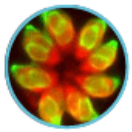
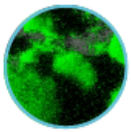
BIO-X
STANFORD UNIVERSITY

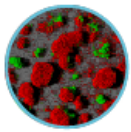
Bio-X *fellowships*

NEW ADVANCES IN SCIENCE AND ENGINEERING

The Bio-X Fellowships are made possible by various gifts in order to promote interdisciplinary research for promising scientists working on projects that bridge the gap between biology and other fields, such as physics, engineering, computer science, and chemistry.

Researchers are encouraged to work collaboratively with professors in different departments or schools, drawing on expertise campus-wide.



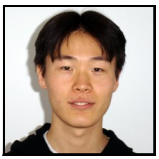
Bio-X Graduate Student Fellowships 2004

Relly Brandman
Chemical & Systems Biology
Professor V. Pande (Chemistry)

Inhibitors and activators of proteins can be used to uncover how cells work and to develop new drugs and therapies. The focus of my project is to develop and use computational tools to design modulators specific for particular proteins that will then be experimentally tested.

David Camarillo
Mechanical Engineering
Professor K. Salisbury (Computer Science)
Graduated Sum 2008

My research is in the area of biomedical device innovation, specializing in robotically enhanced surgery. Presently, I am developing technologies for flexible robotic manipulators. These instruments can be tele-operated by a physician or autonomously controlled. My focus is to improve the controllability of such instruments by creating novel algorithms that rely upon solid mechanics models as well as multiple sensory inputs.



Samuel Kim
Chemistry
Professor R. Zare (Chemistry)

Although a growing body of evidence suggests that many G protein-coupled receptors exist as dimers or higher-order oligomers, including the β_2 adrenergic receptor, the functional significance of oligomerization remains to be determined. Because it is difficult to analyze the heterogeneous populations in biological systems by conventional techniques, single-molecule spectroscopy is a suitable tool to study these systems. The proposed research will use a single-pair fluorescence resonance energy transfer technique to study homodimerization of the β_2 adrenergic receptor and will focus on its role in receptor function.

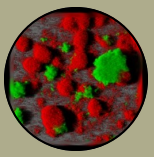
Andy Loening
Bioengineering
Professor S. Gambhir
Graduated Spr 2006

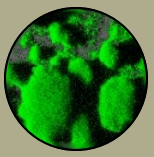
I'll be working on developing a new class of probes for *in vivo* receptor imaging consisting of bioluminescent proteins fused to receptor ligands. Preliminary work has focused on optimizing the bioluminescent proteins for this purpose through rational and random mutagenesis approaches. Work is currently ongoing to develop the ligand/bioluminescent fusion proteins and to validate them both *in vitro* and *in vivo*.

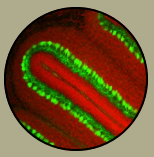
Leslie Meltzer
Neuroscience
Professors T. Palmer (Surgery) and K. Deisseroth (BioEng., Psychiatry)

My research explores the wiring of new stem cell-derived neurons into intact circuits, using techniques bridging bioengineering, neurosurgery, and computer science. I will investigate the following critical questions:
1) How are new stem cell-derived neurons wired into the adult mammalian brain?
2) How does wiring of new neurons according to these rules impact memory storage in computational neural networks? and
3) How does wiring of new neurons in this way impact memory storage in behaving animals?

Bio-X Graduate Student Fellowships 2004



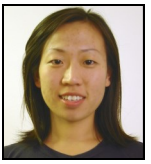




Sergio Moreno
Physics
Profs M. Levitt (Structural Biology) and S. Doniach (Applied Physics)

I will be working in Prof. Levitt's group developing a novel computational framework to study large-scale protein movements as they explore their energy landscapes. The method will be applied to proteins under experimental study in Prof. Frydman's lab.

