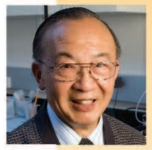
The Institute of Engineering in Medicine (IEM) was established in 2008 at UC San Diego to bring together outstanding faculty in its Jacobs School of Engineering, School of Medicine, Skaggs School of Pharmacy and Pharmaceutical Sciences, and other units, for interdisciplinary research and education at the interface of engineering and medicine for the improvement of health care.



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Local Impact, National Influence, Global Reach

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SYNERGIZING ENGINEERING AND MEDICINE TO IMPROVE HEALTH CARE

Institute of Engineering in Medicine

UC San Diego

Cardiac Biomedical Science and Engineering Center

Co-directors

Sylvia Evans, Ph.D.,
Professor of Pharmaceutical Sciences

Robert S. Ross, M.D.,
Professor of Cardiovascular Medicine
AVC Health Sciences, Academic Affairs

Andrew D. McCulloch, Ph.D.,
Professor of Bioengineering and Medicine

The mission of the **Cardiac Biomedical Science and Engineering Center (CBSEC)** is to synergize the expertise in cardiac research and its translation at UC San Diego and neighboring institutions to combat heart diseases. CBSEC brings together scientists and students from the UC San Diego School of Medicine, the Skaggs School of Pharmacy and Pharmaceutical Sciences, the Jacobs School of Engineering, and other institutions. Together they are creating innovative technologies for cutting-edge cardiac research, elucidating the pathogenic mechanisms of cardiac diseases, and developing novel strategies to improve diagnosis, treatment, and prevention.

The main research areas include cardiac development, cardiac hypertrophy, heart failure, cardiac ischemia/hypoxia, and cardiac regeneration. Unique to CBSEC is the utilization and development of state-of-the-art bioengineering technologies in combination with sophisticated cellular and molecular biological approaches. The bioengineering technologies include biomechanics, tissue engineering, biomaterials, biomedical imaging, biophotonics, systems biology, and multiscale modeling.

UCSD has a strong cardiac mechanics program, which is enhanced by CBSEC's research of the mechanics of ventricular myocardium in relation to heart diseases and tissue remodeling. The interplay between mechanics and electrical activity, which is especially important in heart failure and arrhythmias, is studied by combining in vitro, in vivo, and in silico approaches. Computation modeling and analysis are applied to bedside to improve clinical management of heart diseases. CBSEC is also exploring the great potentials of stem cells and biomaterials for regenerative medicine therapy to restore, maintain, and/or enhance tissue and organ functions.

The Cardiac Biomedical Science and Engineering Center develops innovative approaches to diagnose, treat and prevent heart diseases, trains the next generation of physicians and scientists, and enhances academia-industry interactions.

The focus of the interdisciplinary research is closely linked to the training of the next generation of physicians and scientists, the enhancement of academia-industry interactions, and the translation of research findings to clinical medicine in collaboration with the Sulpizio Family Cardiovascular Center. The ultimate goals are to benefit patients suffering from heart diseases and to improve the health and well-being of all citizens.

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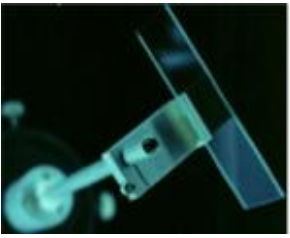
UC San Diego

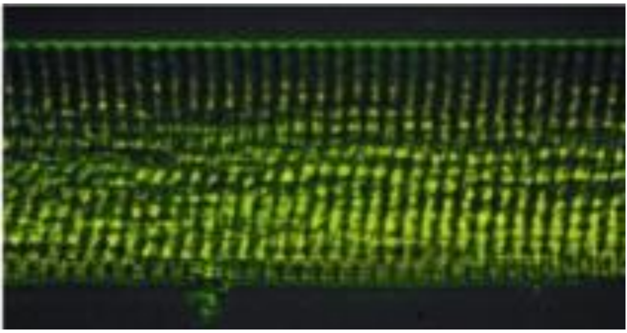
Center for Musculoskeletal Research

Co-directors
Robert Sah, M.D., Sc.D.
Professor of Bioengineering and Orthopaedic Surgery

Samuel Ward, P.T., Ph.D.,
Professor of Radiology and Orthopaedic Surgery

The mission of the IEM **Center for Musculoskeletal Research (CMSR)** is to synergize the expertise in musculoskeletal research within the San Diego community and to translate it into improved treatment of musculoskeletal diseases. The CMSR will bring together scientists, engineers, and clinicians in the UCSD Jacobs School of Engineering, UCSD Health Sciences, neighboring research institutes and industry to elucidate mechanisms of pathogenesis of musculoskeletal disease, create innovative technology for cutting-edge musculoskeletal research, and develop novel strategies to improve diagnosis, treatment and prevention of musculoskeletal diseases.





The Center for Musculoskeletal Research (CMSR) has a synergistic cross-Departmental structure, with members from UCSD Departments of Bioengineering, Medicine, Orthopaedic Surgery, Radiology, and Surgery, as well as neighboring institutions. CMSR members have a track record of strong interdisciplinary collaboration in musculoskeletal science and engineering, applied to health and diseases. This Center harnesses the multitude of strengths that exist on the La Jolla Mesa and provides a synergistic and entrepreneurial environment for creating new knowledge and solving challenging problems.

