Spotlight

Interview with Dr. Ken Hutcherson (Ph.D., 1994)
Staff Scientist, Osram Sylvania

By: Karrie Sue Hawbaker, editor

Recently, I had the pleasure of speaking with Maryland Physics alumnus Dr. Ken Hutcherson, staff scientist for Osram Sylvania. He was kind enough to provide us with an overview of his educational and professional journey and an update on his work since he graduated from the University of Maryland in 1995. He also offered some insight into the pros and cons of careers in both government and private industry as well as some concrete advice for young scientists entering the field of physics.

Dr. Hutcherson began his higher education career at the University of Virginia, where he earned a B.S. in physics. Directly after graduation, he began working for the United States Navy at NSWC Dahlgren in Virginia. In this civilian job, he worked with pulsed power, a plasma-based area of physics. While in this position, he took advantage of an opportunity offered by the Navy to work part-time towards a master's degree. Once a week, the Navy would fly professors from the Virginia Polytechnic Institute in Blacksburg to Dahlgren to teach graduate science courses. Hutcherson says he greatly benefited from this program, not only because it allowed him to earn an advanced degree, but also because it kept his academic problem-solving skills sharp while he gained valuable work experience.

Several months after earning an M.S. from Virginia Tech, Hutcherson left the Navy to pursue a Ph.D. here at the University of Maryland Department of Physics. Under the direction of Dr. Alan DeSilva, he investigated low-temperature high-density plasmas. As plasma density increases and particle temperature decreases, one of the standard assumptions of plasma physics breaks down (that there are many particles in a Debye Sphere). Hutcherson's research, conducted in what was then the Laboratory for Plasma Research (currently the Institute for Research in Electronics and Applied Physics or IREAP) consisted of developing a high density, low temperature plasma source and performing spectral line shape measurements to look for departure from standard plasma theory. Professor DeSilva allowed for a great deal of student independence, which meant that Hutcherson designed and built almost all of his apparatus (from designing to machining to building electronic circuits, optics and vacuum systems) and was required to know the project "from head to toe." The collegial environment at LPR also encouraged students in different labs to learn from

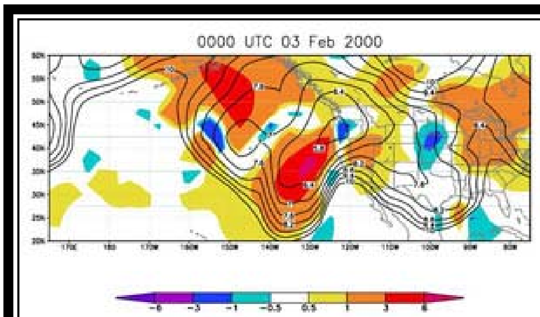
Spotlight

Chaos and Weather Prediction

By: Professor Edward Ott

Recently, members of our Physics Department's Chaos Group have teamed with meteorologists in an effort to develop novel techniques aimed at achieving greatly improved weather forecasts. Currently we are the only University-based group capable of running state-of-the-art global weather forecasting codes on our own computer facilities.

Our goal is to use this capability to conclusively demonstrate superior performance of our methods within the next year, or so. Thus we hope that our ideas will be widely used in future weather prediction.



The chaos group at the University of Maryland is working to improve weather forecasts. Colors show the improvement in a forecast (in surface pressure) compared to conventional forecasting techniques when the information about the local complexity of the atmosphere (contours) is used.

In order to introduce the crucial aspect of weather prediction that our group addresses, we note that weather prediction may be thought of as consisting of three main components: (i) measurement of atmospheric variables (e.g. measurements of temperature, pressure, humidity, and winds taken from ground stations, balloons, aircraft, and satellites); (ii) 'data assimilation', in which the measurements are used to best estimate the current state of the Earth's atmosphere; and (iii) model integration, in which a physics-based computer code modeling the Earth's atmosphere takes the atmospheric state estimate from (ii) as an initial condition and integrates it forward in time to obtain the forecast. The key step that we focus on is step (ii), the estimation of the current atmospheric state. In terms of computer time, it may be surprising for most people to learn that, in present operational weather forecasting, as much computer time is spent on step (ii) as on step (iii). That is, obtaining a best guess of the current state is computationally just as costly as integrating a full global model of the Earth's atmosphere. Furthermore, step (ii) is regarded by many as the most poorly done step in the weather prediction process, and as the step for which major improvement currently holds the greatest potential for significantly enhancing forecasting.

Why is atmospheric data assimilation hard? The measurements have errors and are incomplete: measurements may only be at discrete points; there may be geographic regions or altitudes with little data, etc. The basic problem of state estimation from limited, noisy data and a dynamical model for the evolution of the system is a classical one that arises in many contexts. The weather context, however, presents difficulties, not present in most of the classical applications of data assimilation techniques. In particular, usual data assimilation methods require matrix operations on matrices whose dimensions are equal to the number of variables describing the system state. For current Earth weather models, the number of state variables in the model is huge, on the order of millions. The matrix operations required by the classical methods are way beyond computer

capabilities likely to be available in the foreseeable future. Thus current atmospheric data assimilation adopts much faster, but very much less accurate approaches, and this inaccuracy may be the Achilles heel of present weather forecasting.