We expect that this interdisciplinary collaboration will be very beneficial to both experimentalists and theoreticians as it will help understand particular protein systems and will provide insight into the general mechanisms by which proteins fold and perform their biological functions.



Sara Zhao
Mechanical Eng.
Prof. B. Pruitt
Grad. Win 2005

Mechanotransduction, the process by which cells convert mechanical stimuli into cellular signals, is important in many areas of physiology, medicine, and medical device design. The goal of this project is to study the MEC-4 channel complex that mediates sensory mechanotransduction of touch receptor neurons.

Working with Prof. Goodman, we will combine MEMS and biological techniques to characterize the mechanosensitivity of the ion channel and its influence on the cell structure and mechanical property. A bio-molecular model will be developed to describe the mechanism of MEC-4 channel complex as mechanoreceptor and its critical role in the whole-cell behavior.

BIO-X AT STANFORD

BIO-X

TO EDUCATE...

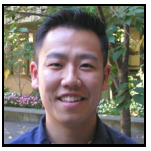
TO DISCOVER....

TO INVENT....

Bio-X Graduate Student Fellowships 2005

Afsheen Afshar
Electrical Engineering
Professor K. Shenoy
Graduated Sum 2008

My research with the Shenoy group involves the design and implementation of neural prosthetics that patients can use. I will be focusing my efforts on the paradigm of point-to-point movements, such as those done by typing on a keyboard. Specifically, I am developing innovative computational models and algorithms that help elucidate how the brain plans and executes movement. I am concurrently working on improving the electronic infrastructure that can support an extremely fast (i.e., realtime) and accurate 'virtual keyboard' that would allow a patient to type by planning movements to desired keys at desired times. Finally, I am collaborating with neurosurgeon Dr. Jaimie Henderson to apply our work to a Parkinson's Disease patient population. I hope to bring all these avenues together to help create a real, useful prosthetic.



David Myung
Chemical Engineering and Ophthamology
Professors C. Frank and C. Ta
Graduated Win 2008

Corneal blindness affects millions worldwide and requires a corneal transplant. A tissue-engineered artificial cornea has the potential to replace the need for human donor tissue while providing better surgical outcomes. My project is the design, fabrication, and characterization of an artificial cornea based on a novel class of double network hydrogels. These "biomimetic" materials have demonstrated great potential for emulating the transparency, biomechanics, and regenerative capacity of a human cornea. My aims are to characterize the unique properties of these polymers, engineer them to promote integration with host corneal tissue, and finally to study the cellular response to them *in vitro*.

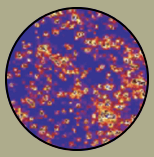
Georgios Asimenos
Computer Science
Professor S. Batzoglou

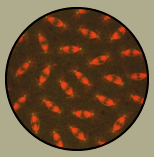
I am developing a next-generation whole-genome alignment pipeline in order to harvest the enormous wealth of genomic data that is becoming available; mainly the 12 Drosophila genomes and the impending 20 mammalian genomes. I will use these alignments to predict putative functional elements based on constraint of evolution. The challenge is not only to identify such elements, but to understand how they act in the context of specific biological systems. I am currently investigating new high-throughput experimental techniques to study predicted elements during development of the Drosophila embryo.

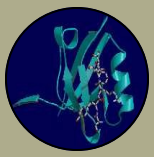
Rachel Kalmar
Neurosciences
Professors K. Shenoy and B. Newsome

I am interested in understanding how ensembles of neurons collectively encode and transmit information, and how this neural activity underlies complex behavior and cognition. Using a combination of behavioral, physiological and computational approaches, I will explore how the brain computes values, how this computation drives decision making, and the applications of this value assessment in the context of neural prosthetic development.

