TEDCO NIST NIH BIO-IMAGING TECHNOLOGIES SHOWCASE
October 6, 2009
NIST Gaithersburg, MD

Revised_9/30/09

AGENDA AND POSTERS

7:15 am – 8:15 am	**REGISTRATION, CONTINENTAL BREAKFAST, NETWORKING**
8:15 am – 8:30 am	**WELCOME REMARKS** • John M. Wasilisin Acting President and Executive Director Maryland Technology Development Corporation (TEDCO) • Belinda L. Collins, Ph.D. Director Technology Services, NIST • Mark L. Rohrbaugh, Ph.D., J.D. Director Office of Technology Transfer, NIH
8:30 am – 9:15 am	**KEYNOTE SPEAKERS** • Gary Griffiths, Ph.D. Director, Imaging Probe Development Center National Heart Lung and Blood Institute (NHLBI) • Jason Boehm, Ph.D. Acting Director of Program Office, NIST
9:15 am -10:15 am	**TECHNICAL SESSION I** **"Background Suppression in Broadband Coherent Anti-Stokes Raman Scattering (CARS) Microscopy Processing for Cellular Metrology"** Marcus Cicerone, Ph.D. (NIST) **"Optimizing Multi-photon Fluorescence Microscopy Light Collection by Total Emission Detection (TED)"** Christian A. Combs, Ph.D. (NHLBI) **"Optical Microscopy and Image Analysis at the National Cancer Institute - Frederick with Emphasis on Validation"** Stephen J. Lockett, Ph.D. (SAIC/NCI – Frederick) **"The Advanced Technology Partnerships Initiative: Access to World-Class BioImaging Resources Through Collaboration"** Bruce Crise, Ph.D. (SAIC/NCI – Frederick) **"Bioimaging Applications of Modern Nanoparticle Constructions"** Joseph J. Barchi, Jr., Ph.D. (NCI-Frederick) **"Nanoparticles in Lymphatic Imaging"** Peter L. Choyke, M.D. (NCI)

	"Quantitative Molecular Sensors and Imaging Techniques for Diagnostic Detection of Infectious Diseases" Jeeseong Hwang, Ph.D. (NIST) **"Method of Preparing Macromolecular Contrast Agents and Uses Thereof"** Martin W. Brechbiel, Ph.D. (NCI)
10:15 am – 10:35 am	**BREAK** (Networking, Poster Sessions, Exhibit Floor)
10:35 am – 11:00 am	**COMPANY SUCCESS STORIES** **NIST:** Reactive Nanotechnologies Joseph Gryzb, Ph.D. **NIH:** Integrated BioTherapeutics M. Javad Aman, Ph.D.

11:00 am – 11:10 am	**FUNDING RESOURCES** **Jim Poulos, J.D.** Vice President, Technology Transfer and Commercialization TEDCO **Christine Kelley, Ph.D.** Director Division of Discovery Science and Technology National Institute of Biomedical Imaging and Bioengineering NIH/DHHS
11:10 am – 12:10 pm	**TECHNICAL SESSION II** **"3D imaging of HIV transmission and entry"** Sriram Subramaniam, Ph.D. (NCI) **"Site-Specific Chemical Mapping of Individual Cells in Two- and Three Dimensions with Imaging Mass Spectrometry"** Christopher Szakal, Ph.D. (NIST) **"Tools for Quantitative Imaging of Cells on Extracellular Matrix Mimics"** John Elliott, Ph.D. (NIST) **"Live Cell Microscopy to Follow the Temporal Regulation of Gene Expression"** Michael Halter, Ph.D. (NIST)