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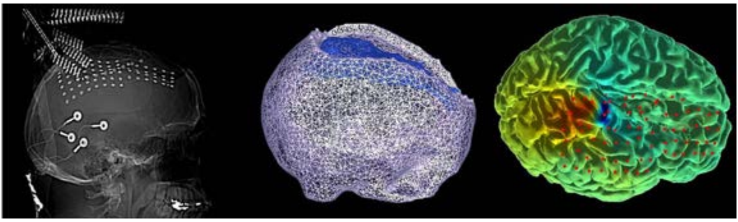

(Left) CT scan of a patient with implantable electrodes. (Middle) Mathematical model of the brain. (Right) Source of epileptic seizure. Red represents positive potentials and blue negative ones.

Center for Advanced Neurological Engineering

Co-Directors
William Mobley, M.D., Ph.D.,
Professor and Chair of Neuroscience

Tzyy-Ping Jung, Ph.D.,
Senior Research Scientist, INC, and Co-director, Swartz Center for Computational Neuroscience

Operated jointly by the Institute of Engineering in Medicine and the Institute of Neural Computation

The mission of the **Center for Advanced Neural Engineering (CANE)** is to integrate the abundant expertise in neural engineering and computation at UCSD with basic scientific and clinical knowledge of the nervous system to improve the diagnosis, treatment, and prevention of neurological diseases and injuries. The center will characterize and clarify neuropathogenic processes, create and apply innovative technologies for advanced neuroscience research, and develop novel methods and strategies to create new ways for improving the lives of patients with neurological disorders.

The center will focus on novel approaches to recording and modeling brain activities and body functions, including the combination of electroencephalographic, electromyographic, behavioral, and physiological measures. Emerging microelectronic technologies will be used to develop human noninvasive, high-density, multimodal, mobile brain/body imaging and analyses, and implantable applications of closed-loop systems. The center will enable wireless transmission of a patient's health status and their needs to health providers to enable noninvasive, personalized remote health care, real time, high-content phenotyping, and longitudinal follow-up. The center will also develop and apply advanced computational approaches to analyzing the flow of information, and create smart databases interfaced with online data mining, allowing the translation of advances in neuroscience into health care in the clinic, the workplace, and the home. Advanced statistical methods, including independent component analysis, will be employed to enable high-throughput feedback to the subject and a reduction of health care costs. These approaches will facilitate diagnosis, monitoring of treatment efficacy, and prediction of outcome for neurological diseases such as Parkinson's disease, Alzheimer disease, Huntington disease, Down syndrome, Lou Gehrig's disease, cerebral palsy, sleep disorders, stroke, and traumatic brain injury.

The Center for Advanced Neurological Engineering will create a leading effort for understanding and treating the nervous system in order to improve the lives of individuals afflicted with neurological diseases.

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Center for Medical Device and Instrumentation

Co-directors
Juan C. Lasheras, Ph.D.
Professor of Mechanical & Aerospace Engineering and Bioengineering

Steven Sparks, M.D.
Associate Physician in Surgery

The mission of the **Center for Medical Device and Instrumentation (CMDI)** is to achieve interdisciplinary innovation to design personalized, intelligent biodevices, especially microdevices. These engineered microdevices will revolutionize current medical protocols and play a central role in bringing about a decentralized paradigm shift for the benefits of patients and the nation as a whole. The CMDI will perform key fundamental research to enable new technology and to translate these basic discoveries into tangible, innovative designs with the close participation of industrial partners. The main innovation of our approach is to develop novel control strategies with smart, dynamically interfaced on-body biosensors and actuators that can control drug release, electrical stimulation and other therapeutic outputs by means of a combination of intelligent feedback and global wireless interconnectivity. These systems will be matched to specific physiological and metabolic sensors embedded in networks of newly designed biodevices for the intelligent management of chronic diseases.

The principal aims of the CMDI are to 1) foster synergistic collaborations in the area of medical devices and instrumentation among faculty members currently in various departments in the School of Medicine and the Jacobs School of Engineering, 2) facilitate the incubation of novel concepts and ideas and to catalyze the technology transfer and commercialization of UCSD inventions in the area of medical devices, 3) establish strategic partnerships with the industrial sector for the development of novel ideas and concepts in medical devices and instrumentation, and 4) satisfy the currently unmet demand for the education of students and the continuous training of scientists and engineers in the growing medical devices industry.

The CDMI collaborates with the UC San Diego's Center for the Future of Surgery in working withmedical device companies and engineering faculty to improve patient care with advances such as robotic surgery devices and instruments that allow surgery with no scars.

The Center has defined seven thrust areas: Metabolic Biosensors; Drug Delivery Systems; Neural Interfaces and Integrated Physiological Instrumentation; Control of Implantable and Wearable Biodevices; Biomaterials; Power Autonomy, Data Accessibility, and Interconnectivity; and System Integration and Embedded Life Sciences Applications.

