Surgical Sciences, Biomedical Imaging and Bioengineering IRG
IRG 21

The Surgical Sciences, Biomedical Imaging, and Bioengineering (SBIB) IRG will review applications for research grants that address topics in a variety of areas that are at the interface between a physical science or engineering and biomedical or clinical research. Major areas are: (1) Development of molecular probes and contrast agents; development of molecular imaging techniques; and basic, applied and pre-clinical aspects of the design and development of medical imaging systems (including hardware, software and mathematical methods) for studying organs or whole animals (including man). (2) Basic research on and application of computational sciences to knowledge and information in biomedicine, healthcare and their integration. (3) Development of: biomedical sensing and measurement instrumentation; diagnostic instrumentation creating knowledge to enhance organ system function and recovery; innovative biologics, materials, processes, implants, devices; and informatics approaches to prevent, diagnose, and treat disease. (4) Anesthesiology; host response to sepsis and injury**;** organ, tissue, and cellular transplantation; surgical implications of immunobiology and organ preservation; plastic/reconstructive surgery; gastrointestinal surgery; cardiothoracic and vascular/microcirculatory surgical and other microsurgical therapies; surgical critical care, and emergency medicine; and pulmonary and cardiovascular response to trauma/surgery/physiologic stress and their implications in rehabilitation.

The following study sections are included within this IRG:

I. Biomedical Imaging, Contrast Agents, and Probes (BCAP)
II. Biomedical Imaging Technology (BMIT)
III. Medical Imaging (MI)
IV. Biomedical Computing and Health Informatics (BCHI)
V. Biomedical Sensing, Measurement and Instrumentation (BSMI)
VI. Bioengineering, Surgical Sciences, and Technology (BSST)
VII. Surgery, Anesthesiology, and Trauma (SAT)
VIII. Surgery, Surgical Critical Care, and Transplantation: Systems and Tissue aspects of Surgery (STAS)
IX. SBIR Biomedical Imaging (SBIR-BMI)
X. SBIR Biomedical Sensing, Measurement and Instrumentation (SBIR-BSMI)
XI. SBIR Bioengineering, Surgical Sciences and Technology (SBIR-BSST)

I. Biomedical Imaging Contrast Agents and Probes (BCAP)

The Biomedical Imaging Contrast Agents and Probes (BCAP) study section reviews grant applications involving basic, applied and clinical aspects of the development of molecular probes and contrast agents, molecular imaging techniques, and related technologies for studies at the organ, small/large animal, and human scale.

Specific Areas Covered by BCAP Include:

- Prediction, selection and monitoring of therapeutic response by administration of agents, accompanied by imaging, to detect the location, amount, and fate of the agents in normal and pathologic structures. This implies multi-temporal, image-based evaluation of tracers and metabolites in a detailed anatomic framework that could require multiple modalities and post-processing of complex data sets.

- Diagnosis of functional disorders and classification of tissue as normal or pathologic based on exogenous agents that may be tailored to specific cellular processes or genetic expressions.
- Synthesis of new diagnostic agents or therapeutic pharmaceuticals with attention to quality control, toxicology, biodistribution, and breakdown products, often involving radiochemistry, pharmacokinetics and pharmacodynamics of macromolecules.

Shared Interests Within the IRG:

- With BMIT and MI regarding imaging modalities, the application of exogenous contrast agents *in vivo* or *in vitro*, and involves applications where equipment, software and technique development are underway simultaneously with application development, evaluation and validation. Where emphasis is on the development of molecular probes, contrast agents, or molecular imaging techniques, the application should be reviewed in BCAP.

Shared Interests Outside the IRG:

- Imaging is pervasive in biomedical research, thus there are shared interests with all other IRGs, the review venue should be based on the nature of the scientific questions being addressed. Where emphasis is on the development of molecular probes, contrast agents, or molecular imaging techniques, the application should be reviewed in BCAP.

II. Biomedical Imaging Technology (BMIT)

The Biomedical Imaging Technology (BMIT) study section reviews grant applications involving basic, applied, and pre-clinical aspects of the design and development of medical imaging systems, their components, software, and mathematical methods, as well as related technologies, for studies at the organ, small/large animal, and human scale.