	"Processing for Cellular Metrology" Alden Dima (NIST) **"Phantom Development to Support Quantitative MRI"** Robert Usselman, Ph.D. (NIST) **"Color Contrast Agents for MRI Utilizing Magnetic Microstructures"** Gary Zabow, Ph.D. (NIST/NINDS) **"Multicolored Fluorescent Cell Lines for High-Throughput Drug Discovery"** Enrique Zudaire, Ph.D. (NCI)
12:10 am – 1:10 pm	**LUNCH** (Networking, Poster Sessions, Exhibit Floor)
1:10 pm – 1:20 pm	**SPECIAL SESSION:** **WHY PARTNER/COLLABORATE WITH THE FED?** **Mojdeh Bahar, M.S., J.D.** Coordinator, Mid Atlantic Region, Federal Lab Consortium *and* Chief, Cancer Branch, Office of Technology Transfer, NIH **Tom Stackhouse, Ph.D.** Assistant Director Technology Transfer Center, NCI
1:20 pm – 1:40 pm	**SPECIAL SESSION:** **RESOURCES AVAILABLE FOR PUBLIC SECTOR** **NIH:** **Jason Cristofaro, Ph.D., J.D.** Intellectual Property Advisor Division of Cancer Treatment and Diagnosis, NCI **NIST:** **Robert Dimeo, Ph.D.** Acting Director Center for Neutron Research, NIST **Vincent Luciani, Ph.D.** Manager Nanoscale Science and Technology Nanofabrication Facility, NIST

1:40 pm – 2:40 pm	**TECHNICAL SESSION III** **"Standards for Quantitative CT and PET Imaging"** Lisa Karam, Ph.D. (NIST) **"Assessing the Performance of Software in Measuring Tumor Change"** Charles Fenimore, Ph.D. (NIST) **"Passive Terahertz Heterodyne Imager for Biomedical Applications"** Eyal Gerecht, Ph.D. (NIST) **"X-ray Microcomputed Tomography to Measure Cell Adhesion and Proliferation in Polymer Scaffolds"** Carl Simon, Ph.D. (NIST) **"Instrumentation for Fast Functional in vivo Imaging of Small animals Employing Free Radical Spin Probes"** Sankaran Subramanian, Ph.D. (NCI) **"Development of RF preamplifiers and RF coils for High Field MRI"** Afonso C. Silva, Ph.D. (NINDS) **"Susceptibility-Matched Multiwell Plates for High-Throughput Screening by Magnetic Resonance Imaging and Spectroscopy"** Kenneth W. Fishbein, Ph.D. (NIA) **"Metrology Tools for Quantitative Medical Optical Imaging"** Maritoni Litorja, Ph.D. (NIST)
2:40 pm – 4:00 pm	**BREAK** (Networking, Poster Sessions, Exhibit Floor)
3:00 pm – 4:00 pm	**TOURS OF NIST IMAGING LABS** **Sign up is required by the Registration Kiosk. Report for tours promptly by 3:00 pm.*

TECHNICAL PRESENTATIONS: SESSION I

Background Suppression in Broadband Coherent Anti-Stokes Raman Scattering (CARS) Microscopy

Marcus Cicerone, Ph.D., Biomaterials Group Leader, Polymers Division, Biomaterials Group, NIST

Coherent anti-Stokes Raman scattering (CARS) microscopy is gaining popularity as a technique for performing three-dimensional chemical imaging of biological and polymeric systems without the need to add fluorescent molecules to the systems of interest. Narrowband CARS microscopes, those that record a narrow spectrum of light wavelengths (colors) scattered from the samples, have already been commercialized, but lack true chemical sensitivity. Broadband CARS, which would record a much wider spectrum of wavelengths from the sample, promises unprecedented noninvasive chemical sensitivity, but the images have been hampered by relatively high levels of noise. We have developed a unique pulse-shaping approach that dramatically enhances the chemical contrast and improves the signal-to-noise ratio of broadband CARS microscopy, in order to remove unwanted background signals while keeping resonant signals of interest.

Optimizing Multi-photon Fluorescence Microscopy Light Collection by Total Emission Detection (TED)

Christian A. Combs, Ph.D., Cell Biology & Physiology Center, NHLBI

Parabolic mirrors and condensers can be combined to collect the totality of solid angle around the spot for tissue blocks, leading to ~8-fold signal gain. We now show a new version of this Total Emission Detection instrument modified to make non-contact images inside tissue *in vivo*. The device is mounted on a periscope to facilitate imaging live animals. Thus, scanning with the same SNR could occur at more than twice the normal rate or at reduced laser power to reduce photodamage. We have also designed a smaller version to directly replace an objective.

Optical Microscopy and Image Analysis at the National Cancer Institute - Frederick with Emphasis on Validation

Stephen J. Lockett, Ph.D., Optical Microscopy and Analysis Laboratory, SAIC/NCI – Frederick

Additional Poster: NCI Optical Microscopy and Analysis Laboratory

Understanding cancer mechanisms requires analysis at the individual cellular level while cells remain in their tissue context. We have developed efficient, interactive tools for whole cell segmentation as well as automatic tools for nuclear segmentation. These software tools offer improvements over existing methods. Anticipated markets are in cancer diagnostics and as software tools for biology researchers.

