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**ON THE COVER**  
A magnetic resonance imaging (MRI) brain scan rendered in three dimensions using the revolutionary Magnetization-Prepared Rapid Gradient Echo (MP-RAGE) technique developed by 2009 Edlich-Henderson Inventors of the Year John P. Mugler III, Ph.D., and James R. Brookeman, Ph.D.  
*Photo by Jackson Smith*
Not unlike the many talented inventors featured throughout this publication, the University of Virginia Patent Foundation has itself been a part of many exciting new developments this year. Of particular note, over the past several months, the Patent Foundation has been involved in discussions with the University’s vice president for research and other administrators concerning new directions for technology commercialization at the University. We are working with the University to develop an enhanced and integrated program for technology transfer and ventures that will best serve the needs of our faculty, staff and student inventors and entrepreneurs.

In the meantime, we’ve enhanced many of our own offerings. This spring, we debuted our new Web site, accessible at www.uvapf.org. In addition to being much easier to navigate, the new site includes all-new content tailored specifically to our inventors and to members of industry. UVa. inventors, for example, can easily access our streamlined disclosure forms at www.uvapf.org/disclosure. And industry representatives can browse the very latest in Patent Foundation technology licensing opportunities using the dynamic tool at www.uvapf.org/technologies. If you haven’t already visited the site, we invite you to check it out and let us know what you think.

Now in our fourth decade of dedicated service to University inventors, we remain committed to advancing UVa.’s groundbreaking discoveries to the global marketplace. In fiscal year 2009, researchers and clinicians throughout the School of Medicine, the School of Engineering and Applied Science, the College and Graduate School of Arts & Sciences, the Office of the Vice President for Research and the School of Nursing disclosed 162 inventions to the Patent Foundation. Despite the tumultuous economy, the Patent Foundation advanced 57 such inventions to companies, bringing the discoveries a large step closer to the marketplace, and a record-breaking 25 U.S. patents were issued to UVa. inventors.

We congratulate our inventors on their many technology-transfer successes this year and look forward to the exciting changes ahead.

Miette H. Michie
Interim Executive Director and CEO
University of Virginia Patent Foundation
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As recently as a decade ago, physicians ordering a magnetic resonance imaging (MRI) scan of a patient’s brain typically reviewed results rendered in only two dimensions. Results were viewed on a series of films held up to light-boxes, with each film representing sets of half-centimeter-thick “slices” of the brain. Important details of tumors or other maladies not adequately captured in any of these relatively thick slices could go unnoticed, and untreated.

Although they didn’t yet know it, what physicians needed was the ability to review MRI results in three dimensions, representing thinner slices and viewable from any orientation. Happily, today — to borrow a common marketing phrase — “There’s an app for that.”

“Just as Apple® does with the iPhone™ and apps,” says James R. Brookeman, Ph.D., “major MRI manufacturers like Siemens have developed software tools and research partnerships that allow groups like the University of Virginia to essentially write applications for MRI scanners.”

Brookeman and John P. Mugler III, Ph.D., professors of radiology and biomedical engineering at UVA, have done just that. The researchers’ innovative pulse sequences, which essentially serve as instructions that tell MRI machines how to operate and collect data, have been implemented in the machines of major industry MRI equipment manufacturers.

Mugler and Brookeman’s leading technology in terms of commercial and societal impact thus far is a fast, 3-D pulse sequence technique referred to as MP-RAGE (Magnetization-Prepared Rapid Gradient Echo).

Prior to MP-RAGE, early 3-D MRI techniques required approximately 10 minutes to obtain enough data to render 3-D images with sufficient detail for many important applications. Consequently, these early techniques proved impractical, and 2-D acquisitions remained the norm.

“With conventional MR imaging methods, the patient has to remain still in order for the images to be clear,” Brookeman says. “But after 10 minutes, even healthy people have to move.”

“We worked to make 3-D MRI technology faster, with higher resolution and other important improvements, making it possible to acquire 3-D images with desirable contrast on the order of five minutes,” Mugler adds. “Suddenly, it became practical to take 3-D images.”

The researchers’ improved pulse sequences yielded images that were more detailed and thus more likely than their predecessors to reveal subtle abnormalities, providing for earlier and more accurate diagnoses. And unlike 2-D acquisitions, 3-D MP-RAGE produces detailed images that
can be viewed from any orientation on modern computer workstations.

Although the U.Va. Patent Foundation received an issued patent on this technology in 1993, it wasn’t until some years later that companies were first willing to adopt MP-RAGE for their scanners. Back then, Brookeman says, MRI manufacturers were skeptical of the technology, fearing information overload. In contrast to the 15 or so half-centimeter-thick slices rendered by traditional 2-D techniques, MP-RAGE rendered the equivalent of 128 one-millimeter-thick slices of the brain for each of the three dimensions. Even one experienced neuroradiologist told the researchers at the time, "That’s too many slices!"

“The field just wasn’t ready for routine 3-D imaging at that time,” Brookeman explains. “For our technology to be adopted, two things had to happen: First, computers had to develop enough to support 3-D functionality, and second, those who had grown up playing with Atari® and Nintendo® had to become doctors.”