Specific Areas Covered by BMIT Include:

- Component technologies used in the design, development, implementation, testing and application of imaging systems such as image detectors and related energy conversion devices; ionizing and non-ionizing detectors; magnets and coils; and other device technologies used in the acquisition of image data.
- Physics and mathematics of medical imaging devices and systems for hardware and software development: application of methods of applied mathematics for solving inverse problems using iterative, non-iterative, deterministic and probabilistic approaches; and analysis of complex dynamical systems.
- Medical image processing methods: display, and computational resources for reconstruction, registration, segmentation, visualization, and analysis of 2-, 3-, and 4- (or higher dimensional) data sets.
- Medical image analysis used in conjunction with other sources of image and non-image data including: multi-media data, data transmitted and archived in databases for data mining, artificial intelligence, computer vision, and computer-aided diagnosis.
- Presentation of images for human observers, derived from voluminous multi-dimensional data sets by visualization, including: man-machine interfaces; real-time interactive systems; multi-modality fusion; multi-temporal data sets; and workstation software and hardware design, implementation, and psychophysical testing.

- Development of methods and strategies for tissue characterization based on images to derive estimates of their local and global biophysical, biochemical, biological, and imaging properties.
- Image-guided interventions that require high performance computing and display for interactive man-machine environments that simultaneously, or sequentially, diagnose, plan, treat, update, and follow-up the use of surgical or physical interventions for both neoplastic and non-neoplastic conditions.
- Imaging system integration to accomplish specific tasks based on assembly of component technologies with one or multiple modalities, including high performance computing environments and software.

Shared Interests Within the IRG:

- With BCAP and MI regarding imaging modalities, the application of exogenous contrast agents *in vivo* and *in vitro*, and involves applications where equipment, software and technique development are underway simultaneous with the development, evaluation, and validation of the application. Applications for which the emphasis is on the design or development of medical imaging systems, their components, or software should be reviewed by BMIT.

Shared Interests Outside the IRG:

- Imaging is pervasive in biomedical research, thus there are shared interests with all other IRGs, IRG assignment should be made on the nature of the scientific questions being addressed. Applications for which the emphasis is on the design or development of medical imaging systems, their components, or software should be reviewed by BMIT.

III. Medical Imaging (MI)

The Medical Imaging (MI) study section reviews proposals involving the application and validation of *in vivo* imaging of humans and small/large animals, including early phase clinical studies of medical imaging systems, agents, software, mathematical methods, and related technologies. The underlying technologies may be refined and optimized during the testing in response to research questions or clinical needs.

Specific Areas Covered by MI Include:

- Application and validation of prototype, and widely available, medical imaging systems to evaluate improvements in underlying technologies.
- Pre-clinical, Phase-I, and -II clinical trials of medical imaging systems and accessories.
- Prediction, selection, and monitoring of therapeutic response based on imaging studies, with or without exogenous agents, using one or more modalities, especially for multi-temporal investigations to measure changes relative to a pretreatment baseline.
- Applications of imaging systems and modification of diagnostic methods for use in: screening; characterizing biological effects, such as normal tissue tolerance or low-level radiation effects; and assessing risk.
- Image-guided interventions in integrated diagnostic and therapeutic systems.
- Methodology for validation of medical imaging systems including: reference objects, databases, quality control criteria, software metrics, and related components.

- Medical-image-observer performance: modeling, metrics, calibration, standards, and simulation of ideal observers using principles of psychophysical experimentation.
- *In vivo* strategies and methods for characterizing tissues based on estimate of biophysical, (biomechanical, bioelectrical, etc.) biochemical, metabolic, perfusion/diffusion, or other properties determined locally or globally by imaging to distinguish between normal and pathologic states.
- Development of surrogate endpoints based on quantitative imaging for use in clinical trials of medical devices, pharmaceuticals, biologics and other therapeutic interventions.
- Incorporation of the results of imaging in medical decision making; modeling imaging systems and applications; application of medical imaging to various populations and throughout the phases of growth and development; use of imaging in outcome evaluation; and cost modeling of medical imaging systems and their applications.
- Development and application of standards for control of image quality and imaging software using reusable, portable, extensible and open source approaches.
- Integrative, correlative and comparative studies of normal and pathologic states that employ multi-modal, multi-temporal, and multi-dimensional medical imaging systems and techniques.

Shared Interests Within the IRG:

- With BCAP and BMI regarding (1) modalities, the applications of exogenous contrast agents *in vivo* and *in vitro*, and (2) applications where equipment, software and technique development is underway simultaneous with the development, evaluation, and validation of applications. Proposals that emphasize the application or validation of *in vivo* imaging approaches should be reviewed by MI.

