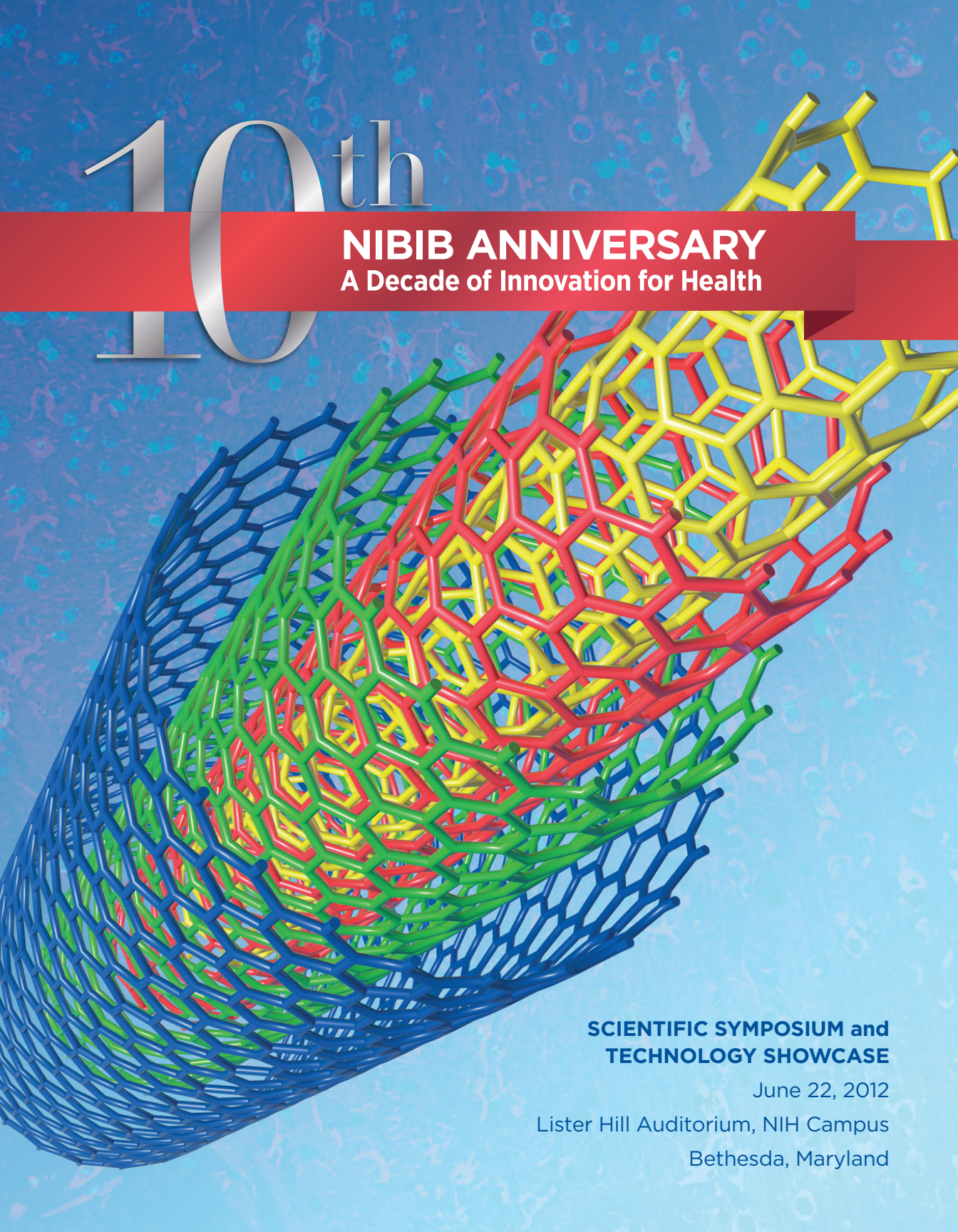

10th
NIBIB ANNIVERSARY
A Decade of Innovation for Health
SCIENTIFIC SYMPOSIUM and
TECHNOLOGY SHOWCASE
June 22, 2012
Lister Hill Auditorium, NIH Campus
Bethesda, Maryland

CONTENTS

WELCOME

On behalf of the National Institute of Biomedical Imaging and Bioengineering (NIBIB), it is my pleasure to extend a warm welcome to the participants and attendees of the Tenth Anniversary Symposium, "A Decade of Innovation for Health."

Since its creation a decade ago, the NIBIB has supported multidisciplinary research and research training at the crossroads of engineering and the biological and physical sciences. Its focus has always been to encourage discovery in imaging and bioengineering, such as MRI, ultrasound, optical imaging, and CT; point-of-care devices; tissue engineering; rehabilitation engineering; and multi-scale modeling.

