Vol.1, No. 3

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FLORIDA STATE UNIVERSITY
Mathematics for the New Millennium

The Department's Research Faculty

Jack Quine *uses modern geometry to study protein shapes;*

De Witt Sumners *uses knot theory and topology to study DNA replication;*

Chris Tam *is modeling jet engine noise to help reduce noise levels at airports;*

Chris Hunter *is researching gravitational lensing to explain the consequences of Einstein's general relativity;*

Washington Mio *and* Phil Bowers, *studying quantum computing and information theory, will conduct a seminar and teach a course on the subject next year;*

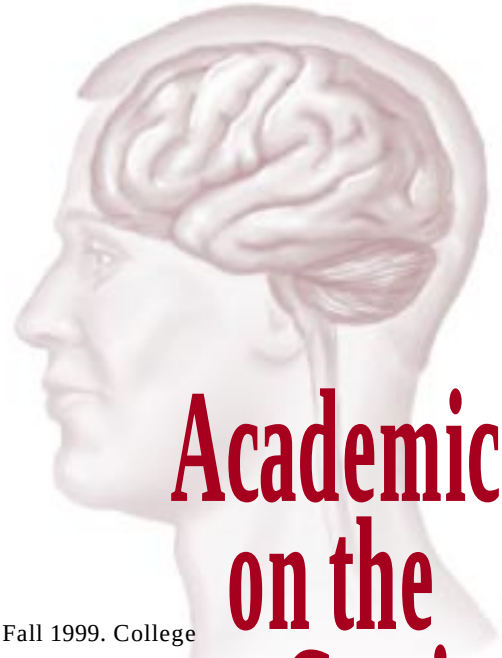
Sam Huckaba *is researching algebraic cryptography and has a PhD student working on an algebraic cryptosystem;*

Craig Nolder *and* Warren Nichols, *teaching in the financial mathematics PMD program, have become interested in mathematical problems that arise there;*

Mike Mesterton-Gibbons *is researching population modeling and mathematical ecology;*

Eric Klassen *works with Statistics faculty in applying modern geometry to visual tracking, and*

Mark van Hoeij *is always symbolically calculating something new that no one has done before.*



Academics on the Cutting Edge

The Department of Mathematics is poised to go through some major changes in the next few years. These changes range from an increase in faculty size driven by an influx of new monies into FSU, through dramatic and technologically driven changes in the way we teach, to the increasing influence of the marketplace on the subjects that will be studied. The following are some of the ways these changes are affecting the academic mission of the department.

Responding to increased pressures from twenty-first century technological advances, we are establishing two-year Professional Master's Degrees (PMD). Begun in the Fall '98 semester, the PMD in Financial Mathematics graduated its first class in Spring '00 and several students are now working in energy derivatives. The Biomedical Mathematics PMD, designed by Jack Quine and established in Fall '00, had a successful first semester with 15 students attending the core course. And, PMDs in Industrial Mathematics and College Mathematics Teaching will begin Fall 2002.

The Department is revamping its preliminary examination structure to allow an easier segue into research for students interested in a multi-disciplinary program. The PMD programs are feeding students into the PhD program who are interested in dissertation topics in nontraditional areas, like financial mathematics and biomedical mathematics. PMD students may substitute that degree for one of the three written qualifiers. For more information, visit out website.

In response to high failure rates (42% in MAC 1105) in basic studies courses, Will Stiles and Annette Blackwelder have been converting all to a Computer Aided Instructional (CAI) mode since Fall 1999. College algebra and pre-calculus have shown great improvement: the failure rate now averages 18%. This "proof of concept" convinced the administration to renovate four computer classrooms in Hoffman Teaching Laboratory, where, beginning Fall 2001, all MAC 1105 and 1106 and half of MAC 1147 will be taught with CAI recitations. Over 3000 students will benefit that first semester, and we expect an 80+% overall pass rate.

How does it work? Each week, students are required to attend recitation classes where they work individually tailored problems on the computer. They access practice tests and a huge bank of exercises on the 25+ topics they must master to pass. The computer immediately grades

(continued on page 9)

View from the Chair…

Spring 2001 has been very busy and productive for the Florida State University Department of Mathematics. For the first time in many years, we have hired tenure-track faculty! The founding of the FSU School of Medicine has meant additional resources in basic science for the University, a portion of which we have successfully secured for mathematics.

Specifically, the Department was authorized to recruit for three additional (growth) positions – one each in applied mathematics, financial mathematics, and biomedical mathematics.

We were also authorized to recruit for two replacement positions – one for a vacancy created when ***Dr. David McMichael*** *resigned to begin a career in actuarial science with Allstate Insurance in Chicago. We will miss David, and wish him well in his new career.*

As of this writing, we have hired four new faculty members for Fall 2001 and expect to finalize an offer to a fifth very soon. Short biographies of our new faculty members follow.

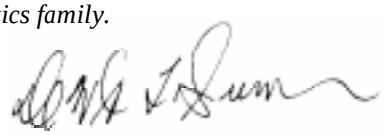
Dr. Richard Bertram *joins us as an Assistant Professor specializing in computational structural biology, cell biology and neuroscience. Formerly Assistant Professor of Mathematics at Pennsylvania State University, Erie, he holds a PhD in Mathematics from this University and was a student of Jerry Magnan. Most recently, Richard served as Assistant Scientist at FSU's Institute of Molecular Biophysics.*

Dr. Monica Hurdal *will serve as an Assistant Professor specializing in visualization and computational analysis of human brain functional and anatomical data. Currently a postdoctoral associate in the FSU Department of Mathematics, she holds a PhD in Mathematics from Queensland University of Technology, Brisbane, Australia.*

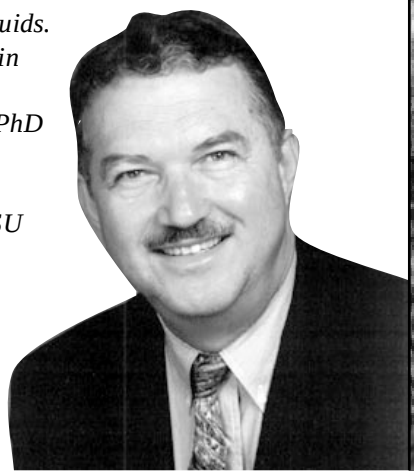
Dr. Alec Kercheval *will come to us as an Associate Professor specializing in financial mathematics. He is now with Barra, a worldwide investment management firm headquartered in Berkeley, CA. He was Marshall Scholar at Oxford University and earned his PhD in mathematics at the University of California, Berkeley. Before joining Barra, Alec was an Assistant Professor of Mathematics at the University of Texas, Austin. Alec's spouse, Dr. Lillian Garcia-Roig, who will join the FSU faculty as Associate Professor of Art in the School of Visual Arts and Dance, is now a tenured Associate Professor of Art at the University of Texas, Austin.*

Dr. Qi Wang *will join us as an Associate Professor specializing in fluid dynamics and rheology of complex fluids. He is now a tenured Associate Professor of Mathematics in the Department of Mathematical Sciences, Indiana University/Purdue University, Indianapolis. Qi holds a PhD in Mathematics from Ohio State University.*

We look forward to welcoming these new faculty members and their families to Tallahassee and into the FSU Mathematics family.