We have developed a way around these difficulties. Briefly, our idea is to geographically break the data assimilation problem up into many overlapping regions, where the size of each region is of the order of several correlation lengths. We then do the assimilations independently (in parallel) in each of these regions. (Because the regions are relatively small, the matrices involved are not large.) Following that, we piece together the assimilations from the individual regions to form our best guess of the state of the Earth's atmosphere. So far, our tests of this method indicate that it is both very accurate and fast. We are keeping our fingers crossed, hoping that things really are as good as they currently seem to be. So, if, in a few years, you notice that your TV weatherman is giving you better predictions, we hope to have been the cause.

Readers interested in more detail on our work can download relevant papers from http://www.chaos.umd.edu/paperframe.html.

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one another. For both of these reasons, Hutcherson says he gained a well-rounded perspective that he has found very beneficial throughout his career.

In the last few years of completing his Ph.D., Hutcherson also began working full-time again for NSWC and he stayed there for several months after he earned his degree in 1995. During this term with the Navy he worked on technologies to destroy hazardous molecules in contaminated air streams. This was a merger of pulsed power and plasma physics and it was quite different than his work here at Maryland. While his Ph.D. research examined high-density low-temperature plasma, this project required the development of low-density high-temperature pulsed corona reactors (called PCR s). With this project, Hutcherson had the opportunity to work with semiconductor manufacturers who needed a way to efficiently clean the gas exhausted during integrated circuit fabrication. The PCR worked quite well.

This applied research with semiconductor companies exposed Hutcherson to the world of industrial research and development. With a job offer from Osram Sylvania, a Fortune 500 company that is the largest supplier of lighting in the United States, he made the transition to plasma-based industrial research.

Nearly every form of commercial lighting, with the exception of incandescent lights and LEDs, is based on plasmas. This includes the fluorescent lights in our offices and the HID and Sodium lamps that light our streets. This provides Hutcherson and the scientists at Osram Sylvania with numerous research endeavors to explore.

Currently, Hutcherson is involved in primarily three areas of research and development. The first is electrode-plasma interface phenomenon. Fluorescent lamp life is limited by how fast the electrodes at the ends of the lamp degrade (via chemical reaction, plasma sputtering and evaporation). He also works with the electronics/plasma interactions, which reveals how the electronics that drive a lamp affect the quality of the light source. His third activity is work with light sources that do not use electrodes. Electrodeless lamps have the potential for longer life, higher efficiency and more interesting shapes.

Hutcherson says that he enjoys many aspects of his work. He finds it challenging and dynamic - it is something different every day. He has had the opportunity to lead both large and small teams and has learned to find enjoyment in whatever challenge is presented. Some of these challenges are associated with leading a teams, particularly difficulties in managing different personalities, different capabilities and different work styles of the people in on the team. Another challenge is the need to translate technical concepts to business leaders who often don't have a strong enough technical background to really understand the risks and difficulties of a task. He finds communication to be a critical skill in explaining to business executives the amount of time and/or money that a project requires.

Since Dr. Hutcherson has had experience working for a federal government laboratory as well as private industry, I asked him to compare the two and explain why he chose a career in industrial research and development.

He says that, in both organizations, decisions have to be made on what work gets done - essentially, what projects get funded. In the military, the criteria for who receives funding and who does not lacks some clarity because there are so many intangibles involved in what "makes a better military." Often, receiving funding is dependent upon a researcher's track record. Since those with an established record of success have a significantly greater chance at receiving funds, it is difficult for new scientists to obtain funding for new ideas. Also the process of "chasing the money" is very time-consuming.

In private industry, the company's goal is simple and clear - to increase profits. This goal lends itself to more objective ways of deciding which project is funded and which does not. By setting concrete goals for a project, it is easier to argue for funding for your proposed activity. Also, without as much time required to pursue funding, scientists have more time to focus on the technical work.

However, the advantage of working for the military is the emotional reward of working on something with a social benefit, e.g. national security. While Hutcherson recognizes that, in private industry, one still contributes to society by maintaining jobs, fueling an economy and producing technologies that benefit the lifestyle of a consumer, it is a less direct reward.

I also asked Dr. Hutcherson to provide some advice to our current students or recent graduates preparing for a career in physics. He offered two specific recommendations for these young scientists.

" Consider all your options. Professors often consider academia the best career path, which is natural because that is the path that they chose and are the most familiar with. While there are many benefits to a career in academia, there are also many exciting careers for physicists in applied physics or both government and industrial research and development. There are many opportunities in government and industry to learn about new science and new technologies. Also, the research in government and industry tends to be interdisciplinary where you work with a cross-functional team involving chemists, materials scientists, engineers, manufacturers, marketers and accountants.

" Improve your communication skills. Good communication is more than just good papers. It is also good presentations, the ability to discuss your work with non-technical people and the ability to explain the ramifications of your work in the broader context of your field. These skills are very important, even in the world of academia.

If you have questions for Dr. Hutcherson, please feel free to email me at karrie@physics.umd.edu with "Question for Dr. Hutcherson" in the subject line. I will be happy to pass the inquiry along to him.