NIBIB supports innovative research within its internal laboratories and through extramural grants, collaborations, and training. It has enabled researchers in academia, industry, and government to explore new approaches to healthcare solutions, and to provide valuable insights into biology and medicine.

This scientific symposium will inform the public about the current and future potential of technological innovation in healthcare, and highlight the accomplishments of NIBIB-supported researchers. A Technology Showcase with interactive demonstrations of NIBIB-supported bioengineering and imaging research projects will enable attendees to see first-hand developments that have already improved and will continue to enhance the way healthcare is delivered.

I thank you for joining us at our Anniversary Symposium to commemorate 10 years of exciting technology research at the NIBIB. I hope you will find the program stimulating and insightful.

Sincerely yours,

Roderic I. Pettigrew, Ph.D., M.D.
Director, NIBIB

AGENDA

8:00 am	**Registration and Continental Breakfast**	
Session I	***Moderator, Dr. Kenneth Lutchen*** Dean, College of Engineering, Boston University and Immediate Past President of the American Institute for Medical and Biological Engineering (AIMBE)	
8:30 am	**Welcome Address**	*Roderic I. Pettigrew, Ph.D., M.D.* Director, NIBIB
9:00 am	**Vision for Medicine in the 21st Century**	*Francis S. Collins, M.D., Ph.D.* National Medal of Science Laureate Director, NIH
9:30 am	**The 3rd Revolution: Convergence of the Physical, Engineering, and Life Sciences**	*Phillip A. Sharp, Ph.D.* Nobel Laureate, Physiology or Medicine Institute Professor, Koch Institute for Integrative Cancer Research Massachusetts Institute of Technology
10:00 am	*Break* Technology Showcase – Exhibits and Demonstrations	
10:20 am	**NIBIB in Video I: Innovation, Discovery and Health**	
10:30 am	**Advancing the Translation of Science: An Industrial Perspective**	*Jeffrey Immelt, M.B.A.* Chairman and CEO, General Electric Company
11:00 am	**Technological Innovation and Serving the Globe**	*Charles M. Vest, Ph.D.* National Medal of Science Laureate President, National Academy of Engineering
11:30 am	**A Patient's Story I**	*Robert Summers*
11:50 am	*Lunch* Technology Showcase – Exhibits and Demonstrations	

Session II	***Moderator, Dr. Steven Seltzer*** Chairman of Radiology, Brigham and Women's Hospital, Harvard University and Immediate Past President, Academy of Radiology Research (ARR)	
1:00 pm	**NIBIB in Video II: Innovation, Discovery and Health**	
1:10 pm	**Presidential Early Career Award for Scientists and Engineers (PECASE) Presentation: Use of Sensors and Simulation Technology to Quantify Clinical Palpation**	*Carla Pugh, M.D., Ph.D.* PECASE Awardee Vice-Chair of Education and Patient Safety, Department of Surgery University of Wisconsin School of Medicine
1:30 pm	**Featured Research Presentation: Improving Surgery Through Target Specific Molecular Imaging**	*Roger Y. Tsien, Ph.D.* Nobel Laureate, Chemistry HHMI Investigator and Professor of Pharmacology, Chemistry, and Biochemistry University of California, San Diego
2:00 pm	**NIBIB Intramural Science Presentation: New Technologies for High Spatial and Temporal Resolution Imaging of Cells and Organisms**	*Hari Shroff, Ph.D.* PECASE Awardee Chief and Investigator, Section on High Resolution Optical Imaging, NIBIB
2:20 pm	*Break* Technology Showcase – Exhibits and Demonstrations	
2:40 pm	**NIBIB in Video III: Innovation, Discovery and Health**	
2:50 pm	**A Patient's Story II**	*Arthur Cassano*
3:10 pm	**Horizons in Innovation and Health: What the Future Holds**	*Hedvig Hricak, M.D., Ph.D.* Carroll and Milton Petrie Chair Chair, Radiology Memorial Sloan-Kettering Cancer Center
3:45 pm	**Concluding Remarks**	*Shu Chien, M.D., Ph.D.* National Medal of Science Laureate Director, Institute of Engineering in Medicine University of California, San Diego

SPEAKER BIOGRAPHICAL SKETCHES

Shu Chien, M.D., Ph.D.

Shu Chien, M.D., Ph.D., is University Professor of Bioengineering and Medicine in the University of California System and Director of the UC System-wide "Bioengineering Institute in California." At UCSD, he is Y.C. Fung Professor of Bioengineering and Medicine and Director of the Institute of Engineering in Medicine. He was the Founding Chair of the Department of Bioengineering from 1994-1999 and Chair from 2002-2005.