De Witt Sumners



Mapping the Human Brain

By Jill Elish
FSU Communications Group
Reprinted from ***FSTimes***

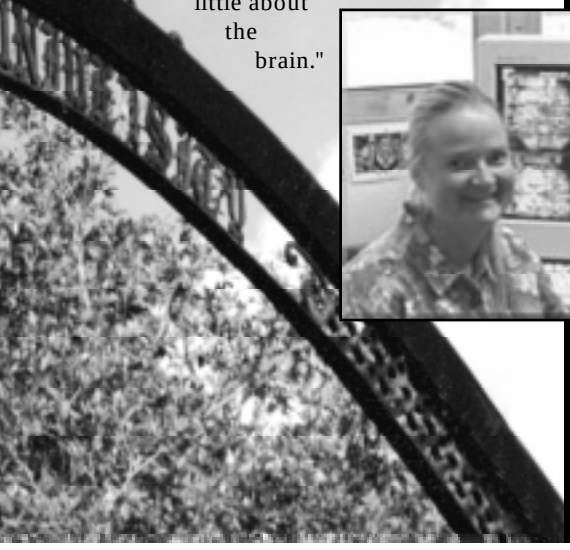
Using a 150-year-old mathematical theorem, Florida State University researchers are creating cutting-edge maps of the cerebellum to chart a groundbreaking new course in the study of the human brain.

Monica Hurdal, a postdoctoral research associate of mathematics who is working for FSU Professor DeWitt Sumners, and a team of researchers have developed a one-of-a-kind computer program that can map the human brain in ways never done before. The program is a computer realization of the Riemann Mapping Theorem, which allows a three-dimensional surface to be flattened – while preserving the angular information.

While there are other researchers who are looking at new ways to create maps of the brain, the FSU team is the only group to create conformal brain maps – those that preserve the angles – using information from magnetic resonance imaging (MRI) scans. Other techniques usually display cross-sections of the brain surface, making it difficult to view the entire brain surface at once.

The new method allows researchers to observe the entire surface of the brain, particularly regions buried within cortical folds.

"Everybody's brain is different, like a fingerprint," Hurdal said. "The fissures of the brain vary greatly from person to person, and we think this method will allow scientists to make comparisons that will hopefully lead to a greater understanding of how the brain works. Even though there has been a lot of research, we still know really very little about the brain."



This new way of brain mapping will allow scientists to impose a unique coordinate system on the brain's surface in order to measure and compare brains. The maps can be used to compare anatomical regions of the brain, compare brains from two or more subjects and display data from PET and MRI scans.

"It's a mathematically sound method to create maps that will allow comparison of brain activity to diagnose illness or identify a problem, such as a tumor," she said. "These maps are unique for each person."

In addition to using them as diagnostic tools, Hurdal said doctors may eventually use the maps to help them prepare for brain surgery.

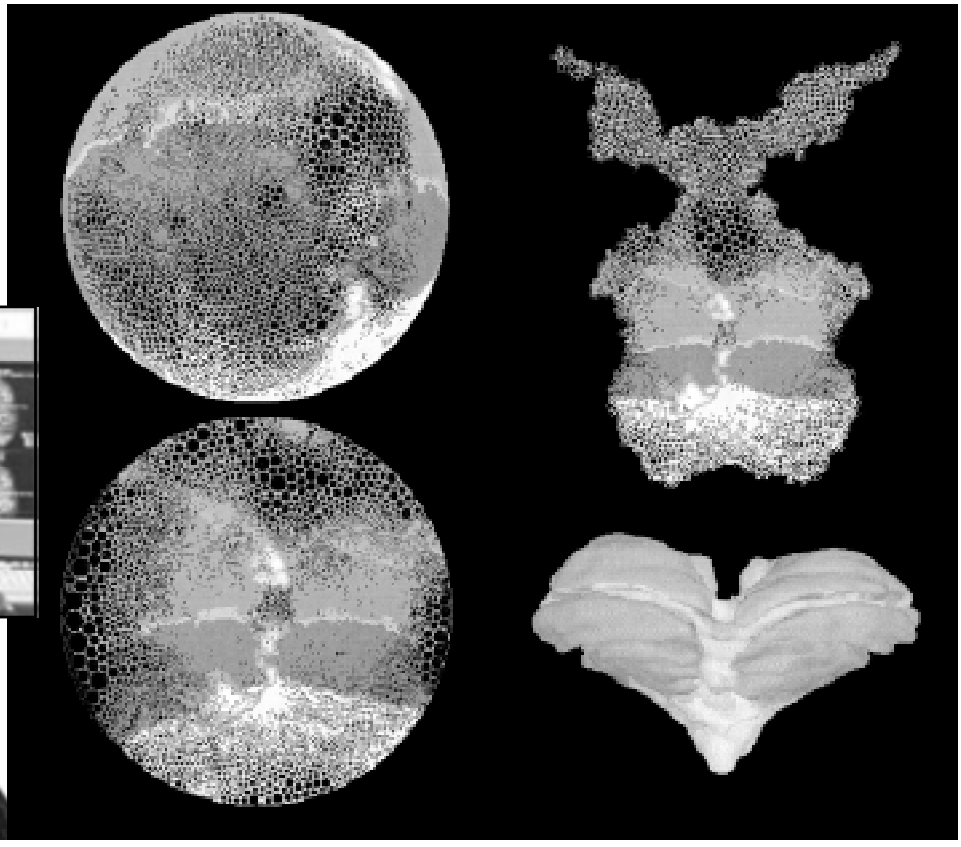
The maps could also help researchers discover how different brains handle the same task or how brains change as people age. The maps may also allow scientists to observe how diseases such as Alzheimer's affect the way the brain functions, she said.

Hurdal is using the computer program to produce maps in a number of different ways. For example, the new maps can be created in the Euclidean plane where distance is measured or scaled as expected, as on a road map.