Shared Interests Outside the IRG:

- Imaging is pervasive in biomedical research, thus there are shared interests with all other IRGs, review venue should be decided on the basis of the scientific questions being addressed. Proposals that emphasize the application or validation of *in vivo* imaging approaches should be reviewed by MI.

IV. Biomedical Computing and Health Informatics (BCHI)

The biomedical computing and health informatics study section reviews applications involving both basic research and application of computational sciences to knowledge and information in biomedicine, healthcare and their integration. The focus is on the development and application of computational modeling and computational sciences to biomedical and clinical problems. This includes methods and techniques from such disciplines as software engineering, telecommunications, human-computer interaction, advanced computing architectures, and knowledge/information management. This study section reviews all grant mechanisms, including SBIR and STTR.

Specific Areas Covered by BCHI Include:

- Application of modeling methods to various levels of normal and pathophysiological processes.
- Application and development of human-centered computing (human-machine interfaces) to biomedical and clinical systems, including the application of social

sciences, cognitive sciences, ergonomics and the study of collaboration to engineer-usable effective software systems.
- Application of intelligent systems to biomedical and clinical problems.
- Application of data analysis, management, and mining to areas such as: electronic medical records, picture archiving, tele-imaging, consumer informatics, population-based databases, and probabilistic atlases.
- Development of medical and biomedical knowledge and information-management systems, including ontologies and controlled vocabularies.
- Application of clinical and biomedical software engineering, including software validation in clinical situations.
- Development of telemedicine systems.
- Development of computer-assisted diagnosis and treatment systems with non-imaging data.
- Integration of information and knowledge management regarding genomics and proteomics with clinical information.
- Application of advanced computing architectures to biomedical and clinical information and knowledge management.
- Application of computational techniques based on the imitation of biological processes such as artificial life, genetic and evolutionary computing (Bio-mimetics).
- Application of virtual environments to the solution of biomedical and clinical problems.
- Development and dissemination of standards in biomedical computing and health informatics.
- Development and application of evaluation and validation techniques for biomedical and health informatics systems and applications.

Shared Interests Within the IRG:
- BMIT, BCAP, and MI review applications that focus on specific methods, techniques or validation of medical and biomedical imaging questions. If the emphasis is on informatics they should be reviewed by BCHI.
- BSST and BSMI review applications that develop or use informatics within the context of medical devices and instrumentation. If the emphasis is on informatics they should be reviewed by BCHI.

Shared Interests Outside the IRG:
- Applications in which informatics is used merely as a tool in the basic or biomedical discovery process or to support clinical studies would be assigned to study sections dealing with the particular biomedical or clinical topic. If the emphasis is on informatics they should be reviewed by BCHI.
- Applications dealing with the particular biomedical or clinical topic should be reviewed in IRGs treating that topic; applications in which the basic research, development, or implementation questions or issues are focused on informatics and use a biomedical discovery, process, or clinical area to demonstrate and/or validate the approach should be reviewed by BCHI.

V. Biomedical Sensing, Measurement and Instrumentation (BSMI)

This study section reviews grant applications involving biomedical sensing, measurement, and the development of diagnostic and therapeutic instrumentation. Research that focuses on the development of innovative sensors ranges from fundamental physical,

mechanical or chemical transduction through basic measurement principles to the design of novel instruments for clinical deployment.

Specific Areas Covered by BSMI Include:

- Sensor technology: including micro- and nanotechnology and micro-electromechanical systems.
- Measurement devices and systems including diagnostic instrumentation, instrumentation for animal models, and patient monitoring.
- Processing biological signals and control systems.
- Design and development of hybrid systems including tissue-engineered constructs, and device-tissue interfaces and interactions.

Shared Interests Within the IRG:

- BMIT reviews: developments of new technology, system design, detector methods and image acquisition. If the emphasis is on instrument development it should be reviewed by BSMI.
- BSST reviews grant applications involving biomedical devices and systems for treating human diseases. If the emphasis is on instrument development it should be reviewed by BSMI.
- SCCT reviews surgical applications of new technology in the areas of transplantation surgery, cardiovascular and thoracic surgery and critical care. If the emphasis is on instrument development it should be reviewed by BSMI.

Shared Interests Outside the IRG:

- IRG-6 Fundamental BioMedical Technology Development
- With organ-system IRGs: Applications focused on bioengineering or instrument development should be reviewed by BSMI.

