My brilliant career

Michael Anderson

Where can a mathematics education lead you? In this series, mathematics and statistics graduates from Australian university's write about their careers, proving that the world is their oyster.

Mathematics has always been in my blood. My parents tell stories about me as a boy, wandering the beaches of the South West on family holidays, trying to determine the volume of a torus, or looking at the patterns of eddies formed by rocks. I was interested in how mathematics related to natural phenomena.

At the same time I was dabbling with computers. Admittedly, my interest was mostly in games, but with time, I also became interested in how games worked. To me these games formed their own worlds, ones with simplified rules and clear objectives.

While I was in high school, Hollywood started using computers to fake reality for the generation of scenes and characters for films. The results were generated by a combination of artistry, mathematical rendering equations and raw computing power. The extent to which "reality" could be faked by such simulations was driven home to me by the computer generated special effects in the film Terminator 2.

In years 11 & 12 I attended the National Mathematics Summer School (fondly known to its attendees as NeMeSiS). This summer school serves to gather together students with mathematical potential from all over Australia, and expose them to a variety of aspects of mathematics not covered in the high school curriculum. This rekindled my interest in the more traditional aspects of mathematics.

These factors shaped my decision to study both applied and pure mathematics, and computer science at university. Computer graphics was an emerging discipline at this stage and unfortunately not particularly well covered by my universities curriculum. This meant that nearly all my attention was focused into mathematics. Here I learnt the wonders of differential equations, the basis of most physical simulations, and met Dr. Neville Fowkes, who would become my Honours and Ph.D supervisor.

My Honours Thesis and Ph.D in Applied Mathematics looked at the behaviour of the Laplace-Young equation, a partial differential equation that models the behaviour of a fluid meniscus. The plan was to investigate the behaviour of various situations computationally. I saw this as an opportunity to work on an interesting problem while obtaining experience in numerical methods, and as a stepping-stone to further simulation work. However, part way through this work I spent several months at the University of Texas in Austin as part of the Computational Fluid Dynamics Laboratory and the Texas Institute for Computational Applied Mathematics, working with Dr. Graham Carey. There I furthered my knowledge of numerical and computational techniques for solving partial differential equations (PDEs).

A year later, I was applying the final touches to my thesis in preparation to return to Austin to undertake a one year post-doctoral position. A large amount of my time in Austin was spent writing numerics code, investigating further aspects of

the Laplace-Young equations, and other behaviour governed by similar equations, such as the flow of glaciers.

Throughout my Ph.D and time in Austin I maintained my interest in computer graphics, spending some of my time on visualisation of the numerical data sets and learning about rendering methods. At my own expense I managed to attend a SIGGRAPH conference, the conference for the ACM Special Interest Group in Computer Graphics. I found that a large number of the computer graphics pioneers had mathematical backgrounds, and many of the technical papers in the area required a strong background in geometry or knowledge of PDEs and numerical methods. It turns out that there remains a strong demand for mathematicians in the visual effects and computer graphics industries.

There is a clear division between two halves of the computer graphics world. There is the real-time part and the non-real-time part. The real time part is dealing with applications like data-visualisation and computer games. Non-real-time is more focused on postproduction and visual effects (VFX) for film, TV and advertising. It was my feeling that the issues arising in simulating reality for the non-real-time applications were given better treatment (both in terms of rigour and technique). This ability to look into the simulations in a deeper way was what drew me towards the non-real-time setting. Recently, more of cross-over between the two areas has been occurring, with ideas from real-time rendering coming into the the non-real-time arena and vice-versa, so this distinction is now less clear than it was three years ago.

There is also another interesting twist in comparing computer graphics for media, with scientific visualisation: for media "It's all about the look". By this, I mean it doesn't matter how you get the results — if it looks right it is right. This means you can take shortcuts and approximations that would be frowned upon in the mathematics/engineering world. But it also means that you come up against artistic directors saying things like, "I'd like that splash to be a bit bigger on the left", asking for things that in a scientific simulation you would have no control over. Consequently, the problems that arise need to be looked at in a slightly different way.

Having decided that the visual effects world was something I was interested in and something that I felt I could contribute to, I started looking for places to apply to. Not surprisingly, there aren't very many places doing research into visual effects in Australia. Most of the companies doing visual effects are located in the USA, and many of these don't do any research of their own. The criteria for an Australian company that I intended to send my resume to was that it would have to have worked on a big name movie of some sort, and that they'd be actively doing some kind of research. The list was very short. As I expected it to be a long shot to actually get work in Australia, I sent my resume to every company on that list, before coming back to Australia from Austin. The results I got were far better than I had expected, within a few weeks of getting back home to Perth, I was packing my stuff to join an Adelaide company, Rising Sun Research.

Rising Sun Research (RSR) started as part of Rising Sun Pictures (RSP), a visual effects company. RSP had just completed work on "The Last Samurai" and "Return of the King", the final movie in the Lord of the Rings trilogy. RSR was working on software for accurately previewing visual effects, an area called "colour management". This software was being used within RSP and at several other visual effects companies.

While colour management was not an area with which I had much experience, I quickly learnt that it was surprisingly rich in mathematics, and that there were many

gaps in the current knowledge. Many of these we are still investigating.

The software products produced by Rising Sun Research have been motivated by the difficulties faced by a VFX production house located in Australia. These difficulties stem from the way the visual effects industry works. Typically, a large film production has several visual effects companies producing effects for it, and these VFX houses may be distributed throughout the world. Often the directors and supervisors are located in Hollywood or somewhere else in the USA or UK. This means that artistic decisions have to be made about material that is being produced in a remote location. A further complication is that there are differences between the film printing process and how images are displayed on a computer monitor. The old way of directors reviewing visual effects was to send the computer files from the VFX house to the production company in the USA, who would then get the film printed, project the film, and finally send information about the required changes back to the VFX house. RSR's software was written to reduce the need for media to be printed to film and to increase the effectiveness and speed of producer feedback, both of which are very costly and time consuming.

Two years ago, Rising Sun Research and Rising Sun Pictures were both small companies, numbering around three and 30 employees respectively. Now they have grown considerably, with RSR having approximately nine full time employees and RSP over 100. With this growth my role has changed dramatically. I am now CTO and one of three managers of RSR, and am responsible for the five other developers. RSR is continuing to develop new software for the visual media industry, branching out of the colour management arena.

While the majority of my time is spent on RSR development, the proximity of RSR to RSP, both physically and historically, means that I am often consulted on any interesting mathematical problems that RSP may encounter. These have recently included dynamical systems for physics and data remapping techniques. Who knows where mathematics will take me next week.

E-mail: michael.anderson@risingsunresearch.com