

THE OFFICIAL UNDERGRADUATE NEWSLETTER OF THE VANDERBILT  
BIOMEDICAL ENGINEERING DEPARTMENT

# BMEPULSE

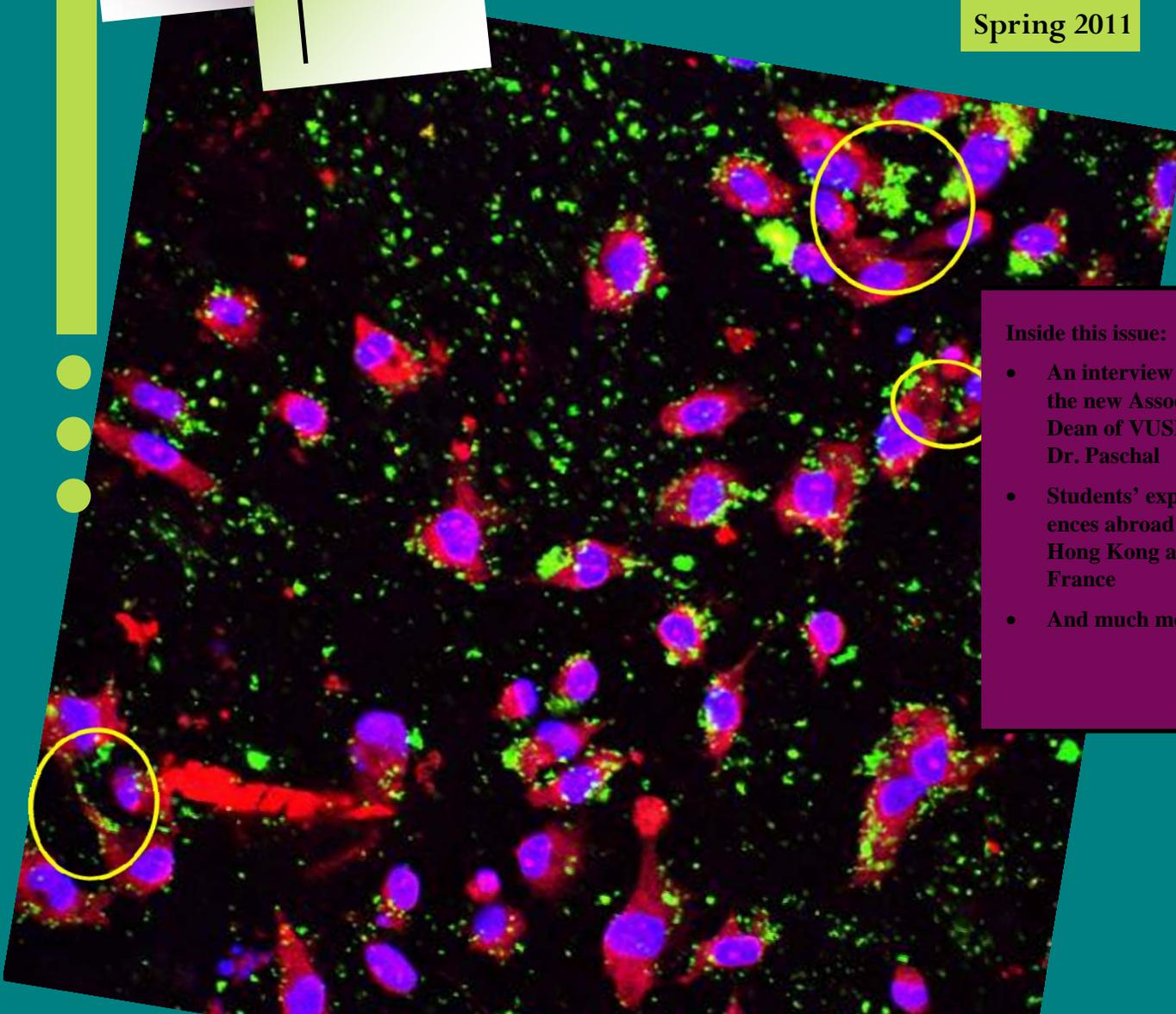


Volume 3, Issue 2

Spring 2011

#### Inside this issue:

- An interview with the new Associate Dean of VUSE, Dr. Paschal
- Students' experiences abroad in Hong Kong and France
- And much more!