Bio-X Graduate Student Fellowships 2005



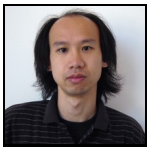




Jules VanDersarl
Materials Sci. & Engineering
Profs N. Melosh & M. Longaker

We are exploring new methods to use nanoscale electronics to direct stem cell differentiation in an effort to better understand and control the spatial and temporal events that occur during differentiation. We are developing an active electronic chip that stores signaling chemicals within nano-reservoirs and releases them when activated with an electronic signal.

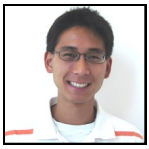
This chip will allow us to extend the spatial and temporal control of soluble signals down to an individual cell for unprecedented control over the local cellular environment.



Yufeng Yang
Neurosciences
Professor B. Lu

The goal of my project is to examine the dopaminergic neuron associated neural circuitry in fruit fly (Drosophila) models of Parkinson's disease, using a combination of genetics, electrophysiology, behavioral analysis and computational modeling approaches.

Bio-X "Pfizer" Graduate Student Fellowship



Vincent Chu
Applied Physics
Prof. S. Doniach

Ion atmospheres play an important role in the function and formation of tertiary structure in charged nucleic acids. However, current understanding of electrostatics around nucleic acids is poorly understood. My research is focused on advancing the theory of nucleic acid electrostatics, the creation of computational tools to model these effects, and experimental verification of new theories. Research in this area may lead to new drug designs, molecular sensor designs, and increased knowledge of gene regulation.

Bio-X Graduate Student Fellowships 2006

Edith Arnold
Mechanical Eng.
Professors S. Delp and G. Gold

Musculoskeletal modeling and simulation tools are powerful resources for both basic research and clinical applications. However, current models incorporate a major simplification by representing muscles as single lines following the effective line of action. In my research I will develop a modeling pipeline that incorporates diffusion tensor magnetic resonance imaging to create three-dimensional finite element models of muscle representing the geometry and architecture of muscle fibers. These models will be used to explore the functional implications of altered muscle architecture and to simulate surgical treatments designed to treat movement abnormalities.

Jennifer Blundo
Mechanical Engineering
Professor B. Pruitt

The powerful potential of stem cell therapy motivates a better understanding of the basic mechanisms regulating developmental biology. The role of mechanical and electrical forces in the adult physiology and pathology has been well documented, and I am interested in what clues these phenomena may hold for generating robust, terminally differentiated stem cells. The pluripotent capacity of human embryonic stem cells makes them an attractive source for cell-based myocardial therapy. Specifically, the delivery of cardiac myocytes, which constitute 70-80% of the adult myocardium, may restore tissue viability and function to ischemic tissue damaged by a heart attack. My research is motivated by the limitations of current methods to derive cardiac myocytes from stem cells. The aim is to increase the differentiation yield of cardiac myocytes through electromechanical conditioning and ultimately the *in vivo* performance of myocardial cell-transplants.

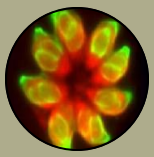
Ian Chen
Bioengineering
Prof. S. Gambhir

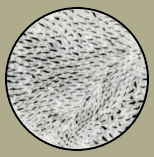
Stem cell therapy has emerged over the past decade as a promising treatment for congestive heart failure. Current clinical studies on cell therapy lack an objective method to non-invasively assess the survival and migration of stem cells following implantation. The goal of my project is to develop a novel multimodality reporter gene for labeling stem cells and monitoring their behaviors in living subjects using a combination of positron emission tomography (PET), optical bioluminescence imaging, and magnetic resonance imaging (MRI). Efforts are underway to develop and validate such reporter gene in terms of its ability to lead to highly specific and sensitive imaging signals which are reflective of stem cell viability. The development and characterization of such reporter gene should provide a valuable tool for investigators in the future to accurately assess the efficacy of stem cell therapy in humans.