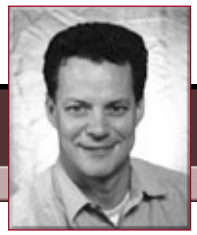
The program also can be used to create a map using hyperbolic geometry. With these hyperbolic maps, the software can be used to select map points or anatomical landmarks to be the new map center, forcing distortion to the map periphery. In this manner, the map focus can be changed to any desired location, much like moving a magnifying glass over a piece of paper or a microscope over a slide specimen. In addition, the hyperbolic maps are all the same shape – a circle – making it easier to compare different maps from different brains.

Brain maps also can be created on a sphere, which is comparable to viewing the surface of the earth on a globe. Hurdal's maps can be viewed at her Web site: www.math.fsu.edu/~mhurdal.

Hurdal is currently producing flat maps of the brains of some patients suffering from cerebellar ataxia – a disease that involves atrophy of the cerebellum – using data from the PET Imaging Center at the Veterans' Affairs Medical Center at the University of Minnesota.



Point of View: A Mathemat



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It was June 1999 and Tallahassee was enduring its second straight year of drought (now into year three). Somewhere between finishing my latest research project and sweating over the reality of becoming associate chair, the phone rang.

This was not an ordinary call. It was from that mysterious world known as the private sector, and involved the slippery area of virtual companies and information overload called the Internet.

"Would you be interested in coming to work for an Internet startup being spun out of multi-media giant Primedia, Inc.?"

As an undergraduate majoring in mathematics, I had briefly considered going to work in private industry. There was an offer from Macdonell Douglas to work on airplane wing design. The job sounded good, as did living in a larger city (St. Louis), and I wanted to accept. However, I was already PhD stricken and wanted more to become a teacher and researcher. I departed instead for Purdue to study pure mathematics.

"You would work in the Business Development office, be paid well, and have a shot at company stock through stock options."

I understood and quickly absorbed the compensation package, but what in the world did "Business Development" mean? I asked this question and received a vague answer. It seemed to say a lot and left me initially thinking that I understood it somewhat, but then dissolved into a cloudy string of phrases that hinted at a more complicated story.

A mathematical researcher often faces the challenge of giving a brief and straightforward answer to the question "What exactly is it that you do?" Maybe there was some common ground here.

"We want to fly you here for an interview. How about it?"

So began my year away from FSU. Over the next crazy month, I would discuss this intensively with my wife, Marleena, who was unbelievably supportive (and whose vocabulary does not include the word 'fear' when it comes to career moves), formally request a leave of absence, put our house up for sale, apologize profusely to De Witt Sumners for leaving him hanging (although he landed on his feet, as always, by hooking Phil Bowers to be associate chair), and submerge myself in all things Internet.

We loaded our material possessions and moved to Kansas City, a Midwest metropolis and home to excellent jazz (the birthplace of Charlie Parker), good barbecue (mainly ribs), the Nelson Art Gallery, the elegant Country Club Plaza, the earthy Westport region, and Sprint's world headquarters. The Plaza and Westport between them contain numerous restaurants, nightclubs, coffee shops, and retail outlets of all types. The two are about five blocks apart and blend together to create a heady mixture of wealth flanked by blue jeans, street side art, and vacationers.

My new employer was called IndustryClick and its headquarters were located halfway between the Plaza and Westport, next to the mutual fund company, American Century. Its home was a two-story building with a glass front. Inside were dozens of cubicles.

I walked through the door on August 23, 1999, as Employee Number Eleven. We quickly grew to 55. The ages of my co-workers ranged from the early 20s to the middle 50s, with an average of around 30. I worked next to 25-year-olds who could easily have been students of mine just a few years earlier.

Primedia is a publisher of 220 magazines, including 120 consumer titles (Seventeen, Modern Bride, New York, etc.) and 100 trade publications (*Cable World, Telephony, Catalogue Age, American University, National Hog Farmer, Coal Age, American Trucker*…you get the picture). IndustryClick is a wholly owned subsidiary of Primedia and was formed to leverage the distribution channels induced by its trade publications into a profitable web product.

Making money on the Internet is a supreme challenge, but it is recognized that companies having products that involve communication and delivery of information are positioned well to take advantage of the web. With 100 trade magazines already generating millions of dollars per year in advertising and buyer's guide revenue, Primedia's creation of IndustryClick was a natural.

My job in business development was aptly described to me by one of Primedia's executives. "A business development person is like a chef making a dish without a recipe. One must decide on initial ingredients and begin mixing them together, all the while testing the product and adding more of an ingredient, or perhaps new ones, until the dish seems about right. The end product should be a thriving component of your meal."

The "meal" corresponds to a business and the "dish" to one of its main components. A good business development person must learn as much as possible about the business, while constantly evaluating future needs and aggressively pursuing them.

I spent hours studying the "B2B space," shorthand for "Business to Business" (the business environment in which IndustryClick resides). I learned about marketing and how important and expensive it is to define and then reach your target audience. I was introduced to market research and the many firms that produce it for clients. I visited DoubleClick's headquarters in New York and learned more than I ever wanted to know about delivering and interpreting online ads.

I spoke with dozens of representatives of high tech companies who were peddling everything from online auction technology to electronic marketplaces. I heard pitches for expert database management, data mining technology, highly specialized search engines, and online tradeshow software.

I was introduced to economic worlds that I didn't know existed. For example, the bandwidth exchange market, which is being impacted by the Internet through online marketplaces such as Arbinet, a

cian's Year *Out There*

Huckaba, Professor of Mathematics

commodity-style electronic trading floor moving excess bandwidth capacity from one telecommunications company to another (and eventually to the consumer telephone or ISP sales rack).

I spent several weeks researching the book-selling industry and gauging its viability for IndustryClick (EDI technology, warehousing, packaging, shipping, and the whole works). As part of my research on investment candidates (an ongoing task in business development), I rummaged through S1 documents of companies who had filed to go public and became acquainted with Hoover's online and the enormous SEC database.

I learned a lot of new words, phrases, and abbreviations, like "EBIDTA," "pre-money valuation" and "warrants." Those would usually arise whenever we were pursuing an investment by IndustryClick or Primedia in a small private company. I learned about "term sheets," "NDAs," and "due diligence." Phantom words such as "monetize" began to enter my vocabulary. My closest co-workers and my contemporaries at other companies usually had MBA degrees. I soon found myself talking like I had one, too.

I learned that experience and communication skills are even *more* important than I ever imagined, and that it is a good idea to save every report you prepare (you never know when you will have to drop absolutely everything to prepare something in record time for a superior). The phrase "cut and paste" took on a new meaning.