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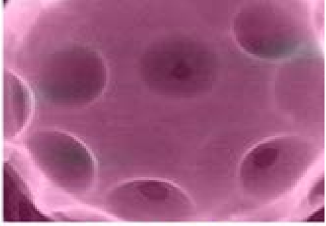
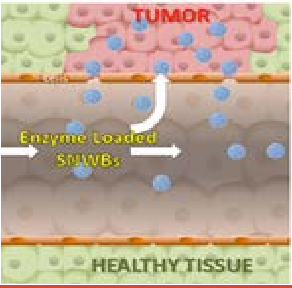
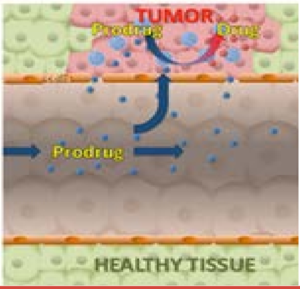
Center of Excellence for Nano-Medicine and Engineering







Co-directors
Adah Almutairi, Ph.D.,
Associate Professor of Pharmaceutical Sciences

Ratneshwar Lal, Ph.D.,
Professor, Bioengineering, UC San Diego
Professor, Mechanical and Aerospace Engineering, UC San Diego

The mission of the IEM **Center of Excellence for Nano-Medicine and Engineering (CNME)** is to synergize the expertise in nanotechnology, bioengineering and medical research in the San Diego community and to translate it to the clinic. Because of its multidisciplinary nature, nanomedicine can benefit immensely from collaboration between Engineering and the Health Sciences. UCSD has one of the few engineering schools (JSOE) that can provide expertise and collaboration in bio-nanotechnology with its recently established NanoEngineering department (one of the first in the nation) in close collaboration with its world renown Bioengineering department in areas emphasized by Health Science including oncology research at the Moores Cancer Center, new imaging and surgical modalities at the departments of radiology and surgery, applications of nanotechnology to treating eye disease at the Shiley Eye Institute, and cell biology and regenerative medicine research at the Skaggs School of Pharmacy and Pharmaceutical Sciences.

The Center for Excellence in Nanomedicine and Engineering (CNME) aims to use responsive and smart materials, nanotechnology, and molecular engineering to transform biological research and medicine.

Nanomedicine is the application of nanotechnology in health research and translation to prevent and treat human diseases. Sub-cellular components and viruses exist and operate at the nanoscale and thus, nanomedicine involves the development of medical applications at the most basic scale of the human body. Some of the potential applications of nanomedicine include:

- In the nearest term, drug delivery systems to improve bioavailability and pharmacokinetic compatibility, targeted imaging contrast agents for MRI and Ultrasound techniques, and assistance in surgical procedures such as determining surgery margins;
- In the medium term, applications to artificial tissues and organs and engineered enzymes; and
- In the longer term, ultimately nano-devices that can be programmed and controlled to target and repair individual cells.

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Whitaker Center for Biomedical Engineering

Director
John Watson, Ph.D.
Professor of Bioengineering

A major goal of the **Whitaker Center for Biomedical Engineering (WCBE)** is to foster interactions between the UC San Diego Department of Bioengineering, constituents of the Institute of Engineering in Medicine, and industry, with a focus on training students in biomedical engineering.

INDUSTRIAL AFFILIATE MEMBERS AND INDUSTRIAL ADVISORY BOARD

WCBE has industrial affiliate member companies that have representation on the Industrial Advisory Board (IAB). IAB is a forum for advising WCBE on policies and developing activities that benefit students, faculty, and industry. IAB is the conduit for student-employer relationships—it enhances students' professional development and provides member companies with specialized access to students for internship and career oportunities. IAB also matches member companies with IEM faculty and researchers who have common research interests.

ACCESS TO IEM FACULTY AND RESEARCHERS

IEM has more than one hundred faculty members from disciplines that include engineering, medicine, pharmaceutical services, biology, physics, and chemistry. Member research interests include biotechnology; medical devices; cell biology and biophysics; computation and modeling; molecular biology; tissue, organ, and system responses in health and disease; and translational research.

Through the Whitaker Center of Biomedical Engineering, IEM is training the next generation of scientists to become leaders in applying engineering principles to advance medical care.

ACCESS TO THE INDUSTRIAL INTERNSHIP PROGRAM

WCBE, in cooperation with the Department of Bioengineering, cosponsors the Graduate and Undergraduate Internship Program. Industrial affiliate members receive priority access to students and their placement.

COMPANY VISITS

WCBE coordinates on-campus and company site visits, providing industry professionals and students an opportunity to discuss research and collaborative possibilities with UCSD.

COMPANY SPONSORED EVENTS AND OUTREACH

IAB, working with WCBE, sponsors many student programs, as well as a new seminar series that focuses on science and engineering advances created in the laboratories of industry.

DIVERSITY

Amgen Scholars Program
Hughes Scholars Program
Initiative for Maximizing Student Diversity

The Whitaker Center's quarterly newsletter can be found on the IEM Web site.

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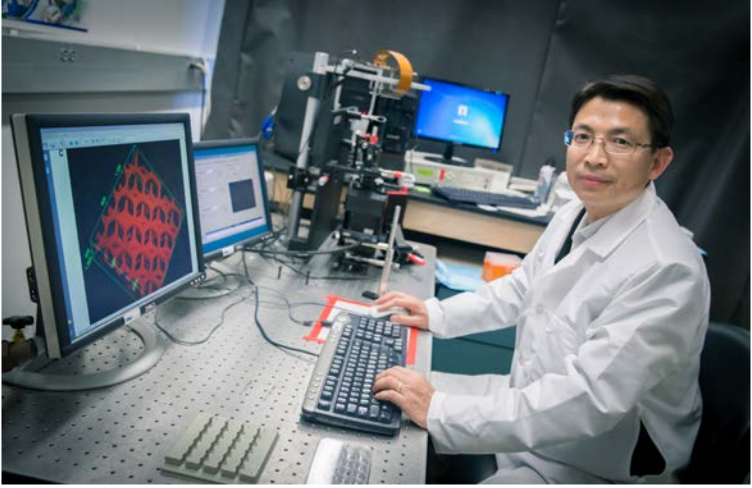