Dr. Chien is a world leader in molecular, cellular and integrative studies on bioengineering and physiology in health and disease. He served as President of many societies, including the Microcirculatory Society, American Physiological Society, Biomedical Engineering Society, International Society of Biorheology, American Institute for Medical and Biological Engineering (AIMBE), and Federation of American Societies for Experimental Biology. While serving as AIMBE President, he worked closely with C. Douglas Maynard of the Academy of Radiology Research to foster the establishment of NIBIB.

He has authored more than 500 journal articles and edited 11 books. Dr. Chien is one of only 10 scientists in the world who are members of all four US National Academies: National Academy of Science, National Academy of Engineering, Institute of Medicine, and American Academy of Arts and Sciences. He is also a member of Academia Sinica in Taiwan and Chinese Academy of Sciences in Beijing (Foreign Member).

Dr. Chien has received numerous awards and honors, including the Landis Award, Zweifach Award, Fahraeus Medal, Melville Medal (twice), Poiseuille Medal, and the Founders Award of National Academy of Engineering. He is the only living Honorary Member of the Chinese Association of Physiological Sciences and IEEE Engineering in Medicine and Biology Society. In 2009, he received the Presidential Prize in Life Sciences in Taiwan. In 2011, he received from President Obama the National Medal of Science, the highest honor for scientists and engineers in the United States.

Francis S. Collins, M.D., Ph.D.

Francis S. Collins, M.D., Ph.D., was officially sworn in on August 17, 2009 as the 16th Director of the National Institutes of Health (NIH). In that role he oversees the work of the largest supporter of biomedical research in the world, spanning the spectrum from basic to clinical research.

Dr. Collins is a physician-geneticist noted for his landmark discoveries of disease genes and his leadership of the international Human Genome Project, which culminated in April 2003 with the completion of a finished sequence of the human DNA instruction book. He served as director of the National Human Genome Research Institute at the NIH from 1993-2008.

Before coming to the NIH, Dr. Collins was a Howard Hughes Medical Institute investigator at the University of Michigan. He is an elected member of the Institute of Medicine and the National Academy of Sciences, was awarded the Presidential Medal of Freedom in November 2007, and received the National Medal of Science in 2009.

Hedvig Hricak, M.D., Ph.D., Dr.h.c.

Dr. Hedvig Hricak is Chairman of the Department of Radiology, Memorial Sloan-Kettering Cancer Center. She is a member of the Molecular and Pharmacology Therapeutics Program, Sloan-Kettering Institute and is Professor, Gerstner Sloan-Kettering Graduate School of Biomedical Sciences and Professor of Radiology, Weill Medical College of Cornell University.

She earned her M.D. degree from the University of Zagreb and her Dr. Med. Sc. (Ph.D.) from the Karolinska Institute.

Her research focuses on diagnostic imaging methods for improving detection, staging, treatment planning, and follow-up for genitourinary cancers. She has been involved in MRI research since the emergence of the field in the 1980s and helped develop applications in ultrasound, MR, and CT for gynecological cancers as well as MRI and MR spectroscopy for prostate cancer.

Dr. Hricak is a member of the Institute of Medicine of the National Academies of Science (NAS) and a Foreign Member of the Croatian Academy of Arts and Sciences and the Russian Academy of Medicine. Her awards include the Marie Curie Award from the Society of Women in Radiology, the gold medals of the International Society for Magnetic Resonance in Medicine, the Association of University Radiologists and the European Society of Radiology, the Beclere Medal of the International Society of Radiology, the Morocco Medal of Merit, and the Katarina Zrinska Croatian presidential award. She holds an honorary doctorate in medicine from Ludwig Maximilian University, Germany.

Jeffrey R. Immelt

Jeffrey R. Immelt is the ninth chairman of General Electric (GE), a post he has held since September 7, 2001. Since coming to GE in 1982, he has held several global leadership positions, including roles in GE's Plastics, Appliance, and Healthcare businesses. In 1989 he became an officer of GE and joined the GE Capital Board in 1997. Several years later, in 2000, Mr. Immelt was appointed President and Chief Executive Officer (CEO).

Mr. Immelt has been named one of the "World's Best CEOs" three times by *Barron's*, and since he began serving as CEO, GE has been named "America's Most Admired Company" in a poll conducted by *Fortune* magazine and one of "The World's Most Respected Companies" in polls by *Barron's* and the *Financial Times*.

Mr. Immelt serves as the chair of President Obama's Council on Jobs and Competitiveness and is also a member of The Business Council. He earned a B.A. degree in applied mathematics from Dartmouth College in 1978 and an M.B.A. from Harvard University in 1982.