Did mathematics help me do my job well? Probably not, but being a mathematician did help. Abstractions were common, and the ability to cut through to the core of a business plan was important. The Internet's capabilities exceed its practical use. As with mathematics, the devil is in the details when executing a proposed plan. One must make things work in order to succeed. The short history of the Internet economy is already littered with dying or dead companies that failed to bridge the gap between concept and operations.

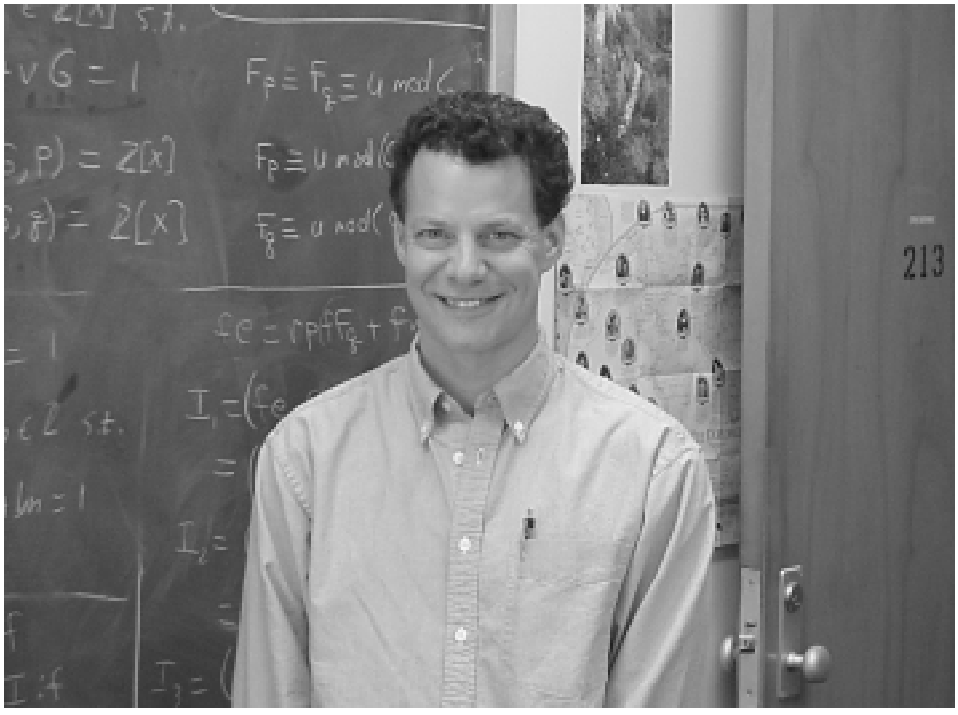
The people I worked with were fantastic. The company's CEO had hired superbly and the place was full of energy and enthusiasm. Employees were grouped by areas: marketing, content, human resources, technical, and, of course, "biz dev." These folks were all very curious about my background and questioned me often. Most of them had no idea that college professors do anything other than teach, but were very receptive (when delivered to them in the right way) to the idea of basic research.

The tech people, in general, were hard working programmers who did not want to trouble themselves with anything concerning the business side. "Just tell me what you want to do and I'll try to make it happen." They tried to convert me. "Get over here on the tech side where a mathematician belongs!" Because they were in such high demand, the coders also had perhaps the least company loyalty of any group (except the business side folks - especially the executives - who had an uncanny ability to ruthlessly, but subtly, look out for their own interests).

Where is IndustryClick today? In January 2000, a new CEO was named and it took him about six months to move the headquarters from KC to his hometown of Princeton, NJ (one reason, but not the only, why yours truly decided to return to FSU). Most of the 55 are no longer working for IndustryClick, having moved on to other (mostly) Internet companies.

Kansas City is not widely known as a high tech mecca but at last count there were some 250 high tech and Internet companies in the area. IndustryClick is still battling and trying to achieve its initial broadly defined goals. The devastating stock swoon of last year stalled its growth. However, IndustryClick still appears to be on track and Primedia continues to funnel resources its way.

My adventure at IndustryClick was most definitely worth the worry and upheaval it caused for me. It was like a sabbatical except that it was experienced in a world vastly different from academia. I enjoyed my year "out there" and I learned a great deal. However, I am glad to be back and again doing the big three: teaching, research, and service.

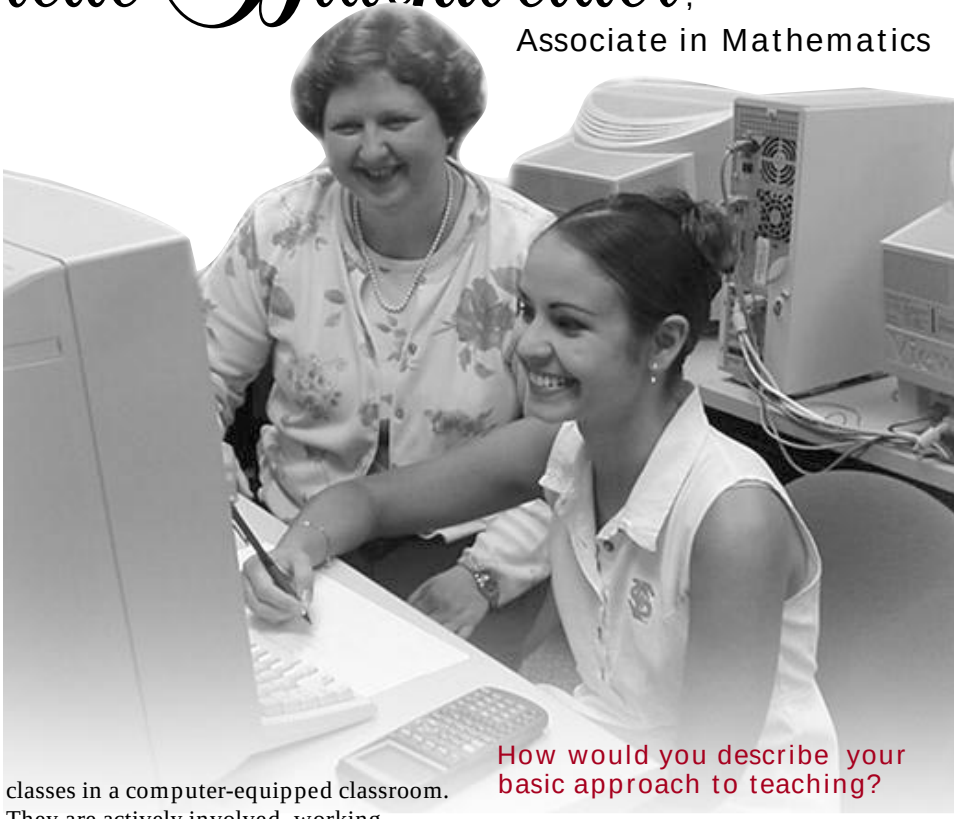


Sam Huckaba is currently professor and Associate Chair for Graduate Studies.