Biomaterials and Tissue Engineering Center

Co-directors
Shaochen Chen, Ph.D.
Professor, NanoEngineering and Bioengineering

Kang Zhang, M.D., Ph.D.
Professor of Ophthalmology

Tissue engineering is an emerging multidisciplinary field involving biology, medicine, materials and engineering that is likely to revolutionize the ways we improve the health and quality of life for millions of people worldwide by restoring, maintaining, or enhancing tissue and organ function. For therapeutic applications, the tissue can be regenerated within the patient or outside the patient and then gets transplanted.
Tissue engineering can also have diagnostic applications where the engineered tissue can be used to test drug metabolism and uptake, toxicity, and pathogenicity.
Important research areas in tissue engineering include biomaterials and bioprinting, stem cell engineering, biomolecular engineering, cell and biomechanics, etc.

The mission of the **IEM Biomaterials and Tissue Engineering Center (BMTEC)** is to synergize the expertise in biomaterials, bioprinting, cell and developmental biology, and medical research in the San Diego community and to translate it for clinical applications. Given its multiscale and multidisciplinary nature, tissue engineering can benefit immensely from collaboration between Engineering, Physical Sciences, and the Health Sciences.

The IEM Biomaterials and Tissue Engineering Center will emphasize translational research so that fundamental knowledge in tissue science and engineering can be applied to clinical problems.

UCSD has a strong team of faculty with expertise in tissue engineering and stem cell in the Jacobs School of Engineering, the School of Medicine, Division of Biological Sciences, and Skaggs School of Pharmacy and Pharmaceutical Sciences.
Our expertise covers a variety of tissues such as bone, cartilage, muscle, neuron, cardiac, liver, kidney, eye, and brain using various biomaterials. The BMTEC investigators have a unique capability in addressing the lengthscale issues of tissue growth from nanometer to micrometer and organ scale using novel biomaterials and bioprinting techniques. Biomechanics issues involved in various cell and tissue types are also important research topics at BMTEC.

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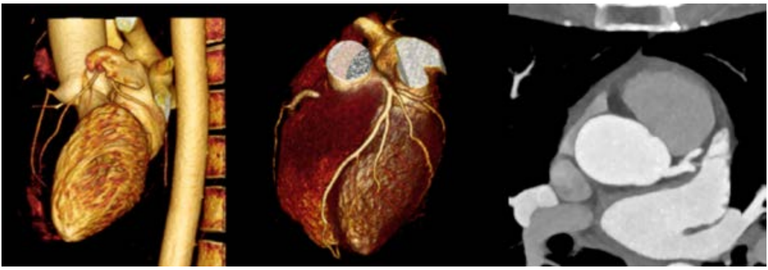

Center for Translational Imaging

Co-directors
Elliot McVeigh, Ph.D.,
Professor of Bioengineering

Alexander Norbash, M.D., M.S.,
Chair/Professor of Radiology

The **Center for Translational Imaging (CTI)** comprises teams of engineers, physicians, graduate students and clinical fellows to bring new imaging technologies into clinical use. Teams are focused on developing solutions for major unmet needs in clinical medicine. The technologies developed can be generated from many disciplines: the physics of image acquisition, imaging hardware, novel clinical protocols, signal processing and image analysis. The broad experience and expertise of the teams encourage rapid prototyping and feedback between disciplines and immediate application to clinical problems. Partnerships with industry give teams the access to engineering expertise and both novel hardware and software to accelerate the development of new clinical techniques. The ultimate goal of the Center is to rapidly put in place new methods of diagnosis and image-guided therapy to reduce suffering. Success is measured by more precise application of therapy and better patient outcomes.

Members of the Center for Translational Imaging develop new imaging biomarkers for early disease detection and new image-guided techniques for precision therapy. Our goal is to dramatically lower death and morbidity through the application of this customized therapy.

Early detection of cardiovascular disease is now possible with new imaging techniques; patients can now receive precision therapy to address their own needs.

As an example, for cardiovascular disease modern CT and MRI techniques allow physicians to evaluate both the morphological and functional states of the human cardiovascular system. Unprecedented resolution and accuracy in vessel morphology, flow, and muscle function and tissue perfusion permit patients and their physicians to plan the appropriate prevention and therapy. Applications include the detection of coronary artery disease well before clinical symptoms arise and the early detection of heart failure. Determination of the appropriate pharmacologic therapy such as statins and anit-coagulation therapy, and determination of the appropriate intervention such as vessel stenting can be vastly improved with new imaging methods under development.