Kenneth R. Lutchen, Ph.D.

Dr. Kenneth R. Lutchen is Dean of the College of Engineering and Professor of Biomedical Engineering at Boston University. He received his B.S. in Engineering Science from the University of Virginia and his M.S. and Ph.D. in Biomedical Engineering from Case Western Reserve University. Dr. Lutchen is one of the world's leading biomedical engineers. He has published over 125 peer-reviewed journal articles and patented several new methods to perform mechanical ventilation.

As Dean, Dr. Lutchen has orchestrated the creation of a new Division of Materials Science and Engineering; a new Division of Systems Engineering within the College of Engineering. He has also created new Concentration programs in Energy and Environmental Engineering and Nanotechnology. Since becoming Dean, undergraduate freshman enrollment has increased by 50 percent, graduate funding per faculty has increased to 18th in the nation, and the college's graduate ranking in *US News and World Report* has improved from 52nd to 38th in the nation.

Dr. Lutchen served as Chair of Biomedical Engineering at Boston University from 1998-2006. During that time the department received a $14 million Leadership Award from the Whitaker Foundation and a $5 million Translational Research Partnership Award from the Coulter Foundation. Boston University is the only institution in the nation to receive both awards. He also conceived and attracted an NIH Ph.D. Student Training Grant in Quantitative Biology and Physiology. During his chairmanship in BME, the Department's ranking in *US News and World Report* improved from 18th to 6th. Dr. Lutchen has twice been the recipient of the College of Engineering's Professor of the Year Award and the Biomedical Engineering Professor of the Year Award.

He is currently the Immediate Past President of the American Institute of Medical and Biological Engineering (AIMBEE). He has been on the Board of Directors for the Biomedical Engineering Society, served on scientific advisory boards for the Whitaker Foundation and several bioengineering departments and colleges of engineering nationwide, and is a member of study sections at the National Institutes of Health.

Roderic I. Pettigrew, Ph.D., M.D.

Roderic I. Pettigrew, Ph.D., M.D., is the first Director of the National Institute of Biomedical Imaging and Bioengineering, part of the National Institutes of Health. Prior to his appointment in 2002, he was Professor of Radiology, Medicine (Cardiology) at Emory University, and Bioengineering at the Georgia Institute of Technology and Director of the Emory Center for MR Research, Emory University School of Medicine, Atlanta, Georgia.

Dr. Pettigrew is known for his pioneering work at Emory University involving four-dimensional imaging of the cardiovascular system using magnetic resonance (MRI). Dr. Pettigrew graduated cum laude from Morehouse College with a B.S. in Physics, where he was a Merrill Scholar. He earned an M.S. in Nuclear Science and Engineering from Rensselaer Polytechnic Institute and a Ph.D. in Applied Radiation Physics from the Massachusetts Institute of Technology, where he was a Whitaker Harvard-MIT Health Sciences Scholar. Subsequently, he received an M.D. from the University of Miami School of Medicine in an accelerated two-year program. In 1985, he joined Emory as a Robert Wood Johnson Foundation Fellow with an interest in non-invasive cardiac imaging.

Dr. Pettigrew is an elected member of the Institute of Medicine and the National Academy of Engineering of the National Academies. He holds a fellowship in the American Heart Association, American College of Cardiology, American Institute for Medical and Biological Engineering, International Society for Magnetic Resonance in Medicine, and Honorary Fellow of the Biomedical Engineering Society.

Carla M. Pugh, M.D., Ph.D.

Dr. Carla Pugh is currently Associate Professor of Surgery and Director of the Center for Advanced Surgical Education at Northwestern University. She obtained her undergraduate degree at U.C. Berkeley in Neurobiology and her medical degree at Howard University School of Medicine. Upon completion of her surgical training at Howard University Hospital, she went to Stanford University and obtained a Ph.D. in Education.

Her research interests are in the use of simulation technology for medical and surgical education. Dr. Pugh holds a method patent on the use of sensor and data acquisition technology to measure and characterize the sense of touch. Currently, over one hundred medical and nursing schools are using one of her sensor enabled training tools for their students and trainees. The use of simulation technology to assess and quantitatively define hands-on clinical skills is one of her major research areas. In addition to a recent NIH R-01 grant to validate a sensorized device for high stakes clinical skills assessments, her work has received numerous other awards from various medical and engineering organizations and a 2010 Presidential Early Career Award for Scientists and Engineers (PECASE). Dr. Pugh is also the developer of several decision-based simulators that are currently being used to assess intra-operative judgment.