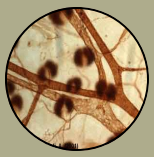
Sanjay Dastoor
Mechanical Engineering
Professor M. Cutkosky

I am researching the application of artificial muscles to robotics and prosthetics through a novel manufacturing method. Electric motors lack many of the dynamic characteristics of biological muscle, limiting their use in biomimetic devices. Electroactive polymer actuators are a promising alternative, with muscle-like performance, light weight, low cost, and silent operation. I am developing methods for fabricating these actuators using shape deposition manufacturing, which allows customized geometries, heterogeneous materials, and embedded components. With the help of Professor Scott Delp, biomechanical modeling and analysis can be applied to these actuators, inspiring the next generation

Bio-X Graduate Student Fellowships 2006







Katy Keenan
Mechanical Eng. & Radiology
Professors S. Delp, G. Gold and G. Beaupre

Cartilage is a complex tissue, capable of |withstanding large compressive loads during everyday activities. Determining the mechanical properties of articular cartilage is important for understanding how the tissue behaves *in vivo*, how the tissue properties might change with age, injury, or disease, and also how we might try to replicate the function of cartilage using tissue engineered constructs. The first step of my research is to develop a robust and computationally-efficient method to calculate cartilage material properties using creep or stress-relaxation indentation experiments. The next step is to develop non-invasive methods to determine the cartilage properties using magnetic resonance imaging.

Guillem Pratx
Electrical Eng.
Professor C. Levin

Positron emission tomography (PET) is an imaging modality that has the powerful capability to non-invasively interrogate cellular and molecular processes occurring deep within the tissue of living subjects. However, image reconstruction algorithms, which are used to generate tomographic images from collected data, have become extremely computational. For high (< 2 mm) resolution PET systems, algorithms that optimize the image resolution and quantitative accuracy require a large computer cluster. To accelerate PET image reconstruction by an order-of-magnitude, I have used graphics processing units (GPUs) as cost-effective high performance co-processor. GPUs are off-the-shelf processors that are designed to deliver high-definition graphics for video games in real-time. This technology will facilitate the use of advanced reconstruction methods for high resolution PET for both the clinical and research use. This is an exciting project that involves collaborations with the graphics industry as well as biomedical scientists.

Aaron Wang
Bioengineering
Professors C. Taylor and D. Liang

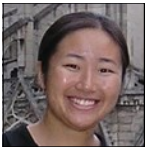
My overall goal is to improve the ability of real-time 3D ultrasound to detect and aid in treating internal bleeding. The application of my work will be for a portable device which uses diagnostic ultrasound to detect internal bleeding and then applies high intensity focused ultrasound to non-invasively coagulate the bleed. I propose adding parametric ultrasound data such as color and power Doppler and B-flow to the B-mode grayscale images to aid in identifying and segmenting vessels. I then propose using physics-based models of blood flow on segmented vasculature to predict expected normal flows and locate vascular injury in the patient.

Bio-X Graduate Student Fellowships 2006

Peggy Yao
Biomedical Informatics
Professor J-C Latombe

It is increasingly appreciated that protein function is not strictly related to its three dimensional structure of the folded state, but to its structural dynamics. Conformational changes occur in various biological events: protein folding upon the presence of appropriate ligand, protein-molecule recognition, enzyme catalysis and etc. Noting that these events are critical in maintaining normal metabolism, understanding protein structural motion is important in drug and protein design. However, there is no experimental technique existing that allows us to observe all proteins at atomic level in real time. Although NMR spectroscopy enables the visibility of dynamic properties of proteins, protein size is limited. Much effort has been paid to developing computational methods. But neither the problem is close to solved nor the solutions are accurate enough for practical usage. I would like to study protein structural dynamics using computer science and statistics techniques, starting from short loops, I will begin loop modeling and flexible protein docking.