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Retinal Engineering Center

Co-directors
William R. Freeman, M.D.
Professor of Ophthalmology

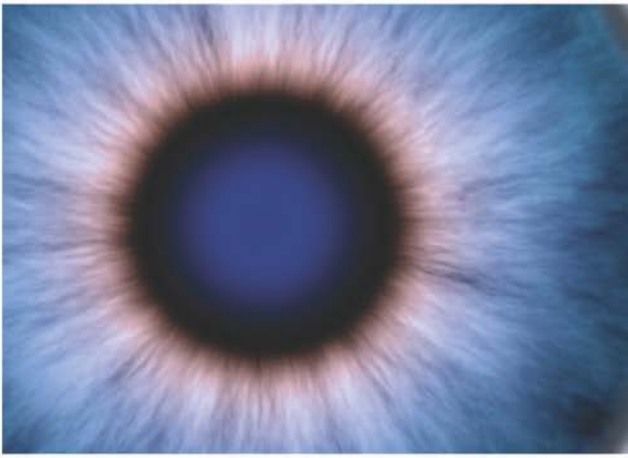
Gabriel A. Silva, Ph.D.
Associate Professor and Jacobs Faculty Fellows Professor of Bioengineering

The mission of the **Retinal Engineering Center (REC)** is to combine the wealth of engineering and medical expertise and resources in the San Diego area to develop a retinal implant capable of restoring vision to patients suffering from any of several retinal diseases. There is a paramount need for such a device, especially given the growing elderly population prone to the most common form of retinal disease: age-related macular degeneration. Improved retinal prostheses will also benefit those suffering from the second most common retinal disease: retinitis pigmentosa, which affects all age groups, notably children with a genetic predisposition.

REC leverages the unique light-detecting and neural-interfacing nanotechnologies developed at UC San Diego. While harnessing the eye's natural capacities, these nanotechnologies are capable of addressing several fundamental challenges plaguing patients who have existing retinal implants.

Building on the interdisciplinary collaborations between the Jacob's School of Engineering and the School of Medicine, REC's research will include nanophotonics, microfabrication, medical device packaging, power and wireless telemetry, neuronal stimulation, and biological interfaces.

REC aims at producing a high-density, high-resolution, long-term visual prosthesis that enables blind patients to perform basic tasks. The effort will provide the UC San Diego community an opportunity to directly contribute to a medical device that will improve the quality of life for patients of all ages. This will help motivate student involvement and prepare young bioengineers for jobs in the medical industry. In addition, the project will create opportunities for patenting technologies developed at UCSD.



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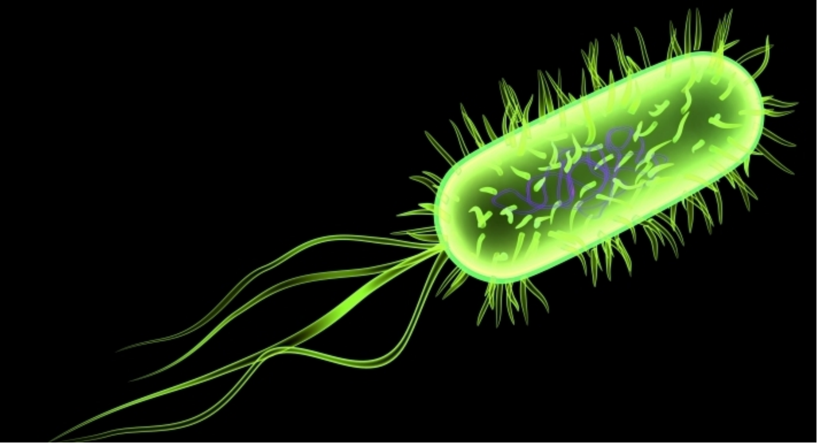

Vaccine Engineering Center

Co-directors
Klaus Ley, Ph.D.,
Adjunct Professor of Bioengineering

Victor Nizet, M.D.,
Professor of Pediatrics and Pharmacy

The vision of the **Vaccine Engineering Center (VEC)** is to meet the need of using engineering approaches to discover novel antigens, epitopes, and adjuvants that can stimulate and manipulate the immune system, as well as their targeted delivery, for the prevention and treatment of important diseases such as cancer and infectious diseases. Vaccination is the single most successful and cost-effective intervention in medical history. However, many of the vaccines that we know and use were discovered more than 50 years ago. About 2 years ago, cancer vaccination moved from a theoretical concept to an actually working intervention. This became possible by manipulating the co-inhibitory receptors PD1 and CTLA4 with antibodies and recombinant fusion proteins.

Many vaccines are delivered by nanoparticles of specific sizes, degradation characteristics, targeted surface molecules, coatings and compositions. Another approach is to engineer virus-like particles. Both are significant research areas in nanotechnology.

Engineering adjuvants is another area where engineering expertise is needed, mainly chemical engineering and formulation science.

A new area in vaccination is the idea of protective autoimmunity, which may lead to vaccinations for autoimmune and other inflammatory diseases.

A third engineering challenge is epitope discovery: Tens of thousands of infectious organisms, autoantigens, cancer antigens and allergens contain millions of epitopes that can be presented to the immune system. Computer engineering challenges exist in curating and standardizing the existing data and aligning them with new data. Much of this is done by computer scientists and bioinformaticians in the Immune Epitope Database (IEDB), a national resource supported by a multi-million dollar contract from the NIH to La Jolla Institute of Allergy and Immunology (LJI).

A new area in vaccination is the idea of protective autoimmunity, which may lead to vaccinations for autoimmune and other inflammatory diseases. The first example of this approach is the atherosclerosis vaccine. Much remains unknown in this exciting new area, including suitable adjuvants, formulations, and the need for priming and booster injections.