The Advanced Technology Partnerships Initiative: Access to World-Class BioImaging Resources Through Collaboration

Bruce Crise, Ph.D., Business Development, Advanced Technology Partnerships Initiative, SAIC/NCI-Frederick

The Advanced Technology Program (ATP) has technology and expertise that accelerates research activities at the National Cancer Institute. Located at the NCI in Frederick and operated by SAIC-Frederick, the ATP provides a wide range of cutting-edge biotechnologies services to support basic and translational research. These technologies include world-class facilities for imaging and nanotechnology characterization. In addition to service activities, the ATP laboratories assist NCI researchers in collaborative projects for technology development resulting in advanced methods and approaches for addressing complex biological problems. Access to these technologies is available to other government agencies, academic institutions, and industry through collaboration and research development agreements.

Bioimaging Applications of Modern Nanoparticle Constructions

Joseph J. Barchi, Jr., Ph.D., Laboratory of Medicinal Chemistry, NCI-Frederick

Semiconductor nanocrystals, also called quantum dots (QDs), are particles that exhibit unique size- and composition-dependent optical properties and one of their most interesting applications is as luminescent labels for cellular imaging. The Laboratory of Medicinal Chemistry, NCI has prepared QDs coated with the tumor-associated carbohydrate antigen (TACA) disaccharide Galβ1-3GalNAcα (Thomsen Friedenreich antigen), conjugated to various linkers, that are highly stable, luminescent and functional. These conjugates permit efficient imaging of tumor cells and in addition, the novel method of synthesis overcomes other reported problems with short-lived and unstable nanoparticles. These new tools hold great promise for labeling cells that express specific carbohydrate-binding proteins on their surfaces.

Nanoparticles in Lymphatic Imaging

Peter L. Choyke, M.D., Molecular Imaging Program, NCI

The lymphatic system is difficult to image, however, injected nanoparticles of precise size are taken up rapidly by the lymphatics and can be used to image the lymphatic channels and sentinel lymph nodes, which are critical to cancer staging. In the optical realm suitable nanoparticles include quantum dots and upconverting nanocrystals both of which provide excellent target to background ratios. In the realm of MR imaging dendrimers tagged with Gadolinium or iron core particles have shown promise for visualizing the lymph nodes and lymphatic vessels.

Quantitative Molecular Sensors and Imaging Techniques for Diagnostic Detection of Infectious Diseases

Jeeseong Hwang, Ph.D., Biophysics Group, Optical Technology Division, NIST

Quantitative detection of pathogens and infectious agents plays a vital role in biological threat surveillance, agricultural safety, and medical diagnosis. While there is increasing interest in highly sensitive detection assays involving either fluorescent molecules or light-emitting chemical reactions, they often pose challenges to quantitative optical analysis. We embark on efforts to quantitatively characterize and model the unique optical properties of novel fluorescent nanocrystal probes to investigate biological processes involving infectious diseases and bacterial pathogens. We are developing and using new measurement platforms and standards to characterize and model the unique optical properties of these nanoscale materials for their applications as quantitative biosensors and detectors.

Method of Preparing Macromolecular Contrast Agents and Uses Thereof
Martin W. Brechbiel, Ph.D., Radiation Oncology Branch, NCI

We describe a new method of pre-forming a metal-ligand chelate in alcohol prior to conjugation to a dendrimer. This results in a dendrimer-based MRI contrast agent with greatly improved homogeneity and stability, and possessing an unexpectedly greater molar relaxivity that allows the use of much less of the agent than previously required to obtain comparable images. Advantages include the efficient preparation of stable dendrimer-based contrast agents suitable for medical imaging; higher molar relaxivity, hence a lower dosage needed for imaging; an ability to control dendrimer size conducive for development of compartment-specific imaging agents.

TECHNICAL PRESENTATIONS: SESSION II

3D imaging of HIV transmission and entry
Sriram Subramaniam, Ph.D., Laboratory of Cell Biology, NCI

This presentation will discuss new strategies to map viral landscapes at molecular resolution using novel 3D electron microscopic technologies.