The activation of endothelial cells (VCAM - red) towards blood vessel formation (tube formation - yellow) in the presence of inflammatory processes (phagocytosis - green) was controlled through bioactive hydrogels that were engineered using combinatorial polymers with synthetic peptides.

~ Dr. Hak-Joon Sung, Ph.D.  
Assistant Professor of BME

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## LETTER FROM BMES STUDENT PRESIDENT

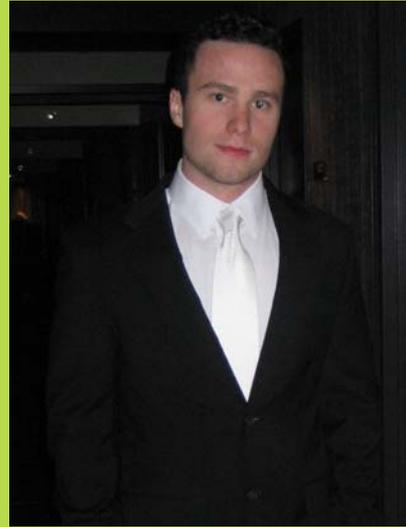
A part of the national Biomedical Engineering Society (BMES) mission statement reads: “Promoting the education and diversity of the next generation of biomedical engineers, providing guidance for their career path...” Our student society’s vision runs parallel to this declaration. Our mission is twofold: to promote the growth of biomedical engineering knowledge and its utilization and to bring together students and industry leaders to develop key contacts and relationships for the future.

The Biomedical Engineering Society at Vanderbilt University is a student-run undergraduate organization open to all undergraduates studying biomedical engineering. With national chapter recognition, we provide members with online access to multiple scientific journals, access to job and resume posting on the BMES Career Center, as well as the ability to submit abstracts for awards and recognition, all in an attempt to provide our members with optimal research material and networking options for pursuing future careers in biomedical engineering.

Our organization strives to benefit students of each class. Underclassmen received invaluable advice concerning BME courses through our *Introduction to BME Electives Seminar* and our recently developed *BME Mentor Program*. As one of the most highly regarded research groups in the world in the area of biomedical imaging, we toured the VU Institute for Imaging Science, giving members an opportunity to network with professors and acquire research positions. As many of our members intend to acquire medical degrees, we co-offered a shadowing program between BMES and physicians at the Vanderbilt Medical Center. In order to provide vital information about higher education, our society held a *Graduate School Information Session* in which professors and graduate students relayed feedback and advice concerning the application and interviewing process. In addition, we stimulated interest in industry through an interactive seminar with National Instruments.

Along with the continuation of these benefits, our society has worked with the Career Center to organize the first annual Spring Career Fair including visits with employers interested in hiring our members. We will be distributing BMES T-shirts as a source of fundraising and have set a goal to participate in philanthropic service where our members’ engineering background can shine. I welcome you and invite you to join the Biomedical Engineering Society at Vanderbilt University and take advantage of the benefits it has to offer. Contact me any time with comments, questions, or concerns at [troy.e.brown@vanderbilt.edu](mailto:troy.e.brown@vanderbilt.edu).

Best,  
Troy Brown



## AN INTERVIEW WITH DR. CYNTHIA PASCHAL

BY MOLLY COWAN

*I had the pleasure of interviewing Dr. Cynthia Paschal about her new position as an Associate Dean of the School of Engineering. In addition to her new title, Dr. Paschal is Associate Professor of Biomedical Engineering and Associate Professor of Radiology and Radiological Sciences.*

**So as the Associate Dean, what are your responsibilities?**

*My responsibilities include international activities for the school such as facilitating study abroad for our engineering students. It also involves assisting faculty members who are working with collaborators in other countries and who want to set up more formal arrangements. I would be called in to facilitate those arrangements.*

*I am also a liaison to the Career Center. I meet very frequently with the folks in the Career Center, so I have gotten to know them and their operations really well. I am still learning! To me, being liaison to Career Center falls under a greater umbrella of professional development of our students. Many of our students go on to graduate school instead of going into industry. Preparing for graduate school is very important, so I have information sessions about graduate school and was thrilled that BMES had one. Next year, I want to work with the societies to coordinate so we can make multiple sessions for all the societies and make them thematic.*