Center for Perinatal Health

Co-directors
Todd Coleman, Ph.D.,
Associate Professor of Bioengineering

Gladys Ramos, M.D.,
Associate Clinical Professor of Obstetrics & Gynecology

The mission of the **Center for Perinatal Health (CPH)** is to advance newborn health by designing novel technologies customized to materno-fetal and newborn physiology. The CPH is a unique collaboration between physicians, engineers and scientists in which the focus is developing first-in-class innovative medical solutions for pregnant mothers and babies before and after birth. The epidermal electronics systems (EES) developed by the CPH are unobtrusive wireless sensor devices far superior to traditional devices with electrode placement used in routine monitoring during labor and in neonates.

The EES come in the form of ultra-thin, flexible electronics that adhere to the skin like a temporary tattoo. EES can detect physiological signals of the pregnant mother and fetus (e.g. materno/fetal heart rate, uterine contractions) as well as the neonate (e.g. electrical rhythms of the lungs, heart, and brain) with quality indistinguishable from traditional equipment to allow effective, non-invasive physiological monitoring during perinatal period near pregnancy and labor, delivery, and as well as the newborn child.

The Center for Perinatal Health epidermal electronics systems (EES) perinatal monitoring will improve the health of baby and mother.

Traditional monitoring of critically ill and premature babies requires many wires and the abrasive application of sensors on to the skin of the baby, involving scrubbing the scalp and gluing electrodes to it. Application of epidermal electronics promise wireless, safe, non-invasive monitoring of the baby's health and avoids increasing the possibility of infection using traditional methods. Moreover, it allows parents to hold their baby during a critical period where skin-to-skin contact promotes a significant neuro-developmental advantage. Additionally, using medically-guided analytics algorithms to analyze the stream of data coming from the device, early complications can be anticipated and detected leading to earlier therapeutic intervention.

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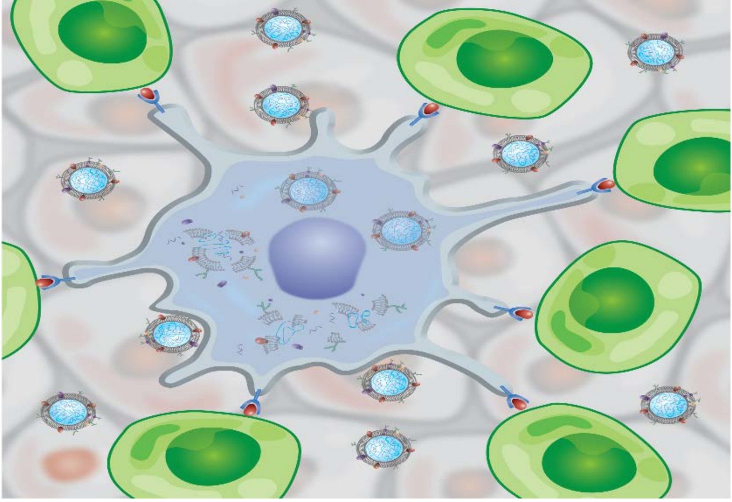

Center for Engineering in Cancer

Co-directors
Stephen Howell, M.D.,
Distinguished Professor of Medicine

Liangfang Zhang, Ph.D.,
Professor of Nano-Engineering

The **Center for Engineering in Cancer (CEC)** will work closely with the Moores Cancer Center to bring together researchers across different disciplines, including engineering, cancer biology, stem cell biology, basic medical science and clinical medicine to foster new collaborations focusing on the integration of engineering principles and technology with cancer medicine. The Center will develop and apply novel approaches in biomedical imaging, genetic and epigenetic engineering, molecular, cellular and tissue engineering, advanced biomaterials and nanobiotechnology, systems biology and medicine, and medical devices to advance prevention, early detection, diagnosis, and treatment of cancer.

The CEC will emphasize translational research involving collaboration with clinical colleagues and industry and will create a conduit for graduate students to be trained in multiple laboratories, broadening the areas of their expertise.

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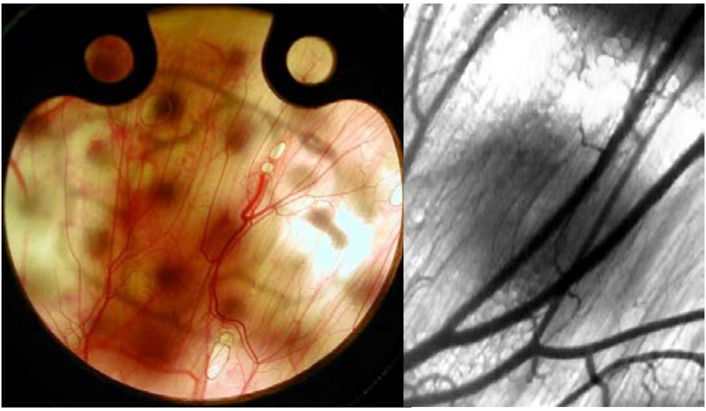

Center for Engineering in Diabetes

Co-directors
David Gough, Ph.D.,
Professor of Bioengineering

Maike Sander, M.D.,
Professor of Pediatrics and Cellular and Molecular Medicine

Diabetes is a growing, world-wide problem with potentially devastating consequences for individuals with the disease as well as for society as a whole. There is a clear and urgent need for new approaches to address challenges in treatment, diagnosis, and prevention of diabetes and its related complications using state-of-the-art scientific and engineering approaches.

The goals of the **Center for Engineering in Diabetes (CED)** are to stimulate research, development and clinical translation of new technologies for the treatment of diabetes.