Site-Specific Chemical Mapping of Individual Cells in Two- and Three Dimensions with Imaging Mass Spectrometry
Christopher Szakal, Ph.D., Surface and Microanalysis Science Division, Analytical Microscopy Group, NIST

Together with collaborators from the Laboratory for Cell Biology at NIH's National Cancer Institute, we have begun to explore the challenging prospect of chemically mapping molecules in single cancer cells in two and three dimensions. By utilizing the surface sensitivity and molecular imaging capabilities in time-of-flight secondary ion mass spectrometry (ToF-SIMS), along with newly developed sample preparation protocols, we have attained state-of-the-art 400-nm resolution chemical maps of immortal cell lines known as HeLa cells, including the distributions of lipid and salt signatures. This technology can provide the foundation for exploring the site-specific chemical changes responsible for disease progression and allow for the development of fast and robust imaging mass spectrometry technologies to be used in clinical settings.

Tools for Quantitative Imaging of Cells on Extracellular Matrix Mimics
John Elliott, Ph.D., Cell Systems Science Group, Biochemical Science Division, NIST

Quantitative fluorescence imaging and image analysis are powerful tools to measure the observable phenotypic characteristics of cells under experimental conditions. We have developed a robust two-color cell staining procedure that greatly facilitates image analysis procedures for determining cell morphology (structure, form and arrangement). We have also focused on the development of highly reproducible cell adhesion substrates coated with a fibrillar collagen type I extracellular matrix. The substrate preparation is compatible with many types of conventional cell culture plasticware and can be used in high-throughput imaging instrumentation. Our studies indicate that these materials mimic many properties of fibrillar collagen gels and provide excellent optical properties for cell imaging on an extracellular matrix substrate. These tools can be important components for observing phenotypic changes in cell behavior.

Live Cell Microscopy to Follow the Temporal Regulation of Gene Expression
Michael Halter, Ph.D., Cell Systems Science Group, Biochemical Science Division, NIST
Quantitative measurements of dynamic processes in single cells are challenging and require the identification, segmentation, and tracking of live cells. Collecting and storing live-cell image data has been greatly facilitated by automated microscopy, but determining quantitative metrics of cell behavior using image-analysis algorithms remains challenging. We illustrate the application of live-cell microscopy and automated image analysis tools developed at NIST to measure the dynamics of gene expression in single cells by monitoring levels of green fluorescence protein.

Processing for Cellular Metrology
Alden Dima, Computational Biology Project, Information Technology Laboratory, NIST
High-throughput technologies for measuring the characteristics of cells are generating large amounts of complex data that are difficult to process and convert into knowledge. Under the auspices of the NIST Computational Biology Project, experimentalists and computational scientists are working together to address mutually defined image-based challenge problems (well-defined challenges embodying essential difficulties in a research area whose solutions have broad impact). One challenge has been to evaluate segmentation techniques (methods to locate objects and boundaries in images) and associated parameters to reliably determine the cell morphology (structure, form and arrangement) for the purpose of comparing cell lines as part of a new standard procedure under development. Another challenge involves the segmentation and tracking of live cells in an image sequence to quantify the total fluorescence intensity of individual cells over time, and thereby gain a better understanding of protein expression over the cell cycle.

Phantom Development to Support Quantitative MRI
Robert Usselman, Ph.D., Biomagnetics Program, Electromagnetics Division, NIST
NIST has recently initiated programs to support quantitative biomagnetic imaging. As part of the International Society for Magnetic Resonance in Medicine (ISMRM) Committee on Standards for Quantitative Magnetic Resonance, NIST is assisting in the design and fabrication of a new phantom, an object used to calibrate imaging systems. The system phantom is designed to measure geometric distortion, contrast properties, resolution, signal-to-noise ratio, and a variety of other parameters. This will be the first MRI phantom that has NIST traceability and will be calibrated for a range of temperatures and fields. The phantom will initially be used for quality control during image-based clinical trials, though widespread clinical implementation is envisioned. NIST is also working with the Quantitative Imaging Biomarkers Alliance (QIBA) to develop a dynamic, contrast-enhanced MRI phantom and will be developing susceptibility phantoms and flow/diffusion phantoms.

