical models for a variety of coastal projects including harbor design, beach nourishment, and bridge scouring analysis. He was a Postdoctoral Scholar at the Jet Propulsion Laboratory of Caltech, developing numerical models to simulate water flow in a coastal zone, using machine-learning techniques to discover knowledge from remote-sensing data, and developing Python tools for hydrological data fusion from multiple instruments. For the past year, he has been doing risk modeling for JPMorgan Chase & Co. in New York.