Bio-X Endowed Graduate Fellowships 2006



Namiko Abe
Paul Berg Biomedical Fellow
Neurosciences
Professor T. Meyer

Although phosphoinositides(PIs) represent a minor fraction of cellular lipids, they are integral components of cell membranes. Recent evidence suggests that PIs have not only a structural role but may also act as important second messengers during membrane trafficking events. My laboratory in collaboration with Tom Wandless's group has recently developed a chemically-inducible translocation strategy to rapidly synthesize or degrade specific PIs at the plasma membrane. I plan to make improvements upon this chemical strategy while developing new bioengineered probes to manipulate levels of different PIs in specific membrane compartments. I will then use these tools to investigate the role of specific PI species in various steps of receptor-mediated endocytosis as well as the synaptic vesicle cycle.

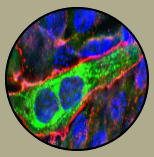
Bertrand Lui
Lubert Stryer Fellow
Bioengineering
Profs. J.R. Cochran and J.R. Swartz

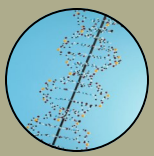
The goal of my research is to develop a technology platform which combines yeast surface display and cell-free protein synthesis to engineer proteins for enhanced biological efficacy. It will be demonstrated by evolving epidermal growth factor, which plays a role in the healing process and has great therapeutic potential for wound repair and regenerative medicine.

Daniel Kimmel
Affymetrix Fellow
Neurobiology
Prof. B. Newsome

As you read these words, your nervous system is coordinating countless small eye movements to different locations on the page. The problem for your oculomotor system is how to encode this information in an efficient, accurate, and decipherable way. A computer system would encode movement commands as a series of binary numbers, whose meaning is universally interpretable and independent of the rate at which the code is transmitted. The nervous system is distinct in that the neural code is highly sensitive to the timing of information-not unlike the Morse code, in which the mere occurrence of a "beep" carries less information than whether the beep was long or short in duration. My research harnesses the oculomotor system to understand the temporal dynamics that encode the planning, selection, and execution of eye movements.

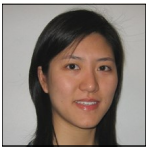
Bio-X Graduate Student Fellowships 2007





Kelsey Clark
Neurosciences
Professor T. Moore

My research focuses on the neural basis of attention, and the relationship between attention and working memory. How are certain regions or objects selected for attention, and how does this selection influence their representation in sensory areas? Which neural circuits and neurotransmitters underlie this attentional modulation of sensory signals? How does attention bias subsequent representation in working memory? To address these questions we are using electrophysiological and pharmacological techniques in a visual working memory paradigm.



Frances Lau
Electrical Eng.
Profs. C. Levin & M. Horowitz

I am designing and building an ultra-high resolution Positron Emission Tomography (PET) system dedicated to breast cancer imaging. PET is a non-invasive, in-vivo, molecular imaging technology that has shown promise for early and accurate identification of breast cancer due to its unique ability visualize increased biochemical changes in malignant tissue well before structural changes occur. My focus is on applying techniques from circuit design and signal integrity to develop data acquisition electronics that read out and process the small signals detected while meeting the demanding data rate and noise requirements.

Jennifer Hicks
Mech. Eng.
Professor S. Delp

My primary research focus is applying biomechanical modeling and simulation to study human movement, particularly to improve the treatment of walking abnormalities in children with cerebral palsy. In my graduate work so far, I have developed methods to simulate a common skeletal deformity found in patients with cerebral palsy and the effect of this deformity on muscle function during walking. My current research projects include quantifying the effect of crouched gait postures on the ability of muscles to support the body against gravity and developing statistical learning algorithms to predict treatment outcome in children with movement disorders.

Cory McLean
Computer Sci.
Prof. G. Bejerano

Evolution of cis-regulatory elements may drive the majority of anatomical evolution, yet the mechanisms of cis-regulation of gene expression are poorly understood. I have uncovered a number of interesting non-coding genomic regions within vertebrates using the computational tools of high-performance computing, statistics, and natural language processing. I am also investigating roles for machine learning in the discovery of a genomic signature of cis-regulatory elements. Additional transgenic experiments will be performed in collaboration with the Kingsley laboratory.