The Patent Foundation has since licensed the patent rights to Siemens AG and Koninklijke Philips Electronics NV (Philips). As a result, MP-RAGE is now implemented in MRI scanners in hospitals and research institutions worldwide.

The widespread implementation of the MP-RAGE technique — and its use in such studies as the Alzheimer’s Disease Neuroimaging Initiative, a pioneering series of trials designed to record an array of brain measurements of Alzheimer’s patients — have helped to establish MP-RAGE as a very useful primary standard in 3-D magnetic resonance imaging.

In honor of their groundbreaking work in MRI techniques over the past two decades, the U.Va. Patent Foundation named Mugler and Brookeman the 2009 Edlich-Henderson Inventors of the Year. The highest honor bestowed by the Patent Foundation, the annual Edlich-Henderson Inventor of the Year award recognizes an inventor or team of inventors whose research discoveries have proven to be of notable value to society.

“Through their incredible talent and foresight, Drs. Mugler and Brookeman have made an indelible impact on the field of magnetic resonance imaging,” says Miette H. Michie, interim executive director.
and CEO of the UVa. Patent Foundation. “We are proud to recognize these dedicated researchers as the 2009 Edlich-Henderson Inventors of the Year and congratulate them on their continued success.”

In addition to MP-RAGE, Mugler, Brookeman and colleagues have developed several other innovative MRI techniques. The researchers’ most recent cutting-edge work with hyperpolarized noble gases as MRI contrast agents for the lungs is currently being explored with colleagues at UVa. and in clinical trials by a major manufacturer.

Mugler and Brookeman partly credit the University’s collaborative clinician–scientist atmosphere and research capabilities, such as a research agreement with Siemens AG, for their success. “This type of research couldn’t happen everywhere,” Mugler says. “With all successful new technologies, it’s not just having the idea; it’s also having the right environment in which to practice.”

Mugler and Brookeman have received research funding from the National Institutes of Health, Virginia’s Commonwealth Technology Research Fund, Siemens AG and Nycomed Amersham Imaging (since acquired by General Electric Company).

*Mugler and Brookeman were honored April 13 at the Patent Foundation’s annual awards banquet, which also celebrated those UVa. inventors who received U.S. patents and copyrights in 2008. See page 16.*
The highest honor bestowed by the U.Va. Patent Foundation, the Edlich-Henderson Inventor of the Year award recognizes an inventor or team of inventors each year whose technology has proven to be of notable value to society. Named for U.Va. Professor Emeritus Richard F. Edlich, M.D., Ph.D., and Christopher J. Henderson, the award is a tribute to their enduring support of and commitment to the University and its inventors. Award winners receive a $10,000 cash prize and formal recognition at the Patent Foundation’s annual awards banquet.

AWARD WINNERS

2009  John P. Mugler III, Ph.D.  
      James R. Brookeman, Ph.D.  
2008  George T. Rodeheaver, Ph.D.  
2007  Wladek Minor, Ph.D.  
2006  George T. Gillies, Ph.D.  
2005  Benjamin M. Gaston, M.D.  
      John F. Hunt, M.D.  
2004  Haydn N.G. Wadley, Ph.D.  
2003  William A. Petri Jr., M.D., Ph.D.  
      Barbara J. Mann, Ph.D.  
2002  Joel M. Linden, Ph.D.  
2001  Doris KuhLMann-Wilsdorf, Ph.D.  
2000  Ronald P. Taylor, Ph.D.  
1999  John C. Herr, Ph.D.  
1998  Richard L. Guerrant, M.D.  
      Timothy L. Macdonald, Ph.D.  
1997  Jessica J. Brand  
      Patrice G. Gu yen et, Ph.D.  
      Richard D. Pearson, M.D.  
      Janine C. Jagger, Ph.D.  
1996  Donald F. Hunt, Ph.D.  
      Jeffrey Shabanowitz, Ph.D.  
      George C. Stafford Jr., Ph.D.  
1995  Gerald L. Mandell, M.D.  
      Gail W. Sullivan  
1994  Joseph Larner, M.D., Ph.D.  
1992  Robert M. Berne, M.D.  
      Luiz Belardinelli, M.D.  
      Rafael Rubio, Ph.D.
RESEARCH WITH DIMENSION

BY THE NUMBERS

UVAPF YEAR AT A GLANCE
FISCAL YEAR 2009

INVENTIONS
162 Invention disclosures by U.Va. inventors

PATENTS
113 Provisional patent applications filed
  46 U.S. applications* filed
  25 U.S. patents issued
  203 U.S. applications* pending

COPYRIGHTS
  4 Copyrights registered to U.Va. authors

DEALS
  57 Total deals with companies and institutions

*Includes U.S. designations in Patent Cooperation Treaty (international) patent applications
INVENTION DISCLOSURES
FISCAL YEAR 2009

* All disclosure totals and percentages are rounded to the nearest tenth. Fractional disclosures represent disclosures made by multiple inventors across different schools or departments (e.g., a single disclosure shared equally by microbiology and chemistry faculty would contribute 0.5 toward each department’s total).