Color Contrast Agents for MRI Utilizing Magnetic Microstructures

Gary Zabow, Ph.D. Laboratory of Functional & Molecular Imaging (joint NINDS and NIST), Stephen Dodd, Ph.D. (NINDS), Alan Koretsky, Ph.D. (NINDS), John Moreland, Ph.D. (NIST)

A joint venture between NIST and NINDS/NIH has resulted in the development of microfabricated structures that can be used as MRI contrast agents with enhanced functionality or as micro-RFID (radio-frequency identification) tags. The microstructures can be engineered to appear as different effective colors when resolved using MRI as opposed to strictly grey-scale contrast of existing MRI agents. In this way they can be thought as radio-frequency analogs to quantum dots. A set of agents could be produced that would enable *in vivo* labeling and tracking of multiple different types of cells simultaneously. The agents can also act as radio-frequency probes of various physiological conditions. Potential applications for these structures include MRI, cardiovascular diseases imaging, drug development, drug candidate distribution tracking, diagnostics, and microfluidics.

Multicolored Fluorescent Cell Lines for High-Throughput Drug Discovery

Enrique Ubani Zudaire, Ph.D., Angiogenesis Core Facility, NCI

We have developed a series of immortalized cell lines that were selected to represent the different cell types found in angiogenesis *in vivo*, that constitutively express different fluorescent proteins. Based on these cell lines, the inventors have developed several *in vitro* angiogenesis assays and a software application that can be used to investigate the relationships between different cells involved in angiogenesis, to develop new combinatorial approaches to boost the efficiency of existing therapeutics, and to facilitate the discovery of new potential single or combination drugs. This technology could potentially be used to develop a high-throughput screening assay for angiogenesis or anti-angiogenesis drugs, or to screen compounds for cytotoxicity. The inventors have already demonstrated proof of concept for this technology by developing a high-throughput screen for potential angiogenic drugs, and they have also recently developed a cytotoxicity assay.

TECHNICAL PRESENTATIONS: SESSION III

Standards for Quantitative CT and PET Imaging

Lisa Karam, Ph.D., Ionizing Radiation Division, NIST

Historically, medical imaging has been mostly *qualitative*, but many health care applications, such as treatment planning, drug development, and clinical studies, demand a more *quantitative* approach for assessing efficacy and for patient safety. Working closely with colleagues in government, academia, and industry, NIST has been developing measurement standards for more accurate calibration of PET instrumentation. In addition, x-ray measurements of our recently developed small, resilient, and inexpensive phantom (a device, calibrated for length, which mimics distances in the body) have shown the potential usefulness of such a “pocket” phantom for patient-based calibration of CT (alone or with PET) systems. The ability to calibrate diagnostic imaging tools in a way that is traceable to national standards will lead to a more quantitative approach, increasing accuracy in treatment planning and increased safety for the patient.

Assessing the Performance of Software in Measuring Tumor Change

Charles Fenimore, Ph.D., Biomedical Imaging Project, Information Access Division, NIST

NIST is conducting the Biochange challenge problems for assessing the accuracy of software and algorithms that measure change in the size of lung tumors. There are two key goals in the Biochange project. The first is to encourage the development of algorithms for measuring change in tumors. The second is the concurrent development of methods for performance assessment of these algorithms. For a set of tumors, Biochange provides algorithm developers with two CT scans. Participants in Biochange run their algorithm(s) on the set of CT scan pairs and report their change measurements to NIST for analysis. From the results of multiple participants, NIST is uniquely able to assess the state-of-the-art and identify future directions of research. The impact of improved accuracy in change measurement should be felt in the clinical treatment of disease and the development of new pharmaceuticals.

Passive Terahertz Heterodyne Imager for Biomedical Applications

Eyal Gerecht, Ph.D., Biomagnetics Program, Electromagnetics Division, NIST

We are developing a new family of detectors, known as hot electron bolometers (HEB), that already demonstrated superior sensitivity and spectral resolution at terahertz frequencies when compared with other detector technologies. Terahertz imaging based on HEB technology promises to be a potent new tool for *in vivo* diagnosis of biological tissues; in particular, for the identification of diseased tissues and the classification of disease states. Because MRI and THz images result from different physical processes, they provide qualitatively different and complementary information. Furthermore, the ability of terahertz radiation to penetrate the sub-surface of a biological tissue also provides access to additional and different information than is obtained with optical images.