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Rebecca Taylor
Mechanical Engineering
Professors E. Kuhl and B. Pruitt

Rebecca is developing both microfabricated and macro-scale electromechanical systems for both electrical and mechanical stimulation and monitoring of stem cell-based cardiac tissue constructs. Her research aims to utilize these systems for 1) characterization of stem cell differentiation to cardiac myocytes in response to electrical and mechanical stimulation 2) constitutive modeling of coupled electromechanical behavior of cardiac myocytes, and 3) the development of continuum mechanics based predictive models of tissue growth.

Larry Wang
Materials Science & Eng.
Professors S. Heilshorn and A. Spakowitz

The goal of my research project is to understand the structural and behavioral characteristics of quaternary protein structure using the coat-vesicle protein clathrin. This study employs two major approaches in parallel: development of a theoretical model using Brownian dynamics simulation to predict quaternary structure and in vitro self-assembly experiments to observe and control the quaternary structure.

The choice of clathrin as our model protein system stems from its well-studied functional characteristics and biological significance. Clathrin proteins perform their biological functions by self-assembling into cages, and recent reports have begun to elucidate the structure of the individual clathrin molecule and have provided a more detailed static picture of the in vivo assembly. A good understanding of the static elementary structural composition provides an appropriate foundation for looking at the dynamic interactions of clathrin quaternary structure.

Kitchner Wilson
Bioengineering
Professors J. Wu and P. Yock

My research focuses on characterizing human embryonic stem cell differentiation and transplantation, with a specific focus on cardiovascular tissue regeneration. I am using genomic and proteomic methodologies such as DNA microarrays and highly sensitive protein arrays to better understand the regulatory networks that govern stem cell behavior, as well as *in vivo* molecular imaging techniques to assess their engraftment in mouse models of disease.

Of particular interest is the cardiac stem cell "niche", or microenvironment within heart tissue, that promotes their regenerative capacity.

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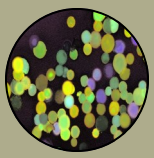
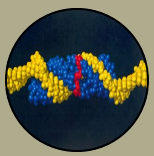
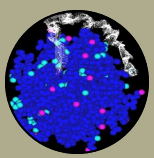
Bio-X Graduate Student Fellowships 2008







Adam de la Zerda
Electrical Eng.
Prof. Sanjiv Sam Gambhir (Radiology, BioEng, MIPS)

In my research, I develop a new technique for non-invasive imaging of living subjects called 'Photo-acoustic Molecular Imaging'. Using this technique, physicians will be able to monitor various proteins specific to a particular disease, indicating the molecular characteristics of the disease (e.g., whether breast cancer is responding to a chemotherapy or not). I design a photo-acoustic imaging instrument and a number of molecular contrast agents that produce a photoacoustic signal upon binding to breast cancer cells. My final goal is to integrate the imaging instrument with the cancer-detecting contrast agents by testing them on mice carrying a human breast cancer.

Mario Diaz de la Rosa
Chemical Eng.
Prof. Andrew Spakowitz (Chemical Eng.)

We examine how proteins find their target sites on DNA, a highly efficient process central to cell survival and proper cellular function. Of particular interest is the role that DNA conformation, including supercoiling and higher-order chromatin organization, plays in this search. We have developed a novel theoretical framework to address this phenomenon on linear, supercoiled, and nucleosomal DNA, and our predictions will be subsequently verified and supported experimentally. The resulting elucidation of the mechanisms behind target site localization will provide fundamental knowledge of gene regulation processes and the nature of protein-DNA interactions.