** The Department of Biomedical Engineering is shared by the School of Medicine and the School of Engineering and Applied Science. Disclosures are attributed to the school(s) in which the inventors have their primary appointments.
When it comes to medicine, one might consider Shayn M. Peirce-Cottler, Ph.D., a professional problem-solver. One of the University of Virginia’s most prolific inventors, the biomedical engineer has developed a number of innovative tools to assist clinicians in battling some of medicine’s most difficult challenges.

“It’s important to me to engage in invention and develop solutions to help real patients,” she says. “Having that tangible impact on human health is why I became a biomedical engineer.”

Peirce-Cottler’s work with special cells found in fat, or adipose, tissue could have a tremendous impact on the treatment and prevention of many complex medical conditions.

Working with U.Va. plastic surgeon Adam J. Katz, M.D., she has found that these cells — known as adipose progenitor cells — can be used to restore the blood flow vital to organs and tissues. Healthy blood flow is a key component in the treatment of a variety of diseases, among them cardiac ischemia; caused by inadequate blood flow to the heart, cardiac ischemia is the leading cause of death in the United States.

“There are a lot of diseases that result from blood vessels essentially being sick; it’s the common thread among diabetes, poor blood circulation in the limbs, diseases of the retina and cardiac ischemia, which causes heart disease,” says Peirce-Cottler. “We’ve found that these cells are very good at keeping blood vessels thriving.”

Progenitor cells found in adult adipose tissues can differentiate into many different types of cells and are thought to be exceptionally good candidates for therapeutic use. Cells are easily harvested using minimally invasive liposuction, after which they can be processed and enhanced for patient treatment. They can also survive in even the most hostile environments, such as that of a diabetic wound.

The researchers are currently seeking FDA approval to conduct clinical testing on the use of adipose progenitor cells for diabetic wound care. They are also exploring several other avenues for this research, including an innovative device for spraying aggregated cells onto a wound for more effective healing. In addition, Peirce-Cottler and colleagues are working to precondition subpopulations of these cells with enhanced capabilities for certain therapeutic applications.

Among Peirce-Cottler’s many other collaborations is the development of a device that streamlines the insertion of pressure-equalization tubes into the eardrums of children with chronic ear infections, the most commonly performed surgical procedure in the United States. Working with otolaryngologist Bradley W. Kesser, M.D., and pediatrician Meg G. Keeley, M.D., Peirce-Cottler is making this procedure safer and faster by combining the work of four instruments in just one device.

The U.Va. Patent Foundation has licensed the training kit the researchers developed for this device to health-care product supplier NASCO International Inc. As a result, the training kits, which are used to instruct medical students and residents in common ear procedures and diagnostic techniques, are now available to academic institutions and others worldwide.
Anyone familiar with video-conferencing is also likely familiar with its many accompanying perils: Jerky and pixilated video streams, unrealistic lag time, touchy audio and other frustrations abound on the video-conferencing scene.

But these are more than mere frustrations, says Steven M. Boker, Ph.D., quantitative psychologist at the University of Virginia: “All of this creates a feeling of being farther apart.”

To remedy this, Boker and graduate students Timothy R. Brick and Jeffrey R. Spies have developed video-conferencing software that could revolutionize the industry and the user experience. Through the use of what are called active appearance models, fitted to accurately represent the coordinated motions of the face, the researchers are able to deliver high-resolution, three-dimensional (3-D) video-conferencing streams in real time, using inexpensive equipment and very low bandwidth.

The team’s inventive technology is based on a statistical method referred to as principal components analysis. Using this method, the software is able to interpret facial expressions as a function of real life, coordinated movement patterns rather than an infinite number of possible individual motions. This enables the software to use the minimum number of data points required to render a facial expression.

These eight to 15 data points are all that is needed to drive the facial expressions of the active appearance model, a realistic, 3-D rendering of the video-conference participant. As a result, the amount of data that must be recorded and transmitted for video-conferencing — and the bandwidth required — is greatly reduced. The resulting high-resolution video can be transmitted over the Internet using only 50 kilobits of data per second, requiring just 1/20th of the bandwidth of standard video-conferencing software and virtually eliminating the quality problems users have come to expect from the video-conferencing experience.

“By reducing the amount of data that needs to be sent, we can make sure the image you see is smoother and more lifelike,” says Brick. “The added 3-D starts to make it really feel like you’re talking to a person who’s sitting right in front of you.”

All of this enables video-conference participants to feel more comfortable using what has traditionally been a rather awkward medium, according to the researchers. And the more realistic the users’ experience, the more effective their communications become.

“Whether you’re in a business meeting or talking with a family member overseas, a sense of closeness — like being in the same room — is important,” says Spies. “With this technology, video-conferencing can become more like normal, face-to-face conversation.”

In addition to improved Internet video-conferencing, the low-bandwidth technology could make video-conferencing possible on small devices such as smart phones. It could also be used to personalize the video-game industry, allowing users to program various characters or avatars used in games to automatically mirror their own facial expressions. Other potential applications for the researchers’ innovative technology, on which the U.Va. Patent Foundation has filed for international patent protection, include telemedicine, distance learning, personalized advertising and military applications.