The CED will facilitate interdisciplinary collaborations between clinicians, engineers, research scientists, and industry, as well as train a new professional workforce of student graduates with specialized engineering skills and clinical perspectives to work hand-in-hand with clinicians and the medical device industry.

These new forms of therapy will be based on effective replacement of the beta cell, either by a cellular technology or by an engineering-based artificial pancreas.

Such as islet replacement, regeneration from stem cells, or islet preservation, constituting a form of “bioengineered pancreas”, or by some combination of implanted sensor and automated delivery technologies that comprise an automatic “mechanical artificial beta cell“. Biological approaches will be explored as a cellular replacement strategy for islet cells. This will require a fundamental understanding of how the pancreas matures from an outgrowth of the duodenum into a highly ordered structure of exocrine and endocrine cells. The maturation process for beta cells in the Islets of Langerhans is guided by spatiotemporally regulated cell interactions, including growth factors, cell-cell signaling, and extracellular matrix components.

The CED will provide a platform for interaction with industry, as this is a key component of translation of new technologies to the clinic.

Development of a bioengineered pancreas seeks to mimic those interactions to recapitulate the natural development process in a dish, resulting in an in vitro, engineered environment that can produce fully functioning insulin-producing beta cells. These advances will involve collaboration with San Diego’s vibrant biotechnology industry. San Diego has an unusually high concentration of companies involved in developing diabetes biosensors, medical devices, and tissue engineering approaches for diabetes. The CED will provide a platform for interaction with industry, as this is a key component of translation of new technologies to the clinic.

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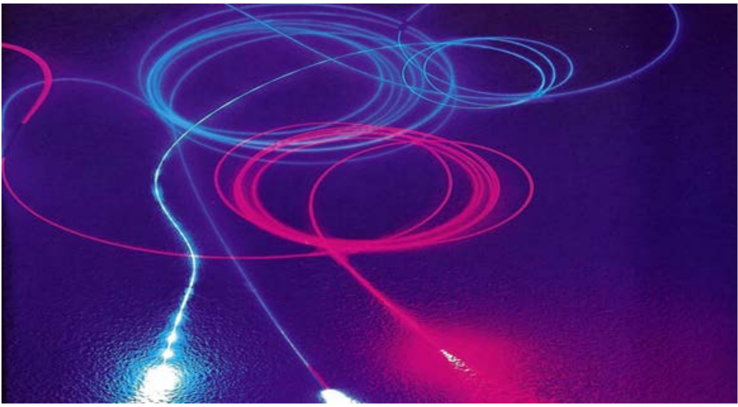

Biophotonics Technology Center

Co-directors

Michael Berns, Ph.D.,
Adjunct Professor of Bioengineering

David Hall, M.D.,
Professor of Radiology Program

The primary focus of the Biophotonics Technology Center (BTC) is to foster research collaboration amongst its members, as well with non-member faculty who collaborate with a BTC member. The translation to the private sector of discoveries made by member of the BTC is also a major objective. Several mechanisms are used to achieve these goals.

First, the BTC will provide funding for innovative pilot projects that are too early to garner funding from conventional venues (government, foundations, industry, etc.). These “spark” awards will be in the range of $50K-100K/year direct costs for one or two years. It is anticipated that 2-4 awards can be made each year. The funds can be used for graduate student and postdoctoral fellow support, but not for faculty salaries. The type of projects funded will generally deal with mechanisms of photon interaction with biological systems, the use of photons to manipulate cells and/or tissues, and the application of photons in clinical diagnostic or therapeutics systems.

Second, to foster collaboration and interchange, there will be an annual one-day symposium devoted to oral presentations in the field of biophotonics. The speakers will be a mix of internal (UCSD) and external presenters from industry and other San Diego area research institutions. The intention of the symposium is to foster collaboration.

Formation of the BTC will place UCSD in a good competitive position for this and other photonic-based interdisciplinary grants/awards.

Third, mechanisms to foster collaboration will unfold with the success of the BTC program in the form of either program project grants, IGERT awards, or grants from agencies where multidisciplinary collaboration is emphasized.

In summary, the formation of a Biophotonics Technology Center under the umbrella of the Institute for Engineering in Medicine (IEM) will establish a campus focus that matches a national priority, foster collaboration between faculty and with the surrounding private sector, attract top students and post-doctoral fellows, and garner funds from other sources government, foundations, industry, and donors.

iem Institute of Engineering in Medicine

UC San Diego

Center for Mobile-health Systems and Applications

Co-directors
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The mission of **Center for Mobile-health Systems and Applications (CMSA)** is to advance the use of mobile technologies for medical, behavioral, social and public health research and promote collaboration among Institutes and ORUs in the Jacobs School of Engineering, the School of Medicine and the general UCSD campus, as well as Centers in the IEM, in these areas.

CMSA's efforts are crosscutting and intended to help ensure that the "whole" of the efforts of the IEM and the other units at UCSD is greater than the sum of the parts. CMSA will focus on systems-level approaches to health and healthcare where multiple levels and types of expertise in addition to engineering and medicine are involved, including qualitative, quantitative and mixed-methods research about how people use and benefit from mobile technologies.

CMSA will develop and support a cadre of research-ready clinicians, behavioral, social and public health scientists at UCSD and Rady Children's Hospital who conduct clinical trials and other studies that are based in part or in whole on the application of mobile technologies in health.

CMSA will also focus on ethical, legal and social issues related to mobile health research and practice.