Steven E. Seltzer, M.D., FACR

Dr. Seltzer has been the Chairman of the Department of Radiology at Brigham and Women's Hospital and the Philip H. Cook Professor of Radiology at Harvard Medical School since 1997. He is the immediate past-Chairman of the Board of Trustees of the Brigham and Women's Physician Organization.

Dr. Seltzer received his baccalaureate and medical degrees from the University of Pennsylvania. He did his Radiology Residency at the Peter Bent Brigham Hospital from 1976 to 1980, and joined the Brigham Faculty immediately afterwards. His clinical interests are in the field of abdominal imaging, particularly advanced applications of helical CT. His research interests are in the arena of perception and psychophysics, focusing on improving our understanding of how radiologists detect, locate and classify abnormalities on diagnostic images. He has published well over 100 peer-reviewed research manuscripts on these topics.

Dr. Seltzer has been involved in projects aimed at improving the quality, safety, productivity and cost-effectiveness of radiology services for more than two decades. As BWH Radiology Department Chair, he helped establish the Center for Evidence-Based Imaging (Ramin Khorasani, founding Director).

Active in many radiological organizations, Dr. Seltzer is a past President of the Association of University Radiologists and was awarded the AUR's Gold Medal in 2004. He currently serves as Immediate Past President of the Academy for Radiology Research and the Society of Chairs of Academic Radiology Departments.

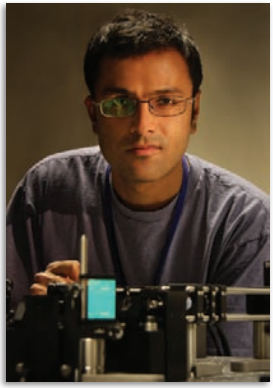
Phillip A. Sharp, Ph.D.

Phillip A. Sharp, Ph.D., is an Institute Professor (highest academic rank) in the Koch Institute for Integrative Cancer Research at the Massachusetts Institute of Technology. He has made fundamental contributions to cancer biology and to understanding gene structure and regulation. Dr. Sharp's seminal discovery of 'split genes' in eukaryotic cells and the associated mechanism of pre-mRNA splicing resulted in numerous awards and honors, including the Nobel Prize in Physiology or Medicine (1993), the Lasker Prize (1988), the Gairdner Foundation International Award (1986) and the 2004 National Medal of Science.

In addition, he holds numerous honorary degrees from universities here and abroad and serves on many advisory boards for the government, academic institutions, scientific societies and companies. He is an elected member of the National Academy of Sciences, the Institute of Medicine, the American Academy of Arts and Sciences, the American Philosophical Society, and the Royal Society of the UK.

A native of Kentucky, Dr. Sharp earned a B.A. degree from Union College, KY in 1966, and a Ph.D. in chemistry from the University of Illinois, Champaign-Urbana in 1969. He did his postdoctoral training at the California Institute of Technology, where he studied the molecular biology of plasmids from bacteria in Professor Norman Davidson's laboratory.

Prior to joining MIT, he was Senior Scientist at Cold Spring Harbor Laboratory. In 1978 Dr. Sharp co-founded Biogen (now Biogen Idec) and in 2002 he co-founded Alnylam Pharmaceuticals, an early-stage therapeutics company.



Hari Shroff, Ph.D.

Dr. Hari Shroff is Chief of the Section on High Resolution Optical Imaging at the National Institute of Biomedical Imaging and Bioengineering, National Institutes of Health. He was appointed to this position in 2009.

His current research program includes the further development of super resolution optical imaging techniques as well as new microscopy techniques for studying neurodevelopment in vivo.

Dr. Shroff received his B.S.E. in Bioengineering from the University of Washington in 2001. He completed his Ph.D. in Biophysics in 2006 at the University of California, Berkeley, under the mentorship of Jan Liphardt, inventing fluorescent force sensors to study highly bent DNA. He undertook his postdoctoral training with Eric Betzig at Janelia Farm Research Campus, where he helped to develop photoactivated localization microscopy.

His honors include a Fannie and John Hertz Graduate Fellowship and a 2010 Presidential Early Career Award for Scientists and Engineers (PECASE).

Roger Y. Tsien, Ph.D.

Roger Y. Tsien, Ph.D., received his A.B. in Chemistry and Physics from Harvard College in 1972. He received his Ph.D. in Physiology in 1977 from the University of Cambridge and remained as a Research Fellow until 1981. He became an Assistant, Associate, then full Professor at the University of California, Berkeley. In 1989 he moved to the University of California, San Diego, where he is an Investigator at the Howard Hughes Medical Institute and Professor in the Departments of Pharmacology and Chemistry & Biochemistry.