*Additionally, I am responsible for matters involving the School of Engineering's Committee of Visitors, which is an advisory board. These are major leaders from industry, people who are in wide variety of industries and high level positions. They come to Vanderbilt to help us know what is going on in the industry on the national landscape of engineering and we share with them the challenges we are facing. They provide*

*us with valuable feedback.*

**What are your plans and goals as the new Associate Dean?**

*We are hoping that we can get at least 20% of our undergraduates studying abroad one way or another. This year's graduating class is at 13.1%, which is well above the national average for engineers, but you know we would like to get that higher. I definitely want to increase student satisfaction with career services, which is part of the reason I am working so closely with the Career Center.*

*Also, along those lines, our sophomores and juniors don't have a formal exposure to the career planning process. As freshmen during ES 140, you get a little information about the Career Center and its services, but very little other than that. The next VUSE-wide formal exposure to career planning comes in the Senior Design course. Not all VUSE majors require the Senior Design seminar and, in terms of career planning, it is rather late in a student's time at VUSE. Where our students quite honestly do not excel right now is in realizing how much they need to do in their own career preparation, especially in the sophomore and junior years. There are a few that get it, and they are the ones who end up with good placements. We need to change the culture. I am starting to look at career preparation practices at other universities. It has been suggested that we create a career prep course. I'm exploring the idea.*

**If a student has issues about careers or study abroad, what should they do? Should they come to you first?**

*The first person to start with is always the academic adviser. The academic adviser will know that student better than I will. They will understand how well they are on track and if their progression to degree has any special con-*

## (CONTINUED)... AN INTERVIEW WITH DR. PASCHAL

siderations with respect to planning to make it happen. Then come to me.

When it comes to study abroad, there are certain resources I would really like students to take advantage of before they see me. One is the Global Education Office. Every Tuesday and Wednesday, they have Study Abroad 101 sessions, at 4:10 pm in 109 in the Student Life Building. They just go over the basics of study abroad and that can be awfully helpful. This is a great resource that is going to answer many questions. Then, the student and I can talk about what part of the world, and what university might be the right fit. So students should talk to their academic adviser, go to a Study Abroad 101 session, then we are ready to get to work. Also, don't forget the School of Engineering website also has information about study abroad and can be quite helpful because it lists out the different universities our students can go to and some sample curricula.

### **Do you have any involvement with study abroad programs, such as VISAGE?**

I have an interest for students to apply their engineering skills while abroad. I ended up creating a course that does not have a permanent course number right now but has a central focus of spending spring break in Guatemala working on medical equipment in medical facilities. In its first offering, the class met an hour a week before spring break and then would spend all time during spring break. I didn't want it to be a burden; I just wanted people to be prepared. I had someone come from the Health Center to talk about international health and vaccines and they were wonderful. I had a Guatemala expert come in and talk about the history. Before the second offering, it became apparent it would be helpful to have the students more prepared. So we had the same topics and presentations but they were also

allowed to engage in understanding the different pieces of medical equipment they could potentially be working with. We could test the equipment and see it. It was similar to a lab, but more practical.

I also work very closely with an organization called the Shalom Foundation. It's great: they are Nashville-based but focused on Guatemala. I could not have done this without them. They were invaluable and arranged for some things that would have been a logistic nightmare. In addition, I made valuable connections with a university there and met faculty. Vanderbilt students are very generous of heart and obviously, our School of Engineering kids are really smart. You put that together and you have a wonderful combination. You have smart, well-trained students with big hearts. A perfect combination.

### **Do you have any closing remarks or advice you would offer to VUSE students?**

Figure out where your profession and passion intersect. That's really key. Then ... take charge in the job search. That will produce results. I would be delighted to talk to anybody about it. Talk with your adviser first and then come see me.



Dr. Cynthia Paschal  
(VUSE Faculty Directory, 2011)

# DESTINATION: HONG KONG

BY AMANDA CHEN

Aside from the rigorous classes and hours spent toiling away at problem sets, one of the many woes experienced by the average Vanderbilt BME student is the inability to study abroad. The sites for BME students are fairly limited in comparison to those available for other majors, and many find it difficult to squeeze in a semester abroad with the abundance of major and minor requirements. However, with the help new Associate Dean Cynthia Paschal, the study abroad options are steadily expanding. Last semester, during the second half of my junior year, I was fortunate enough to have been the guinea pig to travel abroad to the City University of Hong Kong.

