National Institute of Biomedical Imaging and Bioengineering

# Division of Applied Science and Technology (Bioimaging)

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The mission of the National Institute of Biomedical Imaging and Bioengineering (NIBIB) is to improve human health by leading the development and accelerating the application of biomedical technologies. The Institute is committed to integrating the physical and engineering sciences with the life sciences to advance basic research and medical care.

The Division of Applied Science and Technology (DAST) is one of three divisions within the NIBIB's Office of Extramural Science Programs. Through grant, cooperative agreement, and contract mechanisms, the division promotes, fosters, and manages biomedical imaging research programs in the funding areas listed below.

## Research Programs

### Bioanalytical Sensors

This program supports the development of sensor technologies for the detection and quantitation of clinically relevant analytes in complex matrices for use in biomedical applications. Emphasis is on engineering the components and functionality of bioanalytical sensors. Detection could be based on optical, chemical, electrochemical, and/or physical (such as mechanical, gravimetric, thermal) perturbation of a sample, for example. Technologies of interest include, but are not limited to: nano-textured substrates for analyte detection, DNA sensors for liquid biopsy, and small molecule detectors for diagnosing infectious diseases. (Tatjana Atanasijevic, atanasijevict@mail.nih.gov).

### Bio-Electromagnetic Technologies

This program supports the development of technologies that utilize static or dynamic electromagnetic field for sensing, imaging, or therapeutic effects, such as novel hardware or instrumentation, techniques to increase sensitivity and spatial/temporal resolution, inverse and reconstruction algorithms, and multiplexing with other imaging techniques. Examples include, but are not restricted to electroencephalography, magnetoencephalography, magnetic particle imaging or hyperthermia, and microwave or terahertz imaging. (Shumin Wang, shumin.wang@nih.gov).

### Image-Guided Interventions

This program addresses the development of technologies that use images particularly during minimally invasive surgery or biopsy. Technologies may include interventional device development, as well as algorithms and imaging devices used for guidance, navigation, and orientation during minimally invasive procedures. (Guoying Liu, liug@mail.nih.gov).

### Magnetic Resonance Imaging (MRI)

This program involves the technological development of magnetic resonance imaging (MRI) and MR spectroscopic imaging for research and clinical applications. Examples include fast imaging, high field imaging, MRI hardware including novel radio frequency (RF) and gradient coils, new pulse sequences, and new imaging contrast mechanisms. The program emphasizes technological development rather than detailed applications for specific diseases or organs. (Guoying Liu, liug@mail.nih.gov and Shumin Wang, shumin.wang@nih.gov).

### Molecular Probes and Imaging Agents

This program supports development and biomedical application of molecular probes and imaging agents across all imaging modalities for the visualization, characterization, and quantification of normal biological and pathophysiological processes and anatomy in living organisms—at the molecular, cellular and organ levels. The emphasis is on engineering of targeting and responsive molecular probes of high sensitivity and specificity for PET and SPECT (radiotracers), MR (T1, T2, CEST, hyperpolarized agents), EPR, CT, optical (fluorescent and bioluminescent probes), ultrasound (microbubbles) and photoacoustic imaging. (Tatjana Atanasijevic, atanasijevict@mail.nih.gov).

### Nuclear Medicine

Research in this area involves functional and molecular imaging using single photon or positron emissions from radioactive agents that are injected, inhaled, or ingested into the body and then concentrated in specific biological compartments. Two particularly active areas are PET and single photon emission computed tomography (SPECT). Other areas of interest include the design of higher resolution or sensitivity devices, hybrid imaging systems (PET/MRI), the development of better radiopharmaceuticals and nuclear medicine probes, crystal scintillators and semiconductor detectors, high performance collimators, novel approaches to dosimetry, radiation dose reduction via hardware or software, novel reconstruction techniques, and dual isotope imaging. (George Zubal, igeorge.zubal@nih.gov).

### Optical Imaging and Spectroscopy

This program supports the development and application of optical imaging, microscopy, and spectroscopy techniques; and the application of optical imaging contrasts. Examples of supported research areas include fluorescence imaging, bioluminescence imaging, OCT, SHG, IR imaging, diffuse optical tomography, optical microscopy and spectroscopy, confocal microscopy, multiphoton microscopy, flow cytometry, and the development of innovative light sources and fiber optic imaging devices. (Behrouz Shabestari, shabestb@ mail.nih.gov/Afrouz Anderson, afrouz.anderson@nih.gov).

### Ultrasound: Diagnostic and Interventional

The primary focus of this program is the improvement of technologies for diagnostic, interventional and therapeutic uses of ultrasound. The diagnostic ultrasound program includes, but is not limited to the design, development and construction of transducers, transducer arrays, and transducer materials, innovative image acquisition and display methods, innovative signal processing methods and devices, and optoacoustic and thermoacoustic technology. It also includes the development of image-enhancement devices and methods, such as contrast agents, image and data presentation and mapping methods, such as functional imaging and image fusion. The interventional ultrasound program includes the use of ultrasound for therapeutic use, or as an adjunct for enhancement of non-ultrasound therapy applications. Examples include, but are not limited to, high-intensity focused ultrasound (HIFU) as a noninvasive or minimally invasive interventional surgical or therapy tool, and as an adjunct interventional tool. It also includes the use of ultrasound contrast agents for therapy and for targeted drug delivery, and the use of ultrasound for image-guided surgery, biopsy, and other interventions. (Randy King, randy.king@nih.gov).

### X-ray, Electron, and Ion Beam

Computed tomography (CT), computed radiography (CR), digital radiography (DR), digital fluoroscopy (DF), phase-contrast and diffraction-enhanced imaging, and other related X-ray modalities are included in this program. Research areas of support include development of flat panel detector arrays and other detector systems and materials, as well as improved contrast materials and methods. High priority is given to innovative approaches for radiation dose reduction, including improved CT reconstruction algorithms, as well as photon counting detectors for use with CT to improve image quality and utilization of optimal energy bands for specific applications and improved contrast. Research areas dealing with development of clinical application methods of diffraction-enhanced imaging and phase contrast imaging are of great program interest. (Behrouz Shabestari, behrouz.shabestari@nih.gov).

## Collaborations

The division is currently involved in several important collaborative efforts, most notably:

### The Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative

The goal of this initiative is to map circuits of the brain, measure fluctuating patterns of electrical and chemical activity flowing within those circuits, and understand how their interplay creates our unique cognitive and behavioral capabilities. By accelerating the development and application of innovative technologies, researchers will be able to produce a dynamic picture of the brain that, for the first time, shows how individual cells and complex neural circuits interact in both time and space. It is expected that the application of these new tools and technologies will lead to new ways to treat, cure, and even prevent brain disorders. For more information: http://www.nih.gov/science/brain/index.htm. (Guoying Liu, liug@mail.nih.gov and Shumin Wang, shumin. wang@nih.gov).

### Human Connectome Project (HCP)

The HCP involves 16 NIH institutes and centers and is part of the NIH Blueprint for Neuroscience Research (www.neuroscienceblueprint.nih.gov). The HCP supports research that uses cutting-edge imaging technologies to map the circuitry involved in brain function in healthy humans. (Guoying Liu, liug@mail.nih.gov).

## Contact

Contact NIBIB program staff with your questions about funding opportunities or the application process. We welcome the opportunity to speak with potential applicants about the Institute's programs.

Areas of scientific coverage for each member of the program staff are listed in the Research Programs section of this fact sheet and on the NIBIB website at https://www.nibib.nih.gov/research-funding/.

Krishna Kandarpa, M.D., Ph.D.
301-496-8859
kris.kandarpa@nih.gov