Lisa Gunaydin
Neurosciences
Prof. Karl Deisseroth (BioEng., Psychiatry)

Elucidating the neurobiological basis of social behavior is critical to understanding normal human behavior and its dysregulation in psychiatric diseases like autism. I am studying the neural circuits involved in social behavior using light-activated microbial opsins that our lab has engineered for fast optical control of neural activity. These optogenetic tools provide high spatiotemporal resolution in probing the activity of specific cell types within large neuronal populations, which will help elucidate the basic circuit dynamics underlying this complex behavior.

Tyler Hillman
Genetics, MSTP
Prof. Matthew Scott (Dev. Bio., BioEng.)

I research how cells communicate with one another to influence fate decisions during embryo development and tumor formation. In particular, I study the gene regulatory interactions controlled by the mammalian Hedgehog signaling pathway. I primarily study transcription factor proteins, to better understand how the Hedgehog pathway affects target gene expression. As part of these studies, I have used a novel technology invented at Stanford for making high-throughput measurements of DNA-protein binding interations. These measurements allow me to predict which genes might be Hedgehog pathway targets during important developmental and oncogenic processes.

Bio-X Graduate Student Fellowships 2008

Ian Marshall
Civil & Environmental Eng.
Professor Alfred Spormann (Civil & Environmental Engineering, Chemical Engineering)

Complex microbial communities play an important role in a range of environments, including the biodegradation of toxic compounds in groundwater, interactions in the human gut affecting health, and the contribution of agriculture to global atmospheric methane concentrations. I am applying novel molecular methods to understanding interspecies microbial interactions in order to expand our knowledge of how these systems function. In particular, the tiling DNA microarray is a tool that I am developing to query the presence and expression of functional genes from a wide range of microbes in the environment.

Andreas Rauschecker
Neurosciences
Professor Brian Wandell (Psychology)

My work uses several modern imaging modalities, including fMRI and DTI, to understand the neural basis of reading. More than a fifth of the US population reads below their age level and dyslexia is the most common learning disability. In many cases, the visual system of the brain is unable to decode visual patterns into words. Our lab studies the neural mechanisms behind this decoding process in the normal human brain. To complement this work, we also look at patients who are either suddenly unable to read due to a tumor, stroke, or epilepsy, or who have never been able to read (developmental dyslexia).

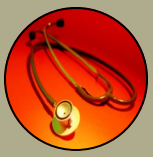
Mark Sellmyer
MSTP student,
Chemical & Systems Biology
Profs. T. Wandless (Chem.& Sys. Bio.) M.Longaker(Surgery)

I am interested in developing chemical tools for improving bioscience research and medical therapies. Specifically, I am working on a technology to improve our ability to make genetic changes at targeted sites within our genome and a chemical technology to expand and control hematopoietic stem cells outside of living animals. These projects address major challenges for researchers and clinicians involved with genetic manipulation and stem cell biology. Both projects take advantage of our expertise in molecular biology and synthetic organic chemistry and interface with imaging, immunology, and regenerative medicine.

Brian Wilt
Applied Physics
Professors Mark Schnitzer and Karl Deisseroth

In order to crack the neural code, we require new tools for probing and perturbing neural circuitry in vivo. I am interested in incorporating these new techniques into my lab's expertise with *in vivo* fluorescence microendoscopy. In particular, I am studying innovative strategies for light delivery in optical stimulation experiments with channelrhodopsin and halorhodopsin. I also have interests in novel, fully-automated data analysis techniques for calcium imaging data. My studies concentrate on visual and motor systems, with a particular emphasis on cerebellar ataxia mouse models. These projects draw on my background in physics, optics, applied math, and computer science.

Bio-X SIGFs in Human Health 2008



Melinda Cromie
Mechanical Eng.
Profs. Scott Delp (Mech.Eng., BioEng) and Mark Schnitzer (Biology, App. Phys.)