## THE PLACE

City U is located in a wealthy and peaceful (relatively so) area of Hong Kong. In general, the city is densely populated and compact, making travel among destinations within city limits fairly quick. There was never a dull moment during the semester; when we were tired of our immediate surroundings, we would hop on the subway or ferry and travel 45 minutes to one of Hong Kong's beautiful islands to hike or learn about life in the small villages.

Almost every weekend, groups of exchange students would travel to a new region of Southeast Asia. Name any country and at least one exchange student is guaranteed to have gone there. Hong Kong is very conveniently situated, with many areas simply a train or short plane ride away (a 40-minute subway trip, and you're in mainland China; a 1.5-hour plane ride, and you're on the beautiful beaches of the Philippines).

## THE PEOPLE

With neither a fellow Vanderbilt student nor acquaint-

ance at the very least, I was more than a little anxious upon my arrival in Hong Kong. My initial shock over traveling solo in a foreign country for the first time was further enhanced when I discovered I would be living with a local Hong Kong student. In total, there were more than 200 exchange students from various countries, so I had anticipated being placed with an equally bewildered newcomer. Not only was my roommate a local student, but so was nearly everyone in my hall, which proved to help me tremendously as the semester wore on. I gleaned valuable tips regarding Hong Kong life and really enjoyed the time I spent with these students whose lifestyles were so different from mine.

Perhaps my favorite aspect of the trip was the diversity of the exchange students. In fact, only one of my close friends was from the States. While I learned a great deal about MRIs, CT scans, and physiology of the human body in my classes, I also walked away from Hong Kong with invaluable knowledge regarding life in Australia, New Zealand, Singapore, Korea and England.

## WHY CITY U?

The general enthusiasm characteristic of both City U and the other exchange students was overwhelming.

The exchange program director coordinated a variety of excursions for us, from trips to restaurants to take shots of snake blood to five-hour grueling hikes on the islands. Unlike many other study abroad programs, exchange students are fully immersed in Hong Kong culture through living and taking classes with local students. I'm sure I speak for most, if not all, who have spent a semester abroad when I say that the experiences I had and friendships I made were worth the sporadic bouts of homesickness and minor difficulties with adjusting to some of the cultural norms.



*Amanda Chen (left) posing for a picture with friends in Hong Kong.*

How does the meal plan work? Will I be able to make an A in any of my classes? Where am I? What if I don't get along with my roommate? What if I don't make any friends? These are questions most incoming freshmen have during their first few weeks at Vanderbilt.

Everyone at Vanderbilt has had the same concerns at some point. However, when

## FRESHMAN WOES

BY KATIE IVY

students find their niche at Vanderbilt, they start asking the hard questions.

After settling down and getting into the daily groove, the students in the Freshmen BME engineering seminar began to wonder about their major and how their predecessors handled the curriculum and medical schools. The following is a set of questions from students in ES 101 that were answered by BME seniors.

### When do students apply to medical school?

Most students apply in the summer before their senior year. The AMCAS application can be submitted in June through first semester but it's best to get your application submitted as early as possible because it takes a while (4-6 weeks) to process. If you have questions about the process talk to Karen at the Health Professions

Advisory Office (HPAO) or look up a medical school application timeline for the school(s) you are interested in.

### How many times did pre-med students take MCATs typically?

Usually once is enough but there are a few people who take it again and improve their score simply from being less stressed the second time around. That is why it is important to schedule it early and with a study plan in mind. Students who prepare for the exam second semester of their junior year should take it around May if they think they might have to take it again as scores are released over a month after the test date. However, this is at the expense of studying for it throughout the summer and taking it in late June or into July where they might be more prepared but wouldn't necessarily be able to take it again.



### Favorite class taken in the BME curriculum?

Different students have different favorites based on their interests and their approach to learning. Not including electives, many students really enjoy Biomedical Instrumentation taught by Dr. Galloway because it is the first class that offers hands-on engineering.

### Why is Sophomore year for BME so difficult?

While some people think sophomore year is another weed-out year, it isn't intended to be. I would say sophomore year is more difficult because it is the first exposure to significantly more new terms compared to the familiar jargon of basic science courses taught in freshman year. Fortunately, once your vocabulary of biomedical terms and formulas increase, the courses aren't as daunting junior and senior year (or you get used to the workload). You also get to explore more electives junior and senior year which make it more appealing.