He was a scientific co-founder of Aurora Biosciences Corporation (1996), which went public in 1997 (ABSC) and was acquired by Vertex Pharmaceuticals in 2001 (VRTX) for approximately $600M. He was also a scientific co-founder of Senomyx Inc. in 1998, which went public in 2004 (SNMX).

His honors include First Prize in the Westinghouse Science Talent Search (1968), Searle Scholar Award (1983), Artois-Baillet-Latour Health Prize (1995), Gairdner Foundation International Award (1995), Award for Creative Invention from the American Chemical Society (2002), Heineken Prize in Biochemistry and Biophysics (2002), Wolf Prize in Medicine (shared with Robert Weinberg, 2004), Rosenstiel Award (2006), E.B. Wilson Medal of the American Society for Cell Biology (shared with M. Chalfie, 2008), and Nobel Prize in Chemistry (shared with O. Shimomura and M. Chalfie, 2008). He is a member of the National Academy of Sciences and the Royal Society.

Dr. Tsien is best known for designing and building molecules that either report or perturb signal transduction inside living cells. These molecules, created by organic synthesis or by engineering naturally fluorescent proteins, have enabled many new insights into signaling via calcium, sodium, pH, cyclic nucleotides, nitric oxide, inositol polyphosphates, membrane and redox potential changes, protein phosphorylation, active export of proteins from the nucleus, and gene transcription. He is now developing new ways to target contrast agents and therapeutic agents to tumors and sites of inflammation based on their expression of extracellular proteases, and to highlight peripheral nerves to aid surgery.

Charles M. Vest, Ph.D.

Charles M. Vest is President of the National Academy of Engineering and President Emeritus of the Massachusetts Institute of Technology.

Dr. Vest earned a B.S. in mechanical engineering from West Virginia University in 1963, and M.S.E. and Ph.D. degrees in mechanical engineering from the University of Michigan in 1964 and 1967 respectively. He joined the faculty of the University of Michigan as an assistant professor in 1968 where he and his graduate students developed techniques for making quantitative measurements of various properties and motions from holographic interferograms, especially the measurement of three-dimensional temperature and density fields using computer tomography. He became an associate professor in 1972 and a full professor in 1977.

In 1981 Dr. Vest turned much of his attention to academic administration at the University of Michigan, serving as Associate Dean of Engineering, Dean of Engineering, and Provost and Vice President for Academic Affairs. In 1990 he became President of the Massachusetts Institute of Technology (MIT) and served in that position until December 2004. He then became Professor and President Emeritus.

He was a director of DuPont for 14 years and of IBM for 13 years, was vice chair of the U.S. Council on Competitiveness, and served on various federal committees and commissions. He serves on the boards of several non-profit organizations and foundations devoted to education, science, and technology.

In July 2007 he was elected to serve as president of the U.S. National Academy of Engineering (NAE) for six years. He has authored a book on holographic interferometry, and two books on higher education. He has received honorary doctoral degrees from seventeen universities. He was awarded the 2006 National Medal of Technology by President Bush and received the 2011 Vannevar Bush Award.

TECHNOLOGY SHOWCASE EXHIBITS

Microneedle Patches Deliver Influenza Vaccine

Microneedles are micron-scale needles that administer vaccines, therapeutics, and other materials into cells and tissues, notably the skin. Their small size permits the vaccine to be targeted to antigen-presenting cells in the skin, allowing administration of lower doses and generating more potent, longer-lasting immune responses. Animal studies using microneedles to deliver influenza vaccine into mice show better protection compared to conventional intramuscular injection. NIBIB has played a critical role in the development of this technology and is enabling its translation from bench to bedside. Microneedle research was part of NIBIB's inaugural grant portfolio and additional funding from NIBIB has supported development of microneedle patches for influenza vaccination through the Bioengineering Research Partnership and the Quantum Grant Programs. Currently, the research team is assessing the safety and effectiveness of a self-administered microneedle patch for influenza vaccination that will culminate in a Phase I clinical trial.

Investigators
Georgia Institute of Technology: *Mark R. Prausnitz, Mark G. Allen*
Emory University School of Medicine: *Richard W. Compans Ioanna Skountzou*
Emory University Hope Clinic: *Mark Mulligan*
PATH: *Darin Zehrung*

Microfluidics Help Detect Rare Cancer Cells in Blood

The microfluidic chip, or "liquid biopsy," has the potential to transform cancer patient care through early molecular diagnosis of epithelial cancers. It may also help identify new biomarkers with potential prognostic value and suggest fruitful targets for future interventions.