VI. Bioengineering, Surgical Sciences and Technology (BSST)

Applications reviewed by BSST integrate physical, chemical, or mathematical sciences and engineering principles to study biology, medicine, behavior, and health. These applications exhibit a systematic, quantitative, and integrative way of thinking about and approaching the solution of problems important to biology and clinical medicine. They advance fundamental and applied concepts, creating knowledge for enhancing the function and recovery of organ systems; or they develop innovative biologics, materials, processes, implants, devices, and informatics approaches for the prevention, diagnosis, and treatment of disease. Surgical science applies biomedical devices and instrumentation to the study, diagnosis, and treatment of living systems. Pre-clinical studies involving the application of devices/instrumentation are also included.

Specific Areas Covered by BSST Include:

- Therapeutic devices and systems, including artificial organs, implantable medical devices, bio-molecule delivery/immobilization devices, neural stimulation and neural prostheses, rehabilitative devices, as well as cardiovascular and other prosthetic devices.
- Advanced techniques and devices that permit tissue engineering, endosurgical approaches, catheter-based surgery, minimally invasive surgery, microsurgical procedures, monitoring devices, robotics, and image-guided intervention.

- Development of cellular and tissue-engineered constructs, including: design, construction, and pre-clinical and clinical evaluation of function.
- Experimental studies in animal models and pre-clinical human studies of surgical systems and technologies.
- Biomechanics, including: molecular and cellular mechanics, mechanics of injury, cardiovascular, as well as musculoskeletal and orthopedic mechanics.
- Fluid mechanics, circulation, microcirculation, and transport systems.
- Development of rehabilitative and assistive technologies, limb prostheses, and robotic applications.
- Vertically integrated development of medical devices from bench to bedside, pre-clinical human studies, translational medical device development, and clinical validation of medical devices.
- Optimization of design, development of standards, as well as monitoring and evaluation of devices.

Shared Interest Within the IRG:

- BMIT reviews the development of new technology, system design, detector methods and image acquisition systems. Applications in which the emphasis is on the integration of physical, chemical, mathematical or engineering principles in the study of biology, medicine, behavior, or health should be reviewed by BSST.
- BSMI reviews proposals for diagnostic, measurement and instrumentation applications of biomedical technology. Applications in which the emphasis is on the integration of physical, chemical, mathematical or engineering principles in the study of biology, medicine, behavior, or health should be reviewed by BSST.
- SCCT reviews surgical applications of new technology in the areas of transplantation surgery, cardiovascular and thoracic surgery and critical care. Applications in which the emphasis is on the integration of physical, chemical, mathematical or engineering principles in the study of biology, medicine, behavior, or health should be reviewed by BSST.
- SAT reviews grant applications focused on anesthesiology, host responses to sepsis and injury, wound repair and injury modulation. Applications in which the emphasis is on the integration of physical, chemical, mathematical or engineering principles in the study of biology, medicine, behavior, or health should be reviewed by BSST.

Shared interest outside the IRG:

- IRG-6 (Fundamental Bioengineering and Technology Development) reviews applications in the fundamental aspects of cell and tissue engineering and molecular and cellular mechanics. BSST reviews grant applications involving the integration of physical, chemical, mathematical or engineering principles in the study of biology, medicine, behavior, or health.
- Studies that are focused on a particular organ are reviewed in the appropriate organ-specific IRG. Applications where the emphasis is on the integration of physical, chemical, mathematical or engineering principles in the study of the organ system should be reviewed by BSST

VII. Surgery, Anesthesiology and Trauma (SAT)

Anesthesiology and host responses to sepsis and injury (trauma, burn, surgical stress, cardiopulmonary resuscitation and tissue respiration) are reviewed in SAT. The study

section reviews predominantly R0-1 applications, but will also review mentored training and SBIR applications relevant to the topics covered.

Specific Areas Covered by SAT Include:

- Wound repair/scarring and tissue regeneration, changes in metabolism associated with trauma, burn, surgical stress, cardiopulmonary resuscitation, and cell signaling/priming/preconditioning, and gene transfer strategies to promote injury modulation.
- Anesthesiology including: pain management, basic aspects of cardiovascular surgical sciences, ischemia/reperfusion, Systemic Inflammatory Response, formed blood elements-endothelial cell interactions, pharmacologic modulation of trauma/surgical stress (including the impact of gene polymorphisms), studies of the etiology and intervention of multiple organ dysfunction, and nutritional/metabolic support of the injured patient.