Faculty Spotlight

Annette Blackwelder,

Associate in Mathematics



What is your academic background and why did you come to FSU?

I knew I wanted to be a teacher by third grade; by eighth grade, I knew I would teach math. When friends asked me for help with math homework, I understood the concepts and enjoyed working with them. While completing my undergraduate degree, however, I discovered a love for computer programming and writing elementary Fortran programs. So I set aside my plans to teach.

After earning a B.S. in mathematics at Appalachian State University, I began the medical computer science program at the University of Texas. It took one semester to know my heart was in teaching. I completed a master's at ASU in 1983 and came to FSU to teach and work on a Ph.D.

In 1985, Betty Anne Case and Ralph McWilliams offered me a Visiting Instructor position and I put my studies on permanent hold. I loved the mix of duties I was given and the home I'd found in Tallahassee.

What is your teaching history at FSU?

I currently teach the only computer-assisted MAC 1105 lecture class in our pilot project to about 190 students. I've taught most precalculus courses, Calculus, Business Calculus, and Discrete Math; coordinated and developed our college algebra course (now MAC1105); worked with the directors of Basic Mathematics, currently Will Stiles, scheduling adjunct and TA teaching assignments, and conducted TA orientations.

I'm particularly interested in college algebra. Due to its large enrollment (about 3800 students a year) and former mandatory status, grades were scrutinized. When they declined in the '90s, we looked for a new approach.

In 1998, Provost Abele sent information to Chris Hunter, then department chair, on an innovative approach Virginia Tech was using in their precalc courses. Dr. Stiles queried their Math Emporium and developed a modified version of their computer-assisted instruction (CAI) methods. In addition to lectures, students take recitation classes in a computer-equipped classroom. They are actively involved, working problems instead of watching them being worked. Out-of-class work is required and TAs are available to help. It's an exciting environment.

We previewed software packages and selected WebTests by Wiley Publishers, which allows Internet delivery of tests and practice problems. TAs Radha Bose, Pene Kirby, Robert Watkins and I developed a test bank of 1400+ items for two experimental lecture classes of MAC 1105. In Fall '99, our project sections had half the D's and F's as other sections.

This success continued last year, with CAI sections earning 17% fewer D's and F's in the spring. After doubling the practice problems over the summer, we continued with one MAC 1105 lecture class and on-line practice for all 1105 students. The grades of all non-CAI sections improved and the CAI sections achieved the same success as in Fall '99.

Because four classrooms in the Hoffman Teaching Lab are being equipped with computers, we'll teach all Fall 2001 sections of MAC 1105 in CAI mode.

How would you describe your basic approach to teaching?

I want to provide my students with the best possible learning environment by giving them carefully planned and captivating lectures, providing adequate examples, directing them to out-of-class resources, and being available to them outside of class.

As the MAC 1105 coordinator, I make every effort to provide clearly defined course and test objectives, a variety of resources, instruction that prepares them for their next mathematics course, and fair, consistent policies. I want my students to have everything they need to be successful, given a reasonable effort on their part.

What are your goals for the department and for yourself?

Departmentally, I'd like to see support for expanding the CAI project to other courses, and continued development of my MAC 1105 on-line problem set and other on-line resources.

Personally, because of recent course changes and our CAI project, I've worked exclusively on MAC 1105 for several years. I hope to soon teach other classes again.

IN THE SPOTLIGHT

Kenneth G. Boback, *Alumnus*

Ken Boback has presented the Department with a gift of $10,000 to be used in the academic support of its students. He has long been "very involved with students" and "wants to give back" to the University that first inspired his love of higher education:

"I wish to express my appreciation for the wonderful academic and faculty experiences I had at FSU, and the great faith in the philosophy of education that so benefited me. I want to help enable that to continue."

Why did Boback attend FSU? He began taking courses when he was stationed at Tyndall Air Force Base in Pensacola, FL in the early '60s. He remembers, "I so greatly enjoyed the basic division professors for history, Spanish, and the humanities who made the trip from Tally that I came to the main campus when I was discharged and completed my degree in Math in '64."

After receiving an MA from Villanova University (PA) in 1970, he began teaching for the Pennsylvania State University system: today, he is at the Wilkes-Barre campus. Its brochure describes the school as having "small, friendly classes and a faculty you can get to know," a style that fits Boback's educational philosophy perfectly: "Education is a path to enrichment, the best way to achieve your goals and careers in life. Students must take advantage of every academic opportunity."

Boback has wonderful memories of FSU – course work, fellowships, professors, fellow students, and special events. He remembers, "Drs. Thompson in Humanities, Norton in History, Collins in Math. It was because I enjoyed my FSU experience so much that I decided to teach in a university environment."

Current activities? "At the moment, I'm teaching freshman and sophomore levels of mathematics and statistics, both at Wilkes-Barre and as an adjunct instructor at Wilkes University and Luzerne County Community College." He also advises business students and has been involved in community services projects for many years.

Previously, he taught mathematics at Penn State's Berks campus, was an adjunct instructor of mathematics at College Misericordia in Dallas, PA, and was an Intake Interviewer for the Pennsylvania Bureau of Employment Security. He has also been a research associate for Health Care Management, a secondary mathematics teacher in Media, PA school district, and on the team of MA-1 Weapons Control Systems in the United States Air Force.

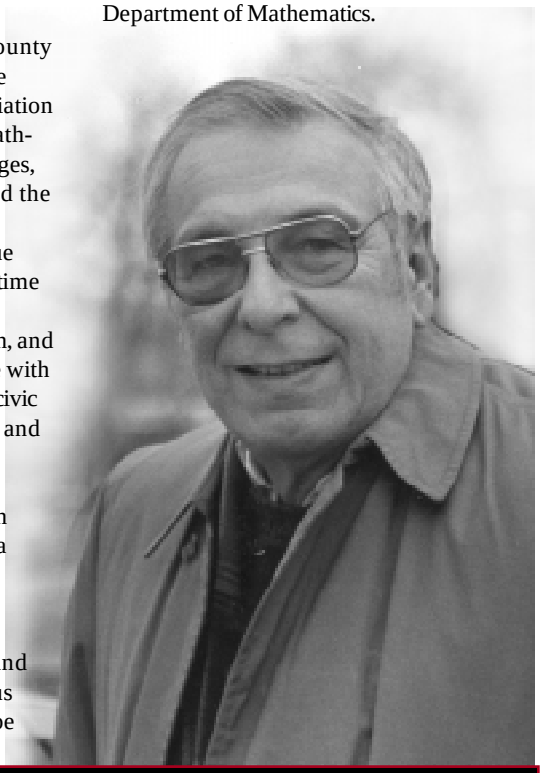
He is a member of the Mathematical Association of America, the Luzerne County Council of Teachers of Mathematics, the Pennsylvania State Mathematics Association of Two-Year Colleges, the American Mathematical Association of Two-Year Colleges, the American Statistical Association, and the Cousteau Society.