X-ray Microcomputed Tomography to Measure Cell Adhesion and Proliferation in Polymer Scaffolds

Carl Simon, Ph.D., Biomaterials Group, Polymers Division, NIST

We have explored the use of X-ray microcomputed tomography (µCT) for assessing tissue generation in polymer scaffolds. µCT is able to image through opaque scaffolds to yield quantitative 3-D spatial information regarding cell distribution, adhesion and proliferation.

Instrumentation for fast functional in vivo imaging of small animals employing free radical spin probes

Sankaran Subramanian, Ph.D., Radiation Biology Branch, NCI

Time-domain (Fourier transform, FT) and Continuous wave (CW) instrumentations for performing three-dimensional imaging of small animals perfused with non-toxic stable free radicals. Methodology for imaging spin distribution and mapping of in vivo partial pressure of oxygen, pO2 [non-invasive in vivo oximetry] both in CW and FT modalities. In vivo tumor oximetry, tissue oxygenation, spin perfusion and tissue redox status can be quantitatively monitored non-invasively with very good temporal resolution. Methods for coregistration with anatomy via MRI (and or CT) have also been developed. Applications include investigating tumor angiogenesis, prognosis of cancer treatment and treatment-outcome in radiation oncology and chemotherapy, wound-healing, transplant organ viability, tissue redox status, peripheral vascular insufficiency (in diabetes mellitus patients), and possibly in radiation dosimetry.

Development of RF Preamplifiers and RF Coils for High Field MRI
Afonso C. Silva, Ph.D., Stephen J. Dodd, Hellmut Merkle, George C. Nascimento, Alan P. Koretsky, and Joseph Murphy-Boesch, Laboratory of Functional & Molecular Imaging, NINDS

There continues to be a push to higher magnetic fields for both animal and human imaging. Due to the specific challenges of these high fields and the need for high performance receivers, we are currently developing the building blocks for coil development for these high field systems. In particular, we are working on the design of low input impedance, low-noise RF preamplifiers and RF coils to optimize the sensitivity and image quality of MRI at high field strengths. We have designed a modular RF preamplifier that has < 1 Ohm input impedance, gain of 28-30 dB and output impedance of 50 Ohms that is fully compatible with the architecture of all major MRI vendors. The design has been fully tested and approved for operations at 7T and 11.7T. In addition, we are working on new RF coil designs and coupling schemes that improve on power transfer and noise rejection characteristics. We are looking for a partner to take our designs from the prototype level to a commercial package.

Susceptibility-Matched Multi-well Plates for High-Throughput Screening by Magnetic Resonance Imaging and Spectroscopy
Kenneth W. Fishbein, Ph.D., Gerontology Research Center, NIA

NMR spectroscopy has numerous established and emerging applications in clinical, agricultural and industrial chemistry. Traditional NMR technology requires clean samples to be transferred to special tubes or flow capillaries, limiting throughput and risking contamination and sample loss. An attractive alternative to this practice would be to directly scan samples in multiwell plates, the containers in which samples are conventionally placed for optical scanning and/or storage. Unfortunately, conventional multi-well plates typically give poor performance for MRI-based assays since they provide inadequate matching of magnetic susceptibility between the plate, the samples and their surroundings. This results in distortion of the magnetic field within the scanner and thus reduces the resolution of NMR spectra. Here, we present novel, NMR-compatible multi-well plates that permit high-throughput screening of samples with minimal handling and that may be used with existing robotic equipment. This design can easily be extended to non-aqueous samples by the selection of an appropriate, commercially-available plastic resin or resin blend. Finally, by reducing background magnetic field inhomogeneities, these plates also offer enhanced sensitivity and throughput for the detection of functionalized magnetic nanoparticles in novel immunoassays and other molecular imaging applications.

Metrology Tools for Quantitative Medical Optical Imaging
Maritoni Litorja, Ph.D., Optical Thermometry and Spectral Methods Group, Optical Technology Division, NIST

The thrust towards quantitative clinical imaging necessitates the use of calibrated instruments and standardization of measurements. Some of the new clinical imaging measurement methods are optical in nature, based on standard biochemical assays. One example is reflectance hyperspectral imaging, a technique commonly used in environmental remote sensing. Our is working on applying lessons learned from measurement issues encountered in the global standardization efforts in climate remote sensing to those in clinical imaging. We are also working on methods and tools to calibrate and validate these instruments. One of them is the hyperspectral imaging projector (HIP) image as a digital tissue imaging reference/calibration sample (phantom (imaging reference)) for calibrating hyperspectral imagers used in the biomedical field.