One of the proposed mechanisms of cancer metastasis is the dissemination of tumor cells from the primary organ into the blood stream. A cellular link between the primary malignant tumor and the peripheral metastases has been established in the form of circulating tumor cells (CTCs) in peripheral blood. While extremely rare (1 in 10 billion cells), these cells provide a potentially accessible source for early detection, characterization, and monitoring of cancers that would otherwise require invasive serial biopsies.

The microfluidic device, called the CTC-Chip, is designed to isolate these rare cells. The research team continues to make advances with the engineering and biological analyses, aiming for early diagnosis and patient monitoring of lung, prostate, breast, and pancreatic cancers.

Investigators
Harvard Medical School: *Mehmet Toner*
Massachusetts General Hospital: *Daniel Haber, Shyamala Maheswaran, Shannon Stott, Ravi Kapur, Ralph Weissleder*

Handheld Ultrasound Scanner for Cardiac/Vascular Diagnoses

The Vscan is a palm-sized ultrasound imaging device. It uses advanced technology to produce high quality images of internal organs, and displays real-time movement, as in the heart. It has capabilities previously available only on mainframe ultrasound machines that cost more than 10 to 20 times as much. One of these capabilities is color-flow Doppler, which allows color-coded images of blood flow to be overlaid on the anatomical images produced by the device. This allows physicians to more quickly identify blood flow problems or heart problems. The small size and sophistication of this device allow it to be used at the bedside, in an ambulance, or in remote areas that are under-served by medical personnel.

Investigators
General Electric: *Kai Thomenius*

Magnetic Resonance Elastography: Reaching Deep Tissues Non-invasively

Many disease processes cause profound changes in the physical properties of tissues. Thus, physicians have for centuries used their sense of touch as an important physical examination technique. Researchers at the Mayo Clinic have developed a new imaging technology that exploits this principle. Magnetic resonance elastography (MRE), uses low-frequency mechanical vibrations and magnetic resonance imaging to generate detailed quantitative images of the mechanical properties of tissues deep in the body. The MRE has been especially successful with the detection of a liver disease called hepatic fibrosis. Traditionally, health practitioners assess liver damage with a biopsy, removing a small sample of tissue with a needle. This process is invasive and can be inaccurate. It is also uncomfortable for the patient and difficult for the health practitioner to perform if the patient is overweight. Recently approved by the Food and Drug Administration, the MRE is noninvasive as well as safer, more comfortable, less expensive, and more accurate than a biopsy. It creates a color-coded visual map so practitioners can easily visualize the extent of liver tissue damage. MRE also has the potential to diagnose brain diseases, detect breast cancer, and replace invasive techniques in assessing heart disease.

Investigators
Mayo Clinic: *Richard L. Ehman, Kiaran P. McGee*

Microsurgery Workstation Aids Delicate Ophthalmic Surgeries

Surgery performed on the retina of the eye is technically demanding for eye surgeons. It requires a steady hand, extreme magnification to view a small surgical area, and precise skill. Currently, ophthalmologists perform retinal surgery with a microscope and freehand instruments, often resulting in hand tremors, fatigue, and in some cases, a career cut short by disability. Innovative technology funded by the NIBIB is changing the future of eye surgery by improving surgeons' abilities to perform microsurgery on the eye. The NIBIB-funded Bioengineering Research Partnership (BRP) project combines the work of engineers, scientists, and micro-surgeons from Johns Hopkins University and Carnegie-Mellon University. Their microsurgery assistant workstation integrates computer software and a technologically advanced system during operation. Surgeons view a 3D image of the patient's eye while using "smart" surgical tools, made up of novel sensors, surgical instruments, and robotic devices to operate on delicate eye tissue. The workstation reduces the impact of human limitations in image and information processing during surgery and improves the clinical care patients receive while also enabling new therapeutic approaches.

Investigators
Johns Hopkins: *R. Taylor (PI), G. Hager, J. Kang, P. Kazanzides, A. Deguet, B. Vagvolgyi, I. Iordachita, R. Richa, X. Liu, M. Balicki, X. He, B. Hu, B. Gonec, K. Olds, J. Handa, P. Gehlbach, S. Sunshine, N. Cutler*
Carnegie Mellon: *C. Riviere, R. MacLachlan, B. Becker, S. Yang*

Novel Sensors and Simulation Technology Can Quantify Clinical Palpation

Although mammograms detect breast cancers in many patients, clinical breast palpation remains an important part of a woman's annual physical. This clinical exam can detect breast cancers missed by mammography or other tissue abnormalities such as cysts. The type of finger pattern and amount of pressure that health practitioners use to find tissue abnormalities can determine if they locate a lump or if it remains undetected. The technique used can also make the difference between a comfortable or uncomfortable exam for the patient. Without hands-on experience, many practitioners are not familiar with the right amount of pressure or finger patterns to use. Dr. Carla Pugh and her research team are developing a device that measures the pressure a health practitioner uses on sensitive breast tissue. This silicone breast model, representing different types of tissue, uses sensors to determine if the practitioner presses too hard or not hard enough. This innovative system also allows the practitioner to learn what different types of breast tissue feel like. The device measures and records the practitioner's hands-on skills so they can rehearse the most effective techniques before applying them in a clinical setting.