Plans for the future? "I want to continue teaching for a few more years, even part-time after I retire. I've conducted several book reviews, have an article up for publication, and will continue to write. I will also continue with community service." He has won many civic awards, particularly from the VETS Club and the American Red Cross.

Mrs. Sandra Boback is a librarian and kindergarten aide at St. Boniface School in Wilkes-Barre, and daughter Stephanie is a freshman at the Pennsylvania College of Technology in Williamsport.

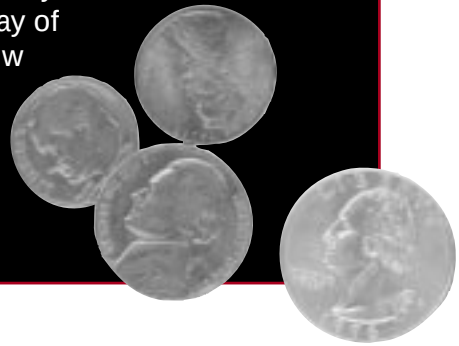
Ken Boback is not one to sit by while others offer a helping hand to students and the community. He believes, "Those of us who have graduated from FSU should be proud that we're alums, and help others reach comparable accomplishments."

This is the reason for his gift to the FSU Department of Mathematics.



When we ask for $$$, what is it for...?

The Department's newly established graduate fellowship fund is an exciting opportunity for you, as alumni, to show your support for students who are working diligently to complete academic and research requirements. The recently announced fellowship is structured to provide domestic graduate student prospects with monetary enhancements from a continuous, interest-accruing balance of $15,000 to $20,000. We invite your financial support of this fund as your way of encouraging students who seek to follow in your footsteps. For more information, and to contribute tax-deductible dollars, please contact Susan Minnerly, Office Manager, at 850.644.8714 or minnerly@math.fsu.edu.



Faculty Research: *Dessins D'Enfants*

During this academic year, the Department of Mathematics has conducted a weekly seminar, entitled "Dessins d' Enfants," that has attracted mathematicians from several research areas and encompasses unique characteristics. Professor Eriko Hironaka directs the seminar. Professors Paolo Aluffi and Eric Klassen, and Roger Vogeler, a first-year graduate student, conduct lectures.

How did the seminar come about? Hironaka explains, "I chose this topic because of its ties to diverse areas of mathematics, and because I was interested in its central role in covering spaces. I wanted to create a forum in which faculty and graduate students of different disciplines could share ideas and knowledge, extending our horizons."

Klassen: "'Dessins d'enfants' is French for "children's drawings." We are interested only in those drawn on a closed surface – a simple sphere or a sphere with one or more attached "handles." Points are drawn on the surface and lines (possibly curved) are drawn from point to point. Lines cannot cross except at the points. There are also a few technical conditions the drawing must satisfy: for instance, a point should be reachable from any other point by traveling along the lines.

Professor Paolo Aluffi

"Imagine two surfaces made of very stretchy rubber. If one surface can be manipulated so that it and its drawing look exactly like the other surface and drawing, the dessins are considered identical. These seemingly elementary objects have become a hot research topic, attracting the attention of illustrious mathematicians and becoming the subject of many books, international conferences, and journal articles. Understanding this widespread interest takes us to very old mathematical ideas whose mysteries are inspiring surprising new mathematics.

"High school students learn to find the roots of 2nd degree polynomials using the famous quadratic formula. Medieval Arabic mathematicians understood the formula, and by the 1500s, formulae had been discovered for the roots of 3rd and 4th degree polynomials. However, efforts to solve advanced polynomials failed.

"In 1832, Evariste Galois, a 20-year-old French mathematician, gave a proof that no such formula can be found for polynomials of Degree 5 or higher. His ingenious ideas (preserved only because he included them in a letter the night before he was killed in a duel!) form the foundation of Galois' theory, a branch of modern algebra usually taught at the graduate level.

"This theory addresses the algebraic closure of the rational numbers, i.e., the set containing all roots of all polynomials with rational coefficients (denoted by $\mathbb{Q}$.) For example, $\sqrt{2}$ is in $\mathbb{Q}$ because it is a root of $x^2-2=0$, but $^1/_4$ is not in $\mathbb{Q}$ because it doesn't satisfy any polynomial with rational coefficients.

"Galois discovered that certain substitutions can be made among the numbers in $\mathbb{Q}$ without altering the basic laws of algebra (i.e., $-\sqrt{2}$ can be substituted for $\sqrt{2}$ without creating any algebraic contradictions). The set of all such substitutions is called the infinite Galois group, denoted Gal $\bar{\mathbb{Q}}/\mathbb{Q}$. This Galois group is a central object of study in modern algebra. Much is known about its structure, but there are important questions still unanswered.

"In 1984, the great French mathematician Alexandre Grothendieck made the fundamental observation that Gal($\bar{\mathbb{Q}}/\mathbb{Q}$) doesn't just act on the numbers in $\bar{\mathbb{Q}}$, but

Ericko "Eco" Hironaka
Seminar Director

Eric Klassen,
Associate Professor of Mathematics

also acts very naturally on "dessins d'enfants." In other words, an element of Gal($\bar{\mathbb{Q}}$/$\mathbb{Q}$) not only substitutes numbers for other numbers, but dessins for other dessins!

"A polynomial in two variables defines a curve over real numbers and complex numbers. Because complex numbers are essentially two-dimensional (x+iy), a curve over them has the structure of a surface, as described above. The dessins we describe arise from complex valued functions (in fact, polynomials) on these surfaces!

"An element of Gal($\bar{\mathbb{Q}}$/$\mathbb{Q}$) acts on these complex "curves" and functions by acting on the coefficients of all the relevant polynomials. It is this action that Grothendieck noticed and proposed to exploit. An excellent way to study a large group is to find a new set (the dessins) upon which it acts. Space does not permit giving all the details here, but the concept is clear."