STEVEN M. BOKER, PH.D., TIMOTHY R. BRICK AND JEFFREY R. SPIES
PSYCHOLOGY
The U.Va. Patent Foundation honored the 2009 Edlich-Henderson Inventors of the Year and those University inventors who received U.S. patents and copyrights in 2008 at a special ceremony held the evening of Monday, April 13, at the Boar’s Head Inn in Charlottesville, Va.

2009 Edlich-Henderson Inventors of the Year John P. Mugler III, Ph.D., and James R. Brookeman, Ph.D., U.Va. professors of radiology and biomedical engineering, spoke before a crowd of approximately 150 inventors and guests. The researchers were honored for their groundbreaking work in magnetic resonance imaging techniques over the past two decades. For more about the 2009 Edlich-Henderson Inventors of the Year, see page 4.

The Patent Foundation presented 50 researchers with award certificates noting their patented invention or copyrighted work. For a list of the U.S. patents issued to U.Va. inventors in 2008, see the chart on the opposite page.
<table>
<thead>
<tr>
<th>U.S. PATENT NO.</th>
<th>TITLE</th>
<th>U.V.A. INVENTOR(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6,599,935CI</td>
<td>Felbamate Derived Compounds</td>
<td>Timothy L. Macdonald, Ph.D., Christine M. Fandozzi, Ph.D.</td>
</tr>
<tr>
<td>7,315,377</td>
<td>System and Method for Remote Sensing and/or Analyzing Spectral Properties of Targets and/or Chemical Species for Detection and Identification Thereof</td>
<td>Stephen K. Holland, Ph.D., Roland H. Krauss, Ph.D., Gabriel Laufer, Ph.D.</td>
</tr>
<tr>
<td>7,320,870</td>
<td>Ocular Tear Growth Factor-Like Protein (I)</td>
<td>Gordon W. Laurie, Ph.D.</td>
</tr>
<tr>
<td>7,323,542</td>
<td>Bone Targeting Peptides</td>
<td>Gary Balian, Ph.D.</td>
</tr>
<tr>
<td>7,347,825</td>
<td>Device and Method for Assessing Asthma and Other Diseases</td>
<td>John W. Vaughan, John F. Hunt, M.D., Benjamin M. Gaston, M.D., Timothy L. Macdonald, Ph.D.</td>
</tr>
<tr>
<td>7,378,094</td>
<td>Therapeutic Uses of Complement Receptor 2</td>
<td>Ronald P. Taylor, Ph.D., Margaret A. Lindorfer, Ph.D., William M. Sutherland, Ph.D.</td>
</tr>
<tr>
<td>7,378,400</td>
<td>Method to Reduce an Inflammatory Response from Arthritis</td>
<td>Jayson M. Rieger, Ph.D., M.B.A., Donald L. Kimpel, M.D., Joel M. Linden, Ph.D., Gail W. Sullivan</td>
</tr>
<tr>
<td>7,381,471</td>
<td>Hybrid Polymers for Functional Tuning of Microfluidic Device Surfaces</td>
<td>James P. Landers, Ph.D., Jerome P. Ferrance, Ph.D., Joy M. Polefrone, Ph.D.</td>
</tr>
<tr>
<td>7,396,825</td>
<td>Agonists of A2a Adenosine Receptors for Treatment of Diabetic Nephropathy</td>
<td>Mark D. Okusa, M.D., Joel M. Linden, Ph.D., Timothy L. Macdonald, Ph.D., Alaa S. Awad, M.D.</td>
</tr>
<tr>
<td>7,401,643</td>
<td>Heat Exchange Foam</td>
<td>Douglas T. Queheillalt, Ph.D., Haydn N.G. Wadley, Ph.D., Yasushi Katsumi</td>
</tr>
<tr>
<td>7,402,136</td>
<td>Efficient Ultrasound System for Two-Dimensional C-Scan Imaging and Related Method Thereof</td>
<td>John A. Hossack, Ph.D., William F. Walker, Ph.D., Travis N. Blalock, Ph.D.</td>
</tr>
<tr>
<td>7,403,814</td>
<td>Method, Apparatus and Computer Program Product for Assessment of Attentional Impairments</td>
<td>Daniel J. Cox, Ph.D., Boris P. Kovatchev, Ph.D., Raina S. Robeva, Ph.D., Jennifer K. Penberthy, Ph.D.</td>
</tr>
<tr>
<td>7,413,894</td>
<td>TAG-1 and TAG-2 Proteins and Uses Thereof</td>
<td>Kevin T. Hogan, Ph.D., Craig L. Slingluff Jr., M.D.</td>
</tr>
<tr>
<td>7,414,078</td>
<td>Oral General Anesthetics and Metabolically Resistant Anticonvulsants</td>
<td>Milton L. Brown, M.D., Ph.D.</td>
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<tr>
<td>7,419,834</td>
<td>System for Detection of Nitrosylated Proteins</td>
<td>Benjamin M. Gaston, M.D.</td>
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<tr>
<td>7,424,967</td>
<td>Method for Manufacture of Truss Core Sandwich Structures and Related Structures Thereof</td>
<td>Kenneth D. Ervin, Haydn N.G. Wadley, Ph.D.</td>
</tr>
<tr>
<td>7,427,606</td>
<td>Method to Reduce Inflammatory Response in Transplanted Tissue</td>
<td>Joel M. Linden, Ph.D., Kenneth L. Brayman, M.D., Ph.D., Gail W. Sullivan</td>
</tr>
<tr>
<td>7,432,301</td>
<td>Use of S-Nitrosothiol Signaling to Treat Disordered Control of Breathing</td>
<td>Benjamin M. Gaston, M.D.</td>
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<tr>
<td>7,439,383</td>
<td>Sodium Channel Blockers</td>
<td>Milton L. Brown, M.D., Ph.D.</td>
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<tr>
<td>7,442,681</td>
<td>Method of Inhibiting Vascular Permeability</td>
<td>Martin A. Schwartz, Ph.D., Rebecca A. Stockton, Ph.D.</td>
</tr>
<tr>
<td>7,442,687</td>
<td>2-Polycyclic Propynyl Adenosine Analogs Having A2a Agonist Activity</td>
<td>Jayson M. Rieger, Ph.D., M.B.A., Joel M. Linden, Ph.D., Timothy L. Macdonald, Ph.D., Gail W. Sullivan, Lauren J. Murphy, Ph.D., Robert A. Figler, Ph.D., Robert D. Thompson, Ph.D.</td>
</tr>
<tr>
<td>7,459,440</td>
<td>Ocular Tear Growth Factor-Like Protein (II)</td>
<td>Gordon W. Laurie, Ph.D.</td>
</tr>
<tr>
<td>7,460,979</td>
<td>Method and System for Enhanced Resolution, Automatically Calibrated Position Sensor</td>
<td>Zachary Buckner</td>
</tr>
<tr>
<td>7,462,019</td>
<td>Implantable Centrifugal Blood Pump with Hybrid Magnetic Bearings</td>
<td>Paul E. Allaire, Ph.D., Ronald D. Flack Jr., Ph.D., Jeffrey A. Decker, Michael Baloh, Ph.D.</td>
</tr>
</tbody>
</table>
While tissue engineers have made incredible strides in restoring function to many critical organs and tissues over the last decade, one organ has remained particularly elusive: bone.

