MATH Drives Careers

Profile: Karen Patterson

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EARLY INFLUENCES

In elementary school my mother asked my older sister to pick up any extra exercise sheets from math and science classes and gave them to me as rainy day activities. I was always ahead of my class so throughout school my teachers would ask me to tutor my struggling classmates to keep me occupied. In high school my Mathletes team coaches strongly encouraged me to become a teacher since tutoring came so naturally, so when I went to college that's what I intended to be. In my junior year one of my education professors told our class that the remaining classes would do nothing in terms of making us good teachers. We had to go out and do it. So I figured instead of wasting my time in classes that weren't going to teach me anything I'd dual major in math and geography and get my teaching certification through an accelerated certification summer program. The dual major led to a couple of summer internships at NASA in Atmospheric Chemistry and Dynamics where I got interested in research. I applied to several graduate schools for various science fields and when one of the fathers of ocean optics showed up on my list of prospective advisors I knew I had to go. I got bitten by the field work and lab work bug in graduate school. As I was finishing up my PhD I saw an ad where the Navy was looking to hire a physical oceanographer to go to sea. I could spend half my life seeing the oceans of the world. Little did I know the timing was just right as the Navy's ocean optics program was really just starting to take off. I worked for eight and a half years making operational support products, such as diver visibility, for the forward deployed Navy and in 2009 took an opportunity to move back closer to family working in Navy research.

CAREER/CAREER PATH

Describe your current position and briefly, the path you took to get there.

I develop methods to determine environmental conditions such as water depth, bottom cover, and water components (algae, sediments, dissolved organic material) from imagery collected by aircraft and satellites. The main challenge to accurately estimating these environmental parameters, is removing the portion of the signal due to atmospheric effects (clouds, aerosols) and viewing geometry (sun glint) as these typically make up >90% of the satellite signal for visible light. With these basic environmental parameters several follow-on products are derived such as underwater visibility for divers or remotely operated vehicle camera operations and finding niche environments where something might exist like the harmful algae that affected the drinking water in Lake Erie recently or an invasive species introduced into a water body. Doing this work involves field work collecting the in situ data from a boat to ground truth the algorithms while collecting simultaneous airborne and/or satellite imagery. Back in the office there is a lot of computer programming to develop the algorithms and using math theory and approximations to verify that the algorithms make sense for the environment being studied.

Since we are developing algorithms to support Navy operations which may occur at any location and time, I also spend a lot of time automating the processing of imagery to a product (i.e. diver visibility) the Navy is interested in so it can be easily posted to a web site or distributed directly to the person who needs the information in the field. The biggest automation project I've done recently was for the Hyperspectral Imager for the Coastal Ocean (HICO) which is a hyperspectral instrument developed by engineers in my group at the Naval Research Laboratory and launched to the International Space Station in 2009. I wrote the automation code to pull in raw downloaded imagery, process it to calibrated and geolocated data, and distribute it to multiple locations typically within two hours of downlink. Although I was the last person to join the HICO team before launch, since I was the automation programmer I got to see the first image collected before anyone else which was really cool! HICO data are now available to anyone at http://oceancolor.gsfc.nasa.gov.

What is a typical day at work for you? Please list your job responsibilities. What are you responsible for?

I am also a computer system administrator and network technical representative for our branch which means I'm responsible for maintaining a variety of Windows, Linux, and Macintosh computers, ensuring network security requirements are complied with, troubleshooting user problems, and installing and maintaining shared data servers. I'm probably responsible for >500TB of on-line shared data at this point.

What do you like best and least about your profession? What is the stress level associated with this type of position?

What I like best about my work is the applied aspect. I get to work with cool imagery and know that the algorithms I come up with are actually going to be used by someone; as far as the Navy use is concerned the products are there so someone can be best prepared for their environment from a safety aspect. What I like least is taking the time to write publications. It's important

to share scientific work but once you already know the outcome of the current study you want to immediately go onto the next challenge.

How many hours per day or week do you typically work? Do you have flexibility that allows a good life/work balance?
Since I'm at a research institute, I keep mostly regular business hours though I start my work day earlier than most so I can take systems off-line if needed while only a few people are in the office. I typically work 40-50 hours per week and resist the urge to work more to maintain a healthy work/home life ratio.

CAREER EXPECTATIONS FOR YOUR FIELD/POSITION

Where do you see the future of math in industry or in your particular career?
Up until now there have been relatively few sensors with the range and precision needed to develop ocean optical algorithms. Pixels had to be hundreds of meters in size in order to have enough remaining water signal to work with from space so algorithms were limited to large bays and oceans. Now it seems nearly everyone has a decent imaging device whether it be their cell phone camera, a backyard toy drone, a surveillance camera in their home security system or a camera. Commercial satellite imagery is available with pixel sizes on the order of tens of centimeters rather than hundreds of meters. The range and precision of these sensors is often such that at least rough order of magnitude algorithms can be developed for small lakes and rivers previously unattainable. Now the challenge is working with massive amounts of data from a diverse collection of sensors. The person with a background in applied mathematics and computational sciences is much better prepared to deal with the mass processing and reduction of data while maintaining as much unique information as possible than the scientist who came through the life and environmental science education route. In fact research groups today often have people with a variety of backgrounds just to handle these types of issues and I see that continuing to be the case in the future.

ADVICE

If you could advise someone currently pursuing the same degree or profession, what would you say? What are some steps you would recommend to students, or to those in their early careers, that perhaps you wish you had taken earlier? Are there things you would have done differently?
I give the same advice to all the young people I meet. I ask them what subjects get them excited, what skills come easiest to them and what lifestyle they want to have when they are 30, 40, 50 years old. Say someone wants to work with computers but isn't sure what direction, thinking lifestyle, a system administrator is going to be dealing with a lot of frantic user problems and may be required to be on call late nights and weekends whereas a scientific computer programmer generally has a project with a deadline with somewhat flexible hours occurring mostly during normal business hours. When I started student teaching I loved working with the remedial classes where there were often students with learning and behavioral challenges. However, I realized early on that I did not have the stamina to keep up long hours year after year teaching to a performance level I would hold myself to for these kids and I found out along the way that although I liked working with kids, I dreaded parent conferences which are a significant portion of the job.

I also advise young people to not become too specialized as you may one day find yourself obsolete. A couple of decades ago a skilled photographer was in higher demand because you didn't know the quality of the picture until the film was developed. Now nearly every cell phone has a decent digital camera embedded in it and if the first picture is bad, delete it and take another. Think! Don't believe everything the web search or the computer model tells you. Does it make sense in the real world? Be respectful. Happiness in a job is a combination of what you do and who you work with.

Finally, choose something that is internally rewarding. The biggest reward I've gotten so far in my career did not come in the form of a certificate, medal or bonus. During Operation Iraqi Freedom there was a young officer at sea working long hours on a ship tasked to establish and maintain lanes of safe navigation free of explosives with whom I e-mailed on several occasions to help him assess the water conditions. When that officer returned and was visiting my command he tracked me down in the depths of a large room of cubicles to say thank you. Yes, I could make more money doing something else but that "thank you" means so much more.

SALARY

For 2015, can you speculate about the salary range of starting, mid-level and/or senior positions in your specific field?
Starting with a BS degree: $30-50K; Mid-level: $80-120K; Senior: $140-200K

Where can people find out more about your profession?
Ocean Optics Web Book: http://www.oceanopticsbook.info
International Ocean-Colour Coordinating Group: http://ioccg.org
HICO: http://oceancolor.gsfc.nasa.gov
Naval Research Laboratory: http://www.nrl.navy.mil/research/directorates-divisions/ocean-atmosphere/