POSTERS
(NOTE: The following are additional posters, not included in the Technical Presentation Sessions.)

Nanoparticles for Imaging: Targeted Nanoparticles That Can Be Imaged Through Magnetic Resonance, Optical and Radioisotope Imaging
Martin W. Brechbiel, Ph.D., Radiation Oncology Branch, NCI

Available for licensing and commercial development are patent rights covering tri-imageable nanoparticles which have great potential for application in the laboratory and clinic for labeling at the cellular level, diagnostics, and drug delivery. The particle includes a silica encased ultrasmall superparamagnetic iron oxide (SPIONs) that can be detected using MRI. A fluorescent probe (e.g., Cy5.5) for optical imaging is embedded in the silica. The resulting particles are about 20-25nm in diameter. Target specific antibodies are attached to the surface of the particles. Chelated to the antibodies is a radioisotope (e.g., Indium-111) useful for particle quantification and can be imaged through techniques such as single photon emission computed tomography (SPECT) or positron emission tomography (PET).

Nanoparticles for Imaging and Treatment of Brain Tumors
Hemant Sarin, M.D., Intramural Research Programs, NIBIB

Conventional chemotherapy drugs do not reach therapeutic levels in brain tumor tissue, and do not remain in brain tumor tissue for long enough to enter brain tumor cells and kill them. As a consequence, these chemotherapy drugs are not effective at treating malignant brain tumors growing in patients, even though these drugs are effective at killing brain tumor cells growing in culture. This invention claims that intravenously administered functionalized polyamidoamine (PAMAM) dendrimers of certain sizes can selectively cross the blood-brain barrier (BBB) of malignant brain tumors, and can accumulate over time within individual brain tumor cells. Gadolinium and fluorescent probe conjugated dendrimers with these properties can be used for simultaneous magnetic resonance and fluorescence imaging of brain tumor cells. Applications include anatomic and metabolic imaging of brain and spinal cord tumors for diagnostic and therapeutic purposes, intravenous treatment of brain and spinal cord tumors; imaging of intravenous drug delivery to brain and spinal cord tumors; and the potential to be used for imaging and treatment of other neurological disorders in which the BBB becomes porous.

Hollow Structured Mesoporous Silica Coated MnO Nanoparticles as Highly Efficient T1 Contrast Agents and Their Applications in MR tracking of Transplanted Mesenchymal Stem Cells
Taeho Kim[1,2,6], Eric Momin[5], Jonghoon Choi[1,2,7], Hasan Zaidi[5], Mi-hyun Park[6], Vytas Reipa[7], Alfredo Quinones-Hinojosa[5], Taeghwan Hyeon[6], Jeff W. M. Bulte[1-4], Assaf A. Gilad[1,2*]
([1]Cellular Imaging Section, Institute for Cell Engineering, [2]Dept. of Radiology, [3]Dept. of Biomedical Engineering, [4]Dept. of Chemical & Biomolecular Engineering, [5]Dept. of Neurological Surgery, The Johns Hopkins University School of Medicine, Baltimore, MD, USA, [6]National Creative Research Initiative Center for Oxide Nanocrystalline Materials, School of Chemical and Biological Engineering, Seoul National University, Seoul, Republic of Korea, [7]CSTL, NIST)

Ultrastable Atomic Force Microscopy: atomic-scale stability and registration at ambient conditions
Thomas Perkins, Ph.D., JILA, NIST & CU-Boulder, NIST

Computer Aided Detection (CAD) of Colonic Polyps Using CT Colonography (CTC)
Jack Yao, Ph.D., Diagnostic Radiology Department, Warren Grant Magnuson Clinical Center, NIH

We have developed advanced image processing and machine learning techniques for computer aided detection of colon cancer using CT colonography. Our CAD system achieves high sensitivity and specificity. Automated polyp size evaluation provides a consistent way to characterize the polyps. The tools are useful for colon cancer screening. Most of our techniques are patented and ready for further commercial development.