### What are possible minors that fit in really well with the BME curriculum?

If you are pre-med, a chemistry minor is easy as it only requires a few more hours of courses beyond organic. Most minors are possible, you just have to plan ahead early. If you are thinking of going into industry, a management or economics minor could be helpful. Either way, if you are

BME and looking for a minor make sure it is in something you're interested in and not just a minor for its own sake. Otherwise, it wastes a lot of your rare free elective hours and can hurt your grade point average (GPA).

### How relevant are the engineering modules to actual engineering?

Not sure, we're still seniors so you'd have to ask graduates who do actual engineering. Also I think the modules have changed since our freshman year but I assume they have the same purpose in mind; that is, to tease out your engineering interests, give you a taste for a rudimentary engineering problem, and show you that engineering concepts are cross-disciplinary. If you don't like the modules, though,

don't fret. The modules have an answer and format in mind. In the real engineering field you'll have to come up with creative solutions using your bag of engineering tools which will be a lot more fun and rewarding.

### What are some of the easier writing courses we can take?

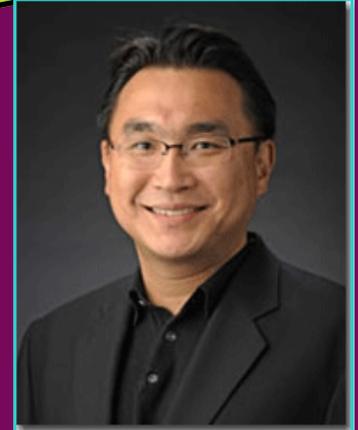
The beginning English courses like 102W are what most students take, but a lot of BME students have said Intro to Poetry is one of the easier courses. Keep in mind that most of what constitutes an 'easy' writing course is having a reasonable teacher who grades nicely (has tenure) and doesn't test you on obscure 17th century British passages...So the best advice is to ask around for who had a good teacher.

## BIOMATERIALS RESEARCH LAB OPENS ITS DOORS TO PROSPECTIVE BME STUDENTS

BY MEHER JUTTUKONDA

The Vanderbilt University School of Engineering (VUSE) Open House is a program for incoming students who have been admitted into VUSE and want to have a closer look at Vanderbilt engineering and the university as a whole. The morning events included presentations by the different engineering departments, as well as a student panel that answered questions raised by prospective students and their parents. Later in the day, the guests were divided into groups based on their major of interest and led by student volunteers on a tour of campus. Professors from various labs organized a few of their graduate students to give demos and presentations of ongoing projects.

The tour given to the BME prospective students included a stop at the Duvall-Sung research lab. The Duvall-Sung research lab is led by Dr. Craig Duvall and Dr. Hak-Joon Sung and consists of four graduate students, four undergraduates, a Postdoctoral Research Fellow, and a lab technician. Since the lab is fairly new, this was their first time organizing a tour for the Open House. Two of the graduate students who interacted with the prospective students at the Duvall-Sung lab were Chris Nelson and Rucha Joshi. They sat down with me to talk about their research and the presentations they gave during the tour as well as



Dr. Craig Duvall and Dr. Hak-Joon Sung  
(Vanderbilt VUSE Faculty Directory, 2011)

their impression of the Open House program.

When asked about the type of research that goes on at the Duvall-Sung lab, Chris replied that the main focus is on the synthesis and characterization of polymers and their interactions with cells *in vivo*. Chris and Rucha presented their research to the Open House students by demonstrating a real world application — synthesis of vascular grafts (a patch on a blood vessel). The presentation had three stages: biomaterial synthesis and characterization, biomaterial manufacturing, and tissue culturing and microscopy. In the synthesis and characterization stage, Chris talked about the necessary laboratory equipment, such as fume hoods, and about relevant chemical processes, such as synthesis and isolation techniques of the polymer. At the manufacturing stage, an electrospinner developed by the senior design team working with Dr. Sung was used. This demonstration revealed how to form a scaffold on a surface by using a

high voltage to force a polymer down an electrical gradient. For the tissue culturing and microscopy stage, a scaffold was displayed and viewed via microscopy to show how cells grew on distinct layers of the material.