Paolo Aluffi's interest involves the bridge that dessins d'enfants build between combinatorics and algebraic geometry. His seminar lectures have explored algebraic identities arising from dessins. For example, the simple dessin consisting of one segment in the plane corresponds to the simple algebraic identity $(x+y)^2 - 4xy = (x-y)^2$.

Aluffi: "Remarkably, every dessin in the plane leads to a similar identity: here is a way to obtain from every "child's drawing" in the plane an expression V - F = E^2, where V, F, E are polynomials suitably associated with the vertices, faces, and edges of the drawing. More remarkably, one can reconstruct the corresponding dessins from each identity!"

Aluffi believes, "Through this correspondence, interesting combinatorial questions about dessins could be translated into algebraic statements, which could then be studied with the tools of algebraic geometry. For example, the celebrated "four-color theorem" asserts that every geographic map can be colored by using just four colors: since a geographic map can be seen as a dessin, this statement should have a counterpart on the corresponding algebraic identity. Can dessins show us a way to prove the four-color theorem by using algebraic geometry? (The four-color theorem was proved in 1976 by strictly combinatorial arguments, using thousands of hours of computer time. Mathematicians are still trying to find a more conceptual proof.)"

The study of dessins involves techniques from several areas of mathematics that have traditionally been taught separately. Gal($\bar{\mathbb{Q}}$/$\mathbb{Q}$) was an invention of algebraists, the study of complex valued functions and their critical points occurs in advanced calculus and analysis, and the study of surfaces and their maps is conducted by geometers and topologists. The seminar has fostered exciting cross-study. Presentations have been made in algebraic geometry, topology, complex analysis, and dynamical systems. Experts in computational algebra and geometric topology have also contributed.

Our graduate students are learning that, while classroom study requires isolating mathematical areas to master techniques, in active research, techniques must be coordinated. The study of dessins d'enfants is a prime example of this.

"'Dessins d'Enfants' is French for "children's drawings." We are interested only in those drawn on a closed surface – a simple sphere or a sphere with one or more attached 'handles'…"

Academics…*(continued from page 1)*

their efforts and instant feedback is given. Students may even take practice tests at home, online!

Twenty years ago, FSU Mathematics boasted of a fine faculty in pure and applied mathematics. Their expertise ranged from analysis, algebra, and topology in pure mathematics, to computational fluid mechanics, aeroacoustics, and galactic dynamics in applied mathematics. Today, applications in areas previously untouched by the power of mathematics have influenced several of the Department's research faculty (see page one).

These are interesting times to be a mathematician, and this cutting-edge research filters through to our graduate students as it influences our teaching in new ways. We do this while maintaining strength in pure mathematics and traditional applied areas. We believe we are justifiably proud of our research faculty.

— Phil Bowers, Associate Chair

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Ivo D. Dinov

Ivo Dinov's curriculum vita is far too complex to list all of his accomplishments.

He is currently conducting post-doctoral research at the UCLA School of Medicine's Department of Neurology in their Neuro-Imaging-Laboratory, and has just accepted an Assistant Professorship in the Department of Statistics, UCLA, to begin Fall 2001. He also worked at the University of California / LA School of Medicine's Department of Neurology as an NIH postdoctoral fellow.

As a research assistant in our Department in 1997-98, Dinov focusing on mathematical and statistical modeling of medical data, and was concurrently a pre-doctoral research fellow in the Department of Engineering, where he developed optimization algorithms.

Dinov's educational credentials include, from FSU, a PhD in Mathematics, an MS in Probability and Statistics, and pre-doctoral training in Industrial Engineering. He earned an MS in Pure Mathematics from Michigan Technological University, and a BS in Mathematics and Computer Science from Sofia University, Sofia, Bulgaria.

His teaching experience includes the UCLA Department of Mathematics' Program In Computing; the FSU Department of Mathematics, and Michigan Technological University's Department of Mathematics.

He is currently a member of the American Mathematical Society, the Mathematical Association of America, Pi Mu Epsilon National Mathematics Honorary Society, and the Organization for Human Brain Mapping.

Dinov is skilled in the programming languages of JAVA, FORTRAN, "C," Pascal, PostScript, and OpenGL; the interactive programming languages of Mathematica, IDL, Splus, PV Wave, and SAS, and PC / NT / Windows; SUN-SPARC, NeXT, SGI-IRIS, and IBM under UNIX hardware.

His interests include neuro-degenerative diseases and neuro-imaging approaches for modeling, diagnosis, prognosis and treatment of such diseases; mathematical and statistical techniques for modeling and analysis of biomedical data; applicable and experimental mathematics, i.e., the practical usage of topological, probabilistic and statistical methods in science, business and engineering; fractals / wavelets and metrics on fractal / wavelet transforms, and optimization algorithms and computer implementation.

His publications are listed at <www.loni.ucla.edu / ~dinov / publications.html>.

Questions? These interview answers may satisfy them.

What brought you from Bulgaria to the States?

I wasn't "mathematically" oriented in high school. In fact, I was enrolled in a four-year business and accounting high school. I was fond of forward (company) and reverse (banking) accounting. My parents were accounting and economics teachers. My older brother, a physics major, advised me to study at the University of Sofia in mathematics and computer science.

My freshman and sophomore years may have shaped my passion for Mathematical Analysis. Graduate school options in Bulgaria in fields such as algebra were excellent, but I wanted to study analysis and applied mathematics. Michigan Tech, one of the few grad schools I applied to, had a strong group working on functional and applied analysis: there, I had the great opportunity to work with Professor Ken Kuttler on Bachner Integrals and Vector Measures."

Why did you choose your field(s)?

I believe the career choices one makes may be driven, to a large degree, by chance (some call it "luck"), and certainly by the ambient environment. I'm no exception: my teachers and mentors affected my choices. I had a truly exceptional instructor in "Real Analysis I" during my freshman year, Professor Skordev. I only hope I give my students a fraction of what he gave me.

Why FSU?

Two factors drove me to FSU – scholastic and environmental. There were several faculty members I wanted to work with. Also, graduate students were allowed to teach classes: I really like teaching and consider it at least as valuable, if not more so, as research. It turned out I was right; during the five years I spent at FSU, I received a wonderful exposure in teaching undergraduate mathematics. A less serious reason was that FSU has an absolutely beautiful campus and the weather is a contrast to the long, white winter in Michigan.

Overall, how would you describe your years here?

Looking back, I had an amazing time. I learned a lot, met some great people and had fun. If only it hadn't been so short.

Academically, I am grateful to Professors Hunter and McKeague for the opportunity to dually enroll as a graduate student in mathematics and statistics. Dr. Sumners, my former advisor and mentor, has a splendid vision of what a rich environment graduate school is supposed to be.