VIII. Surgery, Surgical Critical Care, and Transplantation: Systems and Tissue Aspects of Surgery (STAS)

Reviews predominantly R01 applications, but will also review mentored training and SBIR applications relevant to topics covered by STAS.

Specific Areas Covered by STAS Include:

- Organ, tissue, and cellular transplantation, surgical implications of immunobiology, organ preservation, and plastic/reconstructive surgery.
- Gastrointestinal surgery.
- Cardio thoracic and vascular/microcirculatory surgical and microsurgical therapies,
- Surgical critical care, and emergency medicine.
- Pulmonary and cardiovascular responses to trauma/surgery/physiologic stress and their implications in rehabilitation.
- Studies that utilize a multi-modal approach to clinical correlations.

Shared Interests Within the IRG:

- BSST reviews studies applying new technology to anesthesiology, surgery, and critical care medicine as well as tissue engineering.

Shared Interests Outside the IRG:

- IRG-10 (Immunology): Shares interest in immunologic aspects of surgery and transplantation.
- IRG-11 (Infectious Disease and Microbiology): Shares interest in infectious diseases and agents.
- IRG 14 (Hematology): Shares interest in bone marrow transplantation and other aspects of thrombosis and activation of coagulation in settings other than sepsis.
- IRG-15 (Cardiovascular Sciences): Shares interest in cytokines/nitric oxide and sepsis.
- IRG-16 (Endocrinology, Metabolism, and Reproductive Sciences): Shares interest in islet function in transplantation.
- IRG-19 (Pulmonary Sciences): Shares interest in acute lung injury, particularly as it relates to multi-organ dysfunction.

IX. SBIR Biomedical Imaging (SBIR-BMI)

The SBIR Biomedical Imaging (SBIR-BMI) study section reviews SBIR and STTR grant applications involving basic, applied and clinical aspects of the development of molecular probes and contrast agents, molecular imaging devices, and related technologies. It also reviews applications involving basic, applied and pre-clinical aspects of the design and development of medical imaging systems, their components, software and mathematical methods, and related technologies. Also reviewed are proposals involving the application and validation of *in vivo* human and animal imaging, including early phase clinical aspects of medical imaging systems, agents, software and mathematical methods, and related technologies. The underlying technologies may be refined and optimized during this testing in response to research questions and clinical needs.

Specific Areas Covered by SBIR-BMI Include:

- Prediction, selection, and monitoring of therapeutic response by administration of agents accompanied by imaging to detect the location, amount, and fate of normal and pathologic structures. This implies multi-temporal image-based evaluation of tracers and metabolites in a detailed anatomic framework that could require multiple modalities and post-processing of data sets.
- Diagnosis of functional disorders and classification of tissue as normal or pathologic based on exogenous agents that may be tailored to specific cellular processes or genetic expressions.
- Synthesis of new diagnostic agents or therapeutic pharmaceuticals with attention to quality control, toxicology, biodistribution, and breakdown products, often involving radiochemistry, pharmacokinetics or pharmacodynamics of macromolecules.
- Component technologies used in the design; development; implementation; testing; and application of imaging systems (such as image detectors and related energy conversion devices, ionizing and non-ionizing detectors, magnets and coils, and other device technologies used in the acquisition of image data).
- Physics and mathematics of medical imaging devices and systems for hardware and software development: application of methods of applied mathematics for solving inverse problems using iterative, non-iterative, deterministic and probabilistic approaches; and analysis of complex dynamical systems.
- Medical image processing methods: display, and computational resources for reconstruction, registration, segmentation, visualization, and analysis of 2-, 3- and 4- or higher dimensional data sets.
- Medical image analysis used in conjunction with other sources of image and non-image data including: multi-media data, data transmitted and archived in databases for data mining, artificial intelligence, computer vision, and computer-aided diagnosis.
- Presentation of images for human observers, derived from voluminous multi-dimensional data sets by visualization, including man-machine interfaces, real-time interactive systems, multi-modality fusion, multi-temporal data sets, and workstation software and hardware design, implementation, and psychophysical testing.
- Development of methods and strategies for tissue characterization based on images to derive estimates of their local and global biophysical, biochemical, biological, and imaging properties.
- Image-guided interventions that require high performance computing and display for interactive man-machine environments that simultaneously or sequentially diagnose,