Along with pre-...  
...senting to the touring groups, Chris and Rucha also answered any questions. Chris said prospective students asked very educated questions and that parents knew and asked about some of the lab equipment that went beyond the scope of the presentation. Also, Chris indicated that the students had a high interest in getting involved in research early in their college career. Rucha commented that the students seemed very interested in the ongoing research. Furthermore, many students asked her questions about what BME exactly was and were interested in knowing about all of the disciplines within BME.

When asked about their impression of the Open House, Chris responded, "It seems like a good idea. It gives the students an idea of what kind of research is going on and also a chance to meet some of the professors and some of the graduate students who might be their TAs." Rucha said, "I thought it was fantastic and I hope that it results in more and more biomedical engineers in the future."

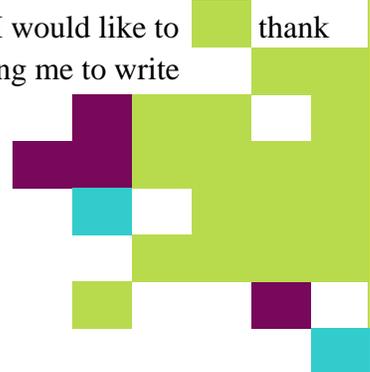
Speaking of the future, Dr. Todd Giorgio, Chair of the BME department, mentioned that one of the big attractions for the prospective students at the Open House was a poster presented by Dr. Cynthia Paschal, the new Associate Dean of VUSE. The poster contains up-to-date infor-

mation about Vanderbilt BME graduates and their desti-

nations following graduation. After hearing this, I inquired about what Dr. Giorgio says to prospective students and parents who choose BME solely as a preparation for medical school. Dr. Giorgio replied, "I give a talk early in the day and one of the things I say is that our program is not Biomedical Engineering but 'Engineering, Biomedical' and that we are founded on all the same quantitative disciplines (such as math, physics, and chemistry) as all the other engineering branches with the additional emphasis on biology as a focus as opposed to as the whole scope of the curriculum." Therefore, incoming BME students should expect and be prepared to take several courses in math, physics, and chemistry.

Both a former attendee of the Open House and a volunteer for the program this past year, I agree with Chris and Rucha that the program is an excellent idea. This invaluable tool gives prospective students insight into what VUSE is all about and helps them make the important decision of whether or not the school is a good fit. I would like to thank Dr. Duvall for allowing me to write about his lab and Dr. Giorgio, Chris, and Rucha for taking the time to talk with me.

**(CONTINUED)...BIOMATERIALS RESEARCH LAB...**



## VUIIS IMAGING CENTER

BY JOSHUA SHANNON

For many BME undergraduates interested in performing research, there seems to be an enormous amount of options to choose from. One could study biomaterials, biomechanics, or even health care. Those interested in imaging, however, are especially fortunate because there is a tremendous resource right here on campus that allows them to undertake cutting-edge research with state-of-the-art equipment alongside skilled faculty. This resource is the Vanderbilt University Institute of Imaging Science (VUIIS).

VUIIS was formed in 2002 and is one of the leading research facilities in the nation for imaging science. Since imaging science covers a broad range of topics, there are four main centers at VUIIS that concentrate on different aspects of the field. These centers are mainly focused on human studies, small animal imaging, cellular and molecular imaging, and image analysis.

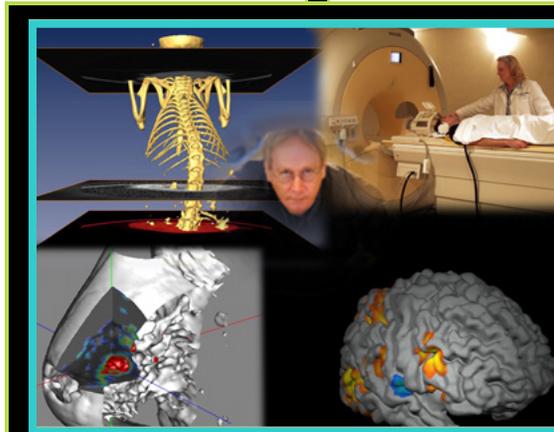
Several different imaging techniques are implemented at the Institute. Each technique offers advantages and disadvantages, along with unique insights into the organism being studied. For instance, X-ray Computed Tomography uses X-rays that irradiate the tissues from different perspectives to provide a high spatial resolution between hard and soft tissues. On the other hand, PET and SPECT imaging provide images with very high sensitivity but low resolution by using radioactive materials to

target tissues with specific properties. VUIIS also has MRI/MRS machines that use very high magnetic fields that provide excellent spatial resolution to a wide variety of tissues and organs, such as the brain. The Institute uses the latest ultrasound technology for real-time guidance. This is accomplished by using high frequency sound waves to form an image, similar to the way a bat uses echolocation to navigate the corridors of a cave. This wide variety of powerful imaging techniques can be used to explore the insides of living organisms without ever having to pick up a scalpel.