Bone Imaging: Bone Mineral Density as a Biomarker for Assessing Bone Health
Herbert S. Bennett, Ph.D., Semiconductor Electronics Division, NIST; Andrew Dienstfrey, Ph.D, Information Technology Laboratory Office, NIST; Tammy Oreskovic, M.S., Materials Reliability Division, NIST; and Lawrence Hudson, Ph.D., Ionizing Radiation Division, NIST

Multilayered RF Coil System for Improving Transmit B1 Field Homogeneity in High-Field MRI
Alan Koretsky, Jeff H. Duyn, Shumin Wang and Hellmut Merkle,, Laboratory of Functional & Molecular Imaging, NINDS

We have developed a multilayered radio-frequency (RF) coil system for improving the transmit B1 field homogeneity for magnetic resonance imaging (MRI) at high field strengths. The current invention aims at manipulating the inhomogeneous profile of the transmit B1 field, which causes MR images to become less uniform as the magnetic field strength is increased, by utilizing an inner array of RF elements (e.g. surface coils) within and coupled to an outer transmit unit (e.g. a birdcage coil or other volume coil). The current design provides an effective approach for reducing B1 field homogeneity at high fields and can be implemented without the need for independent RF channels, thereby reducing MRI system complexity. Furthermore it can be readily implemented on existing MRI coil systems by detuning surface coils rather than decoupling them during the transmit phase, thus further reduces the cost of a system. The current status of the technology includes development of optimized methods based on real-time simulations of specific heads and a working coil for use with phantoms. We are looking for commercial partners to further develop the coil system and are working towards finishing the design for work in phantoms, the construction of a coil for use on human heads, and looking to explore benefits for whole body imaging.

Chip-Scale Atomic Magnetometers for Low-Cost Biomagnetic Imaging and NMR
Svenja Knappe, Ph.D., and John Kitching, Ph.D., Time and Frequency Division, Physics Labs, NIST

Enhancing Bio-imaging Through Chemical and Elemental Mapping of Biological Structures
Stephan Stranick, Ph.D., and Keana Scott, Ph.D., Surface and Microanalysis Science Division, NIST

Increasing the Throughput of in vitro Assays to Measure the Function of Antibodies to Pneumococci
Matthew L. Clarke, Ph.D., Optical Technology Division, NIST

Fluorescence Reporter Proteins for Studying the Protein Traficking of Malaria Infected Human Red Blood Cells

Georgeta Crivat, Ph.D., Guest Researcher, Optical Technology Division, NIST, Laboratory of Malaria and Vector Research, NIH/NIAID

Neutron Radiography in Biological Systems at Submicrometer Resolution

Jayne B. Morrow, Ph.D., R. David Holbrook, Ph.D., Muhammad Arif, Ph.D., R. Gregory Downing, Ph.D., Brian B. Maranville, Ph.D., NIST

Introduction to the NIBIB/NIH Clinical Center Laboratory of Molecular Imaging and Nanomedicine

Xiaoyuan (Shawn) Chen, Ph.D., Laboratory of Molecular Imaging and Nanomedicine,
NIBIB/ NIH CC

Brief introduction of my laboratory that is divided into 4 sections: PET radiochemistry group, biological molecular imaging group, molecular imaging probe toolbox group, and theranostic nanomedicine group. We specialize in synthesizing molecular imaging probes for positron emission tomography (PET), single-photon emission computed tomography (SPECT), magnetic resonance imaging (MRI), optical (bioluminescence, fluorescence and Raman), contrast enhanced ultrasound, photoacoustic imaging as well as multimodality imaging. We aim to develop molecular imaging toolbox for better understanding of the biology, early diagnosis of diseases, monitoring therapy response, and guiding drug discovery and development. Our lab puts special emphasis on high sensitivity nanosensors for biomarker detection and theranostic nanomedicine for imaging, gene and drug delivery, and monitoring of treatment. A few exemplar images will be shown.

NIAID Integrated Research Facility

Richard C. Reba, M.D., Department of Nuclear Medicine, NIAID/NIH Clinical Center

The NIAID Integrated Research Facility (IRF) at Fort Detrick will occupy a unique niche in the world of Biosafety Level 4 containment laboratories. In addition to employing state-of-the-art laboratory research methods to study the pathogenesis and treatment of diseases caused by virulent viruses and bacteria, investigators will make use of an array of imaging instruments to track the course of illness in infected animals and assess the efficacy of new vaccines and therapies.

Standard Reference Materials and Protocols for Calibrating Fluorescence Microscopy Image Data

Michael Halter, John T. Elliott, Kevin J. Coakley, John Lu, Gregory A. Cooksey, and Anne L. Plant, NIST