Bone presents a unique challenge for tissue engineers, says Edward A. Botchwey III, Ph.D., because “with bone, it’s really important to have tissue that can not only successfully integrate with the existing tissue but also provide the strength and functionality of healthy bone.”

When a large portion of bone becomes significantly damaged or diseased, the tissue must typically be replaced either by donated bone tissue, known as an allograft, or by a synthetic bone substitute. Unfortunately, the majority of existing substitute materials currently fail upon implantation or over time. While bone allografts offer many structural and practical advantages over substitute materials, they, too, carry a high complication rate. The difficulty lies in reinvigorating the donor tissue and integrating it with the existing tissue.

Botchwey, an assistant professor of biomedical engineering and orthopaedic surgery at the University of Virginia, is helping to bring these donor bone tissues back to life. He has developed an innovative technique that could significantly improve the success rate for bone transplant procedures.

Botchwey’s technique involves the application of a very thin drug-infused coating to the donor bone’s external surface and throughout its internal porous network prior to the transplant procedure. Measuring just hundredths of a millimeter thick, thinner than a human hair, this coating delivers a healing agent to the bone while leaving its microscopic pores open and free to integrate with host cells.

“In successful bone regeneration, a balance is eventually established among donor and new tissue that is characteristic of healthy bone,” Botchwey says. “We found that this balance was restored much more rapidly with our coating than with any other existing methods, making allografts much more likely to succeed.”

Botchwey developed the novel coating using molecules designed by U.Va. colleagues Timothy L. Macdonald, Ph.D., and Kevin R. Lynch, Ph.D., to mimic naturally occurring drug sphingosine-1-phosphate (S1P). While S1P had previously been shown to promote blood vessel formation, or vascularization, the researchers found it also assisted in bone allografts’ ability to integrate with and adhere to existing bone.

“We’ve essentially developed a new system for delivering therapeutics and identified a particular drug that promotes the bone regeneration, vascularization, integration and remodeling that are so critical to a successful transplant,” Botchwey says.

The U.Va. Patent Foundation has filed a provisional patent application covering Botchwey’s technology and is seeking an industrial partner to help bring it to market, which Botchwey says cannot come too soon for the 2.2 million people worldwide in need of bone graft procedures each year.

“Unfortunately, we’re seeing an increasing amount of battlefield injuries that call for massive bone reconstruction,” he says. “People suffering from these types of injuries, be they members of the military or civilians in car accidents, could benefit tremendously from this technology.”
It may be difficult to fathom, but every time you draft a document, surf the Web or even check your e-mail, you are actually putting yourself at risk for a cyber attack.

Without sufficient security measures in place, "There are all kinds of bad things that can happen," says Jack W. Davidson, Ph.D. "People's identities have been stolen because the software they were using was not secure."