In order to perform novel research, the latest in high-tech imaging equipment is needed. Subsequently, VUIIS has spent millions of dollars on the most advanced imaging tools. For example, VUIIS is in possession of a 7 Tesla human MRI scanner that is one of only a handful in the world. This scanner is powerful enough to scan humans for minuscule tumors, and provides the incredibly high resolution needed for certain research. Also, VUIIS has recently acquired a vertical bore MRI scanner, which allows a subject to sit upright during a scan instead of lying down. These are

just a few examples of some of the very powerful (and very cool) tools that faculty have on hand at VUIIS.

There are various fields of imaging research that an undergraduate can get involved in at VUIIS. In fact, VUIIS has several ongoing scientific programs, including neuro-imaging and spectroscopy, cancer imaging, cellular and molecular imaging, as well as physiologic and metabolic imaging. If you are interested in being a part of this exciting research, you can visit their website at <http://vuiis.vanderbilt.edu>. Email



Assorted Images from VUIIS website, 2010



or call a faculty member to set up an appointment! Freshmen searching for early exposure to research could work during the semester or over the summer. Juniors and Seniors could conduct their own investigations over the semester for credit as part of the BME 240 course. Either way, VUIIS provides an invaluable opportunity to work at a cutting-edge facility here at Vanderbilt.

## SCIENCE ON THE SEINE

BY CHELSEA SAMSON

After his discovery of the rabies vaccine, scientists sought Louis Pasteur as a research mentor, catalyzing the creation of the Institut Pasteur in Paris, France. The tradition of scientific training and education in the field of infectious disease continues with the Pasteur Foundation Summer Internship Program. I was intrigued upon discovering a program that combined scientific bench research and international travel to Europe. After applying, I found myself flying to the City of Light last May to conduct research in the Plate-Forme Imagerie Dynamique for 10 weeks. An incredible destination for art and culture, Paris also has an unexpectedly vibrant scientific community.

With the mentorship of scientists from across the globe, I custom built imaging equipment for use during our experiments to develop a new method for improving whole-animal imaging using bioluminescence. Bioluminescence imaging has been a useful research tool in the past for monitoring things like infection or tumor growth progression. However, the limitation for *in vivo* testing has been the low light levels reaching the detector due to losses from absorption and scattering in tissue. This can be avoided by using red light wavelengths. Using a light source, like luminescent bacteria, in conjunction with a tunable

fluorophore, like quantum dots, one can shift the light into the red. We proved that this can happen without binding the light source and fluorophore.

I was granted a lot of independence and input, quite typical for interns in French labs; I saw the project through from initial design to publication. The international assemblage of researchers at the Institute from over 70 countries encourages collaboration. Exposing young researchers to such a laboratory setting fosters an attitude of cooperation and sharing that they will continue to implement throughout their scientific careers. No matter what country you work in or visit, there are always people who are ill or need help. The biomedical language is universal and I believe that greater progress can be made when we train our researchers to think about science in global terms, instead of competition.

*If you would like to read more about Chelsea's summer adventures in France, please read her blog: [science-on-the-seine.blogspot.com](http://science-on-the-seine.blogspot.com)*

*Details about applying for the Pasteur Foundation Summer Internship Program can be found here: [pasteurfoundation.org/internships.shtml](http://pasteurfoundation.org/internships.shtml)*



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## SUPPORTING BME

The Biomedical Engineering Program at Vanderbilt is continually striving to be the very best biomedical engineering program in the country. Your support will help us achieve that objective. Please consider donating to the program—this will directly impact the resources for our undergraduates, the quality of the cutting-edge research taking place here in our laboratories, and ultimately the visibility of this very unique program.

- Todd D. Giorgio, Ph.D.  
Chair of Biomedical Engineering

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