plan, treat, update, and follow-up the use of surgical or physical interventions for both neoplastic and non-neoplastic conditions.
- Imaging system integration to accomplish specific tasks based on assembly of component technologies with one or multiple modalities, including high performance computing environments and software.
- Application and validation of prototype and widely available medical imaging systems, when there are improvements in underlying technologies.
- Pre-clinical and Phase-I, and -II clinical trials of medical imaging systems and accessories.
- Prediction, selection, and monitoring of therapeutic response based on imaging studies, with or without exogenous agents, using one or more modalities, especially for multi-temporal investigations to measure changes relative to a pretreatment baseline condition.
- Applications of imaging systems and modification of diagnostic methods for use in: screening; characterizing biological effects, such as normal tissue tolerance or low-level radiation effects; and assessing risk.
- Image-guided interventions in integrated diagnostic and therapeutic systems.
- Methodology for validation of medical imaging systems, including: reference objects, databases, quality control criteria, software metrics, and related components.
- Medical-image-observer performance metrics, calibration, standards and simulation of ideal observers using principles of psychophysical experimentation and modeling.
- *In vivo* strategies and methods for characterizing tissues based on estimated biophysical, (biomechanical, bioelectrical, etc.) biochemical, metabolic, perfusion/diffusion, or other imaging properties, determined locally or globally, to distinguish between normal and pathologic states.
- Development of surrogate endpoints based on quantitative imaging for use in clinical trials of medical devices, pharmaceuticals, biologics and other therapeutic interventions.
- Incorporation of imaging examination in medical decision making, modeling of imaging systems and applications; application of medical imaging to populations and through growth and development; the use of imaging in outcome evaluation; and cost modeling of medical imaging systems and their applications.
- Development and application of standards for control of image quality and imaging software using reusable, portable, extensible and open source approaches.
- Integrative, correlative and comparison studies of normal and pathologic states that employ multi-modality, multi-temporal, and multi-dimensional medical imaging systems and techniques.

Shared Interests Within the IRG:
- With BCAP, BMI, and MI, however, SBIR-BMI reviews predominantly SBIR and STTR grant applications.

Shared Interests Outside the IRG:
- Imaging is pervasive in biomedical research, thus there are shared interests with all other IRGs, review venue should be decided on the nature of the scientific questions being addressed.

X. Biomedical Sensing, Measurement and Instrumentation (SBIR)

This study section reviews grant applications from small businesses involved in innovative research and technology development on biomedical sensing, measurement, and diagnostic instrumentation.

Specific Areas Covered:
- Sensor technology, micro- and nanotechnology and micro-electromechanical systems.
- Measurement devices and systems, including diagnostic instrumentation, instrumentation for animal models, and patient modeling.
- Processing biological signals and control systems.
- Design and development of hybrid systems including tissue engineered constructs, and device-tissue interfaces and interactions.

Shared Interests Outside the IRG:
- IRG 6 (Fundamental Bioengineering and Technology Development) with regard to micro- and nanotechnology.

XI. Bioengineering, Surgical Sciences and Technology (SBIR)

This study section reviews grant applications from small businesses involved in innovative research and technology development of biomedical devices and systems for treating human diseases. These grant applications involve integration of biomedical devices into living systems. They propose systematic, quantitative, and integrative approaches to thinking about and addressing problems important to biology and clinical medicine.

Bioengineering and surgical sciences integrate physical, chemical, or mathematical sciences and engineering principles into the study of biology, medicine, behavior, and health. It develops innovative biologics, materials, processes, implants, devices, and informatics approaches for the prevention, diagnosis, and treatment of disease. Surgical sciences integrate the device and instrumentation applications to living systems. Applications involving the emerging areas of minimally invasive surgery, microsurgery, computer-assisted surgery, and robotics are reviewed in this study section. Pre-clinical studies and application of device/instrumentation are also welcome.

Specific Areas Covered:
- Therapeutic devices and systems: including artificial organs, implantable medical devices, bio-molecule delivery/immobilization devices, neural stimulation and neural prostheses, rehabilitative devices, cardiovascular and other prosthetic devices.
- Advanced techniques and devices that permit tissue engineering, endosurgical approaches, catheter-based surgery, minimally invasive surgery, microsurgical procedures, monitoring devices, computer-assisted diagnosis, therapy and surgery, robotics, and image-guided intervention.
- Development of cellular and tissue-engineered constructs, including design, construction and pre-clinical and clinical evaluation of function.
- Rehabilitative and assistive technologies, limb prostheses, and robotic applications.
- Development of vertically integrated medical devices, pre-clinical human studies, translational medical device development and clinical device validation.
- Optimization of design, development of standards, and monitoring and evaluating devices.