Thankfully, cyber crime-fighters like Davidson and Jason D. Hiser, Ph.D., have your back. The University of Virginia computer scientists are using cutting-edge virtual-machine technology to keep computer users protected — and cyber attackers guessing.

While software developers currently employ a variety of security techniques, such as encryption and code obfuscation, to modify data and program code in a way that makes it difficult to understand, these defenses do not prevent attackers from analyzing how a program runs, thus leaving the software vulnerable to attack. These strategies also can involve special hardware and high overhead costs, limiting their widespread adoption.

Davidson and Hiser have overcome these challenges with the development of a process for continuous obfuscation and anti-tampering (COAT). COAT extends Strata, a virtual machine developed by researchers at U.Va. and the University of Pittsburgh, to protect individual software programs dynamically, inexpensively and with no specialized hardware.

Virtual machines are software applications that essentially serve as command centers for other programs, providing them with operating instructions. With COAT, the researchers are operating within this framework to provide an added, dynamic layer of protection. That is, when COAT runs a program, the program's instructions are modified not just once, as is typical of most software, but continuously for added security.

"COAT makes it very difficult to detect how a program works, because every time you look at the code it looks different," Hiser says. "As a result, attackers are unable to inject or execute malicious code that could hijack your personal data."

Unlike other virtual machines, which serve as a platform for several programs at once, COAT is unique in that it is directly integrated with an individual program, making it difficult to discern where the virtual machine ends and the program begins for added security. Additionally, because COAT is only responsible for running one program at a time, it is more streamlined than existing alternatives, enabling it to efficiently execute a program at its regular speed.

This software has applications in a number of fields in which data security is crucially important, including critical infrastructure and military operations. The technology could also be used to prevent illegal distribution of software or digital media, and to protect end users of software and games. The U.Va. Patent Foundation has licensed the researchers' technology to Cloakware Corporation, an Irdeto company specializing in software technology solutions for the protection of business and digital assets.

"There are so many types of software that we want to trust," Hiser says. "With this dynamic technology, we can feel secure using our software."
UVAPF–COULTER PARTNERSHIP SPURS

TRANSLATIONAL RESEARCH SUCCESS

In early 2006, the University of Virginia’s top-ranked Department of Biomedical Engineering was selected to receive the prestigious Wallace H. Coulter Translational Research Partnership Award. Providing a total of $4.5M in research funding over five years, the award seeks to promote translational research from the bench to the patient’s bedside.

Since the first UVa. projects were funded in 2006, the UVa. Patent Foundation has taken an active role in the assessment, protection and marketing of these promising new technologies — among them medical devices, imaging techniques, diagnostic tools and more. Several of these exciting technologies are already well on their way to the marketplace; the Patent Foundation has licensed many of these inventions to companies, and some faculty–entrepreneurs have formed their own start-ups to bring these discoveries to the public.

Working closely with colleagues from the Coulter program, Department of Biomedical Engineering, Office of the Vice President for Research and other areas across Grounds, the Patent Foundation currently supports the efforts of biomedical engineers and clinicians involved in 20 active Coulter-funded projects. See page 23.

"At the Patent Foundation, we believe it takes a well-coordinated team to bring an early-stage technology to the marketplace, and we are honored to be a part of the Coulter team," says Miette H. Michie, interim executive director and CEO of the Patent Foundation.
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<th>TITLE</th>
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<td>Real-Time Cardiac Stress Testing Using MRI</td>
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<td>Quantitative Unbiased Immunohistochemical Signaling Pathway Analysis (QUISPA): Development and Application of Therapy-Directed Classification of Malignant Gliomas</td>
<td>Jason A. Papin, Ph.D., James W. Mandell, M.D., Ph.D., David Schiff, M.D.</td>
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<td>Adipose Stem Cells for the Healing of Chronic Wounds</td>
<td>Shayn M. Peirce-Cortler, Ph.D., Adam J. Katz, M.D.</td>
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<td>Enhanced Targeting of Adipose Stem Cells to Ischemic Injury</td>
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<td>The Development of a New Cancer Bioassay System Using the Soft-Plate 96 Technology</td>
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<td>Therapeutic Modification of Myocardial Infarct Anisotropy</td>
<td>Jeffrey W. Holmes, M.D., Ph.D., Gorav Ailawadi, M.D.</td>
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<td>CardioSolutions: Technologies for Treating In-Stent Restenosis</td>
<td>John A. Hossack, Ph.D., Brian R. Wamhoff, Ph.D., Alexander L. Klibanov, Ph.D., Michael Ragosta III, M.D.</td>
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<td>Determination of the Need for Blood Platelet Transfusion During Cardiopulmonary Bypass Surgery with an Ultrasound-Based Technique for Real-Time Blood Viscosity Estimation</td>
<td>Michael B. Lawrence, Ph.D., Gorav Ailawadi, M.D.</td>
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<td>Cytokines as Diagnostic Markers for Prediction of Neonatal Sepsis</td>
<td>Jeffrey J. Saucerman, Ph.D., Karen D. Fairchild, M.D., J. Randall Moorman, M.D.</td>
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<td>Kimberly A. Kelly, Ph.D., Todd W. Bauer, M.D.</td>
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<td>Self-Illuminated Handheld Fundus Lens for Examination of the Retina</td>
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<td>MRI-Based Muscle Impairment Diagnostic Tool Applied to the Treatment of Cerebral Palsy</td>
<td>Craig H. Meyer, Ph.D., Silvia S. Blemker, Ph.D., Mark F. Abel, M.D.</td>
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For more about the U.Va.–Coulter Partnership, visit http://bme.virginia.edu/coulter.
After receiving U.S. Food and Drug Administration (FDA) product approval in 2008, University of Virginia biotechnology start-up ContraVac Inc. launched nationwide sales of its SpermCheck® Vasectomy kit this past May. The first in a family of products based on technology developed by U.Va. cell biologist John C. Herr, Ph.D., SpermCheck Vasectomy is a home test designed to confirm a man’s sterility in the months following the vasectomy procedure.