Investigators
Northwestern University: *Carla Pugh, Chang Liu, William McGahie, Joseph Feinglass, John Boulet , Stephen Clyman, Lawrence Salud, Shenshen Zhao, Calvin Kwan*

Cranial Vault and its CRAVE tools: A Clinical Computer Assistance System for Deep Brain Stimulation (DBS) Therapy

Deep brain stimulation (DBS) therapy involves implanting a "brain pacemaker" to send electrical impulses to specific parts of the brain. It provides therapeutic benefits for illnesses such as Parkinson's disease. DBS therapy involves three phases: a pre-operative stage to localize the area, an intra-operative phase to determine the correct electrode placement, and post-operative programming.

Dr. Dawant's research team has developed a suite of software that allows surgeons to centralize the data and visualize activity at all three stages, thus reducing the amount of time needed at each stage of the therapy and maximizing the efficiency of the entire process. The central repository, called the CranialVault, utilizes a suite of software modules called CRAnialVault Explorer (CRAVE) that permits data entry and data visualization at each stage of the therapy as well as a series of algorithms that facilitates the automatic processing of the data. The central repository contains image data and related information such as intra-operative electrophysiological recordings, response to stimulation, or final implant position for more than 600 patients at several clinical sites.

The system permits researchers to aggregate data for large populations and compute statistical maps of efficacy and side effects that they can use for planning or programming. The system is currently being evaluated clinically at Vanderbilt University.

Investigators
Vanderbilt University: *Benoit M. Dawant, Pierre-Francois D'Haese, Peter E. Konrad, Srivatsan Pallavaram, Rui Li., Chris Kao, Joseph Neimat, Fenna Phibbs, Thomas L. Davis*

Dynamic Imaging Reduces Surgical Risk for Epilepsy Patients

Epilepsy affects more than three million Americans and 50 million people worldwide. For about one-third of them, medications do not control the seizures. For these patients, removing the section of the brain that causes seizures may be an effective treatment; however, traditional methods for accomplishing this involve an invasive two-step process. The first step requires open-skull monitoring in order to determine which areas of the brain are affected. A second surgery is then performed to remove the area of the brain causing seizures. Dr. Bin He and his research team are working to minimize the need for such complex surgery by developing noninvasive methods to precisely pinpoint seizure inducing areas without the need for open-skull monitoring. This noninvasive imaging of dynamic brain activity is achieved by measuring the electrical signals within the brain and identifying seizure generating areas using innovative engineering techniques. With continued development of this technology, Dr. He hopes to make the treatment less demanding for surgeons and safer for patients.

In addition to epilepsy research, Dr. Bin He and his research team are applying this imaging technology to understanding fundamental brain processes. His precise mapping of brain activity is providing insights into elusive cognitive phenomena such as attention and perception.

Investigators
University of Minnesota: *Bin He, Sheng He, Steve Engel, Lin Yang, Yunfeng Lu, Keith Jamison, Zhongming Liu*
Mayo Clinic: *Gregory Worrell*

Brain Mapping in Dementia and Trauma—Computational Challenges and Atlasing Advances

The Laboratory of Neuroimaging Resource (LONIR) is computer software that helps to improve understanding of brain health and disease. LONIR helps researchers understand changes that occur in the brain for patients with Alzheimer's disease or traumatic brain injury. The BrainSuite, a suite of image analysis tools, processes Magnetic Resonance Images (MRI) of the human head. Besides providing automated sequences for extracting surface mesh models from MRI images of the brain, the BrainSuite also provides viewing tools. In addition, the LONI pipeline environment is a free workflow application for neuroimaging researchers. Within this software pipeline, researchers can utilize a graphical user interface (GUI) approach to connect various neuroimaging software tools to enable complex analysis of their data.

Dr. Arthur Toga and his research team will showcase three videos tracking and monitoring the progression of dementia, showing the power of their software. Additionally, they will present two hands-on demonstrations to show how the neuroimaging data is collected. All the data, tools, services, and materials presented at the technology showcase are openly accessible on the Laboratory of Neuro Imaging Resource (LONIR) website (http://cms.loni.ucla.edu/NCRR/).

Investigators
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USC: *Richard Leahy*

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