I served as a representative of math grads in the Graduate Student Council for two years, which helped me understand the process of democratic debating, and public officials' legislature and executive actions on behalf of their constituents in the American system.

I played and coached with the FSU Water Polo club team, and the many tournaments I attended and the friends I made have left a lasting impression. I keep a picture of my FSU H2O team on my desk at UCLA. I also lucked out in going to FSU by meeting a bright and beautiful girl, Magdalena, then a chemistry graduate student. She is now my wife – and a post-doc in Molecular Biology at UCLA.

How would you describe your professional activities since FSU?

I received an NIH-NIMH fellowship in neuro-imaging, and joined UCLA's Laboratory of Neuro-Imaging (LONI) in '98, where my graduate research had direct applied to medical imaging and brain mapping. LONI conducts frontline research in brain imaging and quantitative analysis of stereotaxic brain data. Last summer, I was an assistant professor of Mathematics at UCLA. Occasionally, I teach classes in Computing at the UCLA. And I am a research scientist at the UCLA School of Medicine. In 1999, I consulted for Eastman Kodak on modeling methods for interactions of molecular

structure and function.

What can you tell us about your current research?

I am part of a multi-disciplinary group of researchers, including clinicians, neuroscientists, physicists, and mathematicians. We develop, test and validate mathematical and statistical models for human brain development, normal aging and dementia. Subjects, from normal and diseased populations, undergo a battery of neuropsychiatric evaluations coupled with a series of non-invasive brain imaging techniques like PET (Positron Emission Tomography) and MRI (Magnetic Resonance Imaging). These imaging data are 3-dimensional scalar, or vector, fields stored digitally on our 100 Tera Byte, 40 CPU, supercomputer. Our engineered models address the following:

- *Skull stripping and brain extraction;* <http://www.loni.ucla.edu/ad/AD_protocol/masking.html>
- *Tissue segmentation (white/gray matter, cerebrospinal fluid);* <http://www.loni.ucla. edu/ad/AD_protocol/ segmentation.html>
- *Volumetric image registration and intensity normalization;* <http://www.loni.ucla.edu/~dinov/WAIR.dir/ WAIR_warp_movie.html>
- *Data visualization, denoising and field inhomogeneity correction;* <http://www.loni.ucla.edu/~dinov/LONI_Viz.html>
- *Statistical analysis of functional brain blood/oxygen perfusion data, and* <http://www.loni.ucla.edu/~dinov/SVT.html>
- *Construction of population-specific deterministic and stochastic brain atlases.*<http://www.loni.ucla.edu/ad/AD_ASVPA.html>

These techniques are applied to assess how, when and why various neuro-degenerative diseases and psychiatric symptoms get manifested. Among the disorders we study in the LONI Lab are child-onset schizophrenia, autism and multiple sclerosis, as well as predominantly adult brain ailments like Alzheimer's and Parkinson's diseases, chronic depression, and insomnia.

The most interesting and challenging part of our research is that no single person or scientific field has a realistic chance of producing satisfactory results in understanding any of these cognitive impairments. Working with researchers from diverse backgrounds is perhaps the only way to achieve any progress. I believe that without the combined knowledge from the fields of mathematics, statistics, physics, neurology and other natural and material sciences, some of these problems may long remain an enigma.

What are your plans for the future?

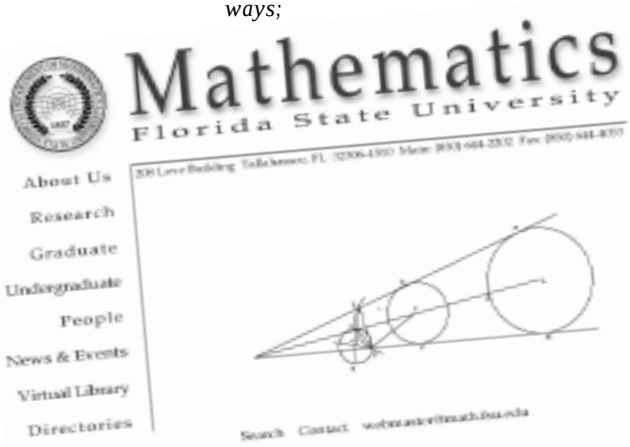
I am developing the theoretical foundation for the first 4D fully stochastic functional brain atlas for Alzheimer's disease. This atlas, which should be completed in 2001, will be constructed in the frequency space (dual to the time domain, where the physical brain data is acquired). The atlas will include anatomical (MRI) and functional (PET) data of 50+ AD subjects, and will allows us to quantitatively evaluate structural and functional temporal changes due to normal aging and dementia in the elderly brain.

I also plan to continue working closely with undergraduate and graduate students in neuroscience, mathematics and statistics in introducing new, and fine-tuning existing, techniques for automated analysis of stereotaxic human brain data. Exciting scientific application problems like the ones we encounter in mapping brain anatomical and functional data could be used as excellent motivation sources for students engaged in applied or theoretical mathematics courses.

Web Notes

Since web-based faculty information is of the utmost importance, it was decided such information should:

- *Be recorded in a database so that data can be presented in various ways;*
- *Be formatted so that faculty can easily maintain and update information, and*
- *Have a consistent, professional appearance.*



In response to this, we now have a faculty information database. Maintenance tools have been made available to the faculty, and a new look has been developed for individual pages.

This technology allows faculty to keep their information current, visitors to the Faculty Research page (automatically created from the faculty information database) to easily find faculty with particular research interests, students to obtain instructor contact and course information, or researchers with common interests to find each other!

Our web master, Kevin Beason, is making progress on web redesign. Recent additions include an online form for graduate applications, the most recent step in our goal of a completely automated graduate application process.

After completing the form online, an applicant receives an automated e-mail response confirming receipt of the application. It is simultaneously e-mailed to the Graduate Committee Chair and staff assistant, where it initiates the candidate's official application folder. Implemented in October, the online form has been used by over 100 prospective students.

Other ideas are in the works, so stay tuned.

http://www.math.fsu.edu

Many of our graduates have kept in touch with the Department, and we invite all other alumni to do the same. In fact, we are in the process of creating an alumni database and would be happy to include your returned contact information on website alumni@math.fsu.edu.

Keep Us Posted!

We'd like to hear from you! Please return this form, with a note about your present affiliation, to the address below.

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Address _____

FSU Degree(s) _____ *Graduation Date(s)* _____

Employer _____

Your News _____

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Introducing...

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Associate Professor
see page 1

Wilbur Stiles
Associate Proffesor & Director of Basic Mathematics
see page 6

Kevin Beason
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