Similar in many ways to a home pregnancy test, SpermCheck Vasectomy uses sperm-specific biomarker SP-10, discovered in Herr’s lab, to determine whether a man’s sperm count has fallen below fertile levels. Because sperm can remain in the male reproductive tract for weeks or months after a vasectomy, monitoring post-vasectomy sterility is important in helping men determine when it is safe to discontinue use of condoms or other forms of birth control. SpermCheck Vasectomy enables men to easily monitor their post-vasectomy sterility in the comfort and privacy of their own home.

Available in physicians’ offices across the country and directly from ContraVac’s Web site, www.contravac.com, SpermCheck Vasectomy kits containing two tests are sold for $39.99. More than 1,600 kits have already been sold throughout the United States, and ContraVac is preparing to launch sales throughout Europe and Canada in the coming months.

“SpermCheck Vasectomy makes post-vasectomy sperm testing more convenient and cost effective for both the physician and the patient,” says Edward J. Leary, ContraVac’s president and chief financial officer. “We are excited to offer this innovative product to the global marketplace.”

ContraVac’s next product, SpermCheck® Fertility, has concluded clinical trials and is currently awaiting FDA approval. Also using the SP-10 protein to determine a man’s sperm count, the SpermCheck Fertility home test determines whether a man’s sperm count falls within the fertile, subfertile or infertile range, in accordance with World Health Organization standards.

A third product, SpermCheck® Contraception, is now being used in a multi-institution study funded by the National Institutes of Health to evaluate the effectiveness of a new contraceptive drug for men. When the first FDA-approved male contraceptive drug or device hits the market, SpermCheck Contraception will allow men using the contraceptive to monitor their sperm count.

“The SpermCheck family of products is intended for use by men on both sides of the fertility equation — those who don’t want to father children and those who do,” says Herr, who worked with U.Va. colleagues to develop the platform technology over the past 25 years. Working with the U.Va. Patent Foundation, Herr and his collaborators have received four issued patents pertaining to the SpermCheck technology. ContraVac, which Herr founded with Leary, has licensed the rights to these patents and is currently raising investment capital to expand its sales and marketing infrastructure.
Spinner Technologies Inc., a for-profit subsidiary of the University of Virginia Patent Foundation, recently welcomed two new U.Va. start-up companies to its portfolio: Alexander BioDiscoveries LLC and UltraGenome LLC. Spinner supports the formation and development of technology companies coming out of the University through investment, mentoring, referrals, inexpensive wet lab space and other assistance of benefit to young companies.

Founded in August 2008, Alexander BioDiscoveries is a biopharmaceutical company committed to the discovery and development of novel drugs to treat viral infections, such as seasonal, avian (H5N1) and swine (H1N1) influenza. Based on technology developed by U.Va.’s Daniel A. Engel, Ph.D., and David T. Auble, Ph.D., the company is developing lead compounds for the treatment of seasonal influenza. The compounds are prototypes of a new class of anti-virals known as “NS-1 inhibitors,” which are designed to prevent the influenza virus from interfering with the body’s immune system.

Founded in August 2009 by U.Va.’s Anindya Dutta, M.D., Ph.D., UltraGenome is a clinical reference laboratory that is capitalizing on the advent of ultra-highthroughput sequencing in the diagnostics market. The company’s services include providing highly complex and unique lab tests for cancer diagnostics, laboratory analytics and an online information system that allows clients to easily access test results, submit statistical data and retrieve secure files.

Spinner currently supports 11 U.Va. start-up companies at various stages of development. In addition, Spinner is now raising funds for the Jefferson Corner Group II LLC, the Charlottesville-based, member-managed “angel” fund it administers. The Jefferson Corner Group provides early-stage investment capital to U.Va. start-ups and other technology companies.
**MY EXPERIENCE AS A UVAPF LAW CLINIC STUDENT AND INTERN**

**Q&A WITH ADAM J. SIBLEY**

When Adam J. Sibley began his internship at the University of Virginia Patent Foundation in summer 2008, he was hoping to supplement his coursework at the U.Va. School of Law with some practical experience in the area of patent law. More than a year later, Sibley, now a third-year law student, has found he got more than he bargained for, including a patent application under his belt, experience in technology licensing, co-authorship of a journal publication and the support of a mentor.