CMSA will also focus on ethical, legal and social issues related to mobile health research and practice. This is a field in considerable flux at present with respect to areas of privacy, data ownership and sharing, and informed consent and other methodological issues that support the "24 X 7" nature of ubiquitous monitoring and interventions in health. Partnering with scientists and other scholars in social and cultural domains can help advance the use of new technologies and the data they create as well as lessen the likelihood of unintended consequences.

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The William J. von Liebig Center

In 2001, the William J. von Liebig Foundation awarded a $10 million gift to UC San Diego's Jacobs School of Engineering to launch the **William J. von Liebig Center of Entrepreneurism and Technology Advancement**, the first commercialization facility of its kind in the country. The mission of the von Liebig Center (VLC) is to inspire entrepreneurism and catalyze commercialization of UCSD inventions through grants, education, and business mentoring. Its main goals are to foster innovation within UCSD; to accelerate the commercialization of university discoveries; to facilitate the exchange of ideas and collaboration between the university and the private sector; and to prepare students for the workplace.

VLC has provided advisory services to 140 faculty, reviewed 270 technologies, awarded more than $3 million in proof-of-concept funding to 66 projects, and assisted in forming 26 companies, which have created more than 180 jobs and $87 million in private capital. More than 70 graduate students and postdoctoral researchers have received grants to explore commercialization of their research and focus on development, testing, or prototype construction that demonstrate the commercial viability of the technology.

VLC advises on a broad range of projects, including medical devices/diagnostics, software, and clean technologies. These projects result in companies and products with far-reaching impacts for sustainability, health care, and quality of life. Examples include an improved screening test for the human papillomavirus associated with cervical cancer, technologies to improve the treatment of shock and acute inflammatory diseases, alternative power sources based on heat-to-electricity conversion, and next-generation energy-efficient lighting devices.

The von Liebig Center is one of the top two organizations in the nation in accelerating the commercialization of university discoveries, according to a Kauffman Foundation report.

VLC popular entrepreneurism courses, which prepare scientists and engineers for an entrepreneurial workplace, have attracted more than five hundred graduate and undergraduate students, some of whom have also completed internships through VLC. The internships provide hands-on experience in pre-commercialization activities. VLC also organizes seminars on company creation, intellectual property, venture capital, and a variety of other topics to help students become more adept at spotting market-ready technologies. Many von Liebig alumni have gone on to enjoy successful careers as entrepreneurs or business development professionals where they foster a culture of innovation and cooperation across disciplines.

The von Liebig Center is the translational arm for the Institute for Engineering in Medicine by providing all translational services.

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Our Partners

UC SAN DIEGO

California Institute of Telecommunication and Information Technology
Clinical and Translational Research Institute
Division of Biological Sciences
Division of Physical Sciences
Institute for Genomic Medicine
Institute for Neural Computation
Jacobs School of Engineering
Moores UCSD Cancer Center
Rady School of Management
San Diego Supercomputer Center
School of Medicine
Scripps Institution of Oceanography
Shiley Eye Center
Skaggs School of Pharmacy and Pharmaceutical Sciences
Sulpizio Family Cardiovascular Center
UC San Diego Medical Center
Veterans Affairs San Diego Health System

COMMUNITY

BIOCOM
Bioengineering Institute of California
Burnham Institute for Medical Research
CONNECT
La Jolla Institute of Allergy and Immunology
Rady Children's Hospital
Salk Institute for Biological Sciences
San Diego Science Festival
San Diego Stem Cell Consortium
Sanford Consortium for Regenerative Medicine
The Scripps Research Institute

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Cadence Pharmaceuticals
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Genomatica, Inc.
GT Lifesciences
Halozyme Therapeutics

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Medtronic, Inc.
NuVasive, Inc.
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Tecellact LLC
Verenium Corporation

FUNDING AGENCIES

American Cancer Society
American Heart Association
California Institute for Regenerative Medicine
Wallace Coulter Foundation
Department of Defense (DARPA, TATRC)
Howard Hughes Medical Research Institute
National Institutes of Health
National Science Foundation
Siebel Scholar Foundation

INTERNATIONAL

China
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New Zealand
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Singapore
Nanyang Technological University
National University of Singapore

Sweden
University of Gothenburg

Taiwan
Academia Sinica
Chang Gung University
China Medical University
Chung Yuan Christian University
National Cheng Kung University
National Chiao Tung Univerisy
National Health Research Institutes
National Taiwan University
National Yang-Ming University
Taipei Medical University

United Kingdom
Oxford University

Our Mission

The Institute of Engineering in Medicine (IEM) at UC San Diego develops novel understanding, prevention, diagnosis, and treatment of important diseases and injuries, including cancer and cardiovascular, metabolic, neurological, ophthalmological, and orthopaedic diseases.

GOALS

- Expedite new discoveries by facilitating and enhancing collaboration in engineering, medicine, pharmacy, and related disciplines
- Promote interdisciplinary research through provision of core facilities, strategic design, and administrative support
- Foster strong industrial partnerships to advance commercialization of innovative health-care technologies for diagnostics and therapeutics

TECHNOLOGY FOCUS AREAS

Development and implementation of novel technologies, including

- Phenotyping/genotyping
- Bioinformatics/systems biology
- Medical devices and instrumentation
- Nanotechnology/nanomedicine
- Stem cells
- Wireless and remote health care