After serving as a law intern, Sibley enrolled in the Patent Foundation’s Patent and Licensing Clinic, offered by the School of Law; he is currently enrolled in the second, advanced clinic. Through its clinic program, the Patent Foundation over the last decade has immersed nearly 150 U.Va. law students in patent drafting and in the negotiation and drafting of patent license agreements.

In the following Q&A, Sibley tells us about his experience as a Patent Foundation intern and law clinic student and how that experience has prepared him for a career in patent prosecution and litigation.

**PATENT FOUNDATION:** How did you first become interested in working as a law intern — and later law clinic student — at the U.Va. Patent Foundation?

**ADAM SIBLEY:** I am planning on practicing patent law, so during the summer after my 1L year, I was looking to do some patent-related work. When I learned about the intern position at the Patent Foundation, I decided to go for it.

After spending the summer as an intern and getting to dig into some really interesting research topics with UVAPF patent attorney Rodney L. Sparks [J.D., Ph.D.], I knew that I wanted to enroll in the clinic; it seemed like a great opportunity to get introductory practical experience in the patent field.

**PF:** What did you enjoy most about your law internship at the Patent Foundation?

**AS:** As an intern, I enjoyed researching the co-inventorship of applied novel chemical compounds with Dr. Sparks. Our work in this area has resulted in a co-authored paper scheduled for publication this year. I consider Dr. Sparks a mentor; he has been a great source of information and advice on how law students should adjust to a career in a private patent firm.

**PF:** And the law clinic?

**AS:** In the first clinic, I was glad to have the opportunity to draft a patent application. This assignment helped me become familiar with a patent prosecution file and gave me a great head start for my summer internship at a private firm.

I also really liked researching neglected diseases with my licensing mentor, Miette H. Michie, to
learn what various organizations are doing to try to increase the commercial viability of associated technologies and treatments. This is not necessarily an issue that is often addressed in a classroom setting, and it was pretty enlightening to learn more about those efforts.

I am presently enrolled in the second clinic, and I’m looking forward to doing various research projects that are of emerging interest in the field, including proposed patent reform.

PF: How has your experience at the Patent Foundation prepared you for the future?

AS: I expect to practice patent law at a private firm, and although I anticipate that I will gravitate toward litigation, the patent prosecution experience I gained from the clinic will be invaluable for this pursuit. In addition, my legal research and writing improved greatly during the summer internship, and I expect those skills will be crucial to any area of the legal profession.

For more information about the U.Va. Patent Foundation’s Patent and Licensing Clinic, please contact Robert J. Decker, J.D., at rob@uvapf.org or 434.924.2640 or Rodney L. Sparks, J.D., Ph.D., at rodney@uvapf.org or 434.243.6103.
FISCAL YEAR 2009

REVENUES AND DISTRIBUTIONS

REVENUES

License fees and royalties $6,347,487
Patent costs reimbursed $1,126,908
Interest income $42,637
Total revenue $7,517,032

DISTRIBUTIONS

Distributions to inventors (see graph) $1,728,839
Distributions to the University of Virginia (see graph) $2,056,407
Other distributions $75,674
Total distributions $3,860,920
Net revenues $3,656,112

U.VA. ROYALTY DISTRIBUTION SCHEDULES

For the latest University of Virginia royalty distribution schedules for patents and software, established by the Office of the Vice President for Research, visit www.uvapf.org/royalties.
DISTRIBUTIONS TO INVENTORS (IN MILLIONS OF DOLLARS)
(Total accumulated distributions to inventors for fiscal years 1978–2009: $20,146,138)

DISTRIBUTIONS TO U.V.A. (IN MILLIONS OF DOLLARS)
(Total accumulated distributions to U.V.A. for fiscal years 1978–2009: $38,671,774)
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MISSION

- To provide accessible, responsive, competent, timely and professional patenting and licensing services to U.Va. and its faculty and staff

- To serve as an efficient and effective conduit for the licensing of promising U.Va. technologies to industry, thus promoting their entry into the commercial marketplace and also generating royalties that can further U.Va. research

- To support and encourage local economic development by licensing locally, by licensing to start-up companies, and by encouraging and supporting faculty start-up activities

- To serve as a resource for information about patents and licensing, and to encourage recognition that such matters have become meaningful and valuable aspects of university life

- To encourage greater integration between academia and industry, thereby improving the flow of innovative university technologies to the public marketplace
FIND OUT HOW FEATURED UVAPF INVENTORS OF 2009 ARE

GIVING NEW DIMENSION TO DIAGNOSTIC IMAGING
PAGE 4

ENGINEERING UNIQUE SOLUTIONS TO COMMON MEDICAL PROBLEMS
PAGE 12

IMPROVING VIDEO-CONFERENCING VIA MODEL BEHAVIOR
PAGE 14

BRINGING BONES BACK TO LIFE
PAGE 18

KEEPING CYBER ATTACKERS GUESSING
PAGE 20