My goal is to understand the fundamental behavior of muscle by imaging sarcomeres, the smallest units of muscle tissue that contract to generate force. Sarcomeres have never been imaged in humans because they are smaller than the resolution of current clinical imaging modalities. Using a novel microendoscopy system, we imaged sarcomeres in humans for the first time. My current work is to use this newly developed system to quantify muscle contractile behavior in healthy humans and in individuals with spinal cord injury to improve surgical treatments that restore muscle function.

Viviana Gradinaru
Neurosciences
Professor Karl Deisseroth (BioEngineering, Psychiatry) & Jaimie Henderson

Deep brain stimulation (DBS) is a powerful therapeutic option for intractable movement and affective disorders (Parkinson's disease, tremor, depression). However, due to the nonspecificity of electrical stimulation, DBS has variable efficacy and can lead to serious side effects, such as speech impairment or paresis. My research under the joint mentorship of Karl Deisseroth (Bioengineering and Psychiatry) and Jaimie Henderson (Neurosurgery) is using precise bioengineering tools to address a critical question in the neurosurgery field: how does DBS exerts its therapeutic effects? By using a cell-type specific optical deep brain stimulator developed in the Deisseroth lab, my research aims to provide the first investigation of the role of specific cell types in PD pathology. These findings could be used to improve the parameters for electrode placement and stimulation in patients.

Bio-X Medronic Fellow 2008

Gaurav Krishnamurthy
Mechnical Eng.
Profs. Craig Miller (Cardio. Surgery)& E. Kuhl (Mech. Eng)

Despite over a century of building evidence no one has accurately described the complex intrinsic nature of the mitral valve in the beating heart as there has been no known method to quantify the *in vivo* material properties of the mitral valve leaflets. I plan on using a combination of unique surgical experiments and inverse finite element analysis to make the first measurements of the *in vivo* material properties of the anterior leaflet of the mitral valve in the beating ovine heart.

Bio-X Bioengineering Graduate Fellowships 2004

Incoming Bioengineering Fellows spend one year in rotation through labs of their choice before committing to a research project.

Amanda Malone

Professor C. Jacobs

It is well documented that bone responds to changes in load with corresponding changes in size and density. My lab believes that Oscillatory Fluid Flow (OFF), generated by pressure gradients in the lacunar cannicular network, is a potent physiological signal that is recognized by bone cells as an anabolic stimulus. While it is known that bone cells respond to fluid flow with various intracellular chemical responses, the actual mechanism that transduces the physical extracellular signal to a chemical intracellular one is not yet known.

I am hoping to determine the actual molecules that take part in this conversion from a mechanical signal to a chemical one. My hypothesis is that this mechanotransduction event could be linked to integrins and the phosphorylation of Focal Adhesion Kinase (FAK). FAK is a good candidate for a mechanotrasduction molecule in bone cells because it has both structural and enzymatic function and has proved relevant in mechanotransduction in other cell types.

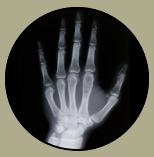
Adam Grossman

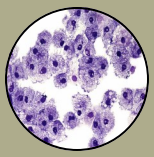
Professors T. Sanger, S.Delp and K. Shenoy

Adam will study children with severe movement disorders in order to generate hypotheses as to the biological cause for their disorders. He will collect data from each child—ranging from simple MRI and CT scans to more complex kinesthetic analyses. The data will help shed light on the specific locations in the brain that may be malfunctioning. Using this information, Adam will design further experiments to test these hypotheses and provide insight for better treatments and potential cures for these diseases.

In particular, Adam is interested in determining how and why deep brain stimulation is an effective treatment for some dystonic children and what parameters of the stimulation can be adapted to optimize the benefits of DBS in these children.

Bio-X Bioengineering Graduate Fellowships 2005





Virginia Chu

Professor T.D. Sanger

Virginia will be working in Dr. Sanger's group to develop a theoretical model for human motor learning. In particular, she is interested in studying motor learning in children and young adults. Various aspects of motor learning will be explored and will help shed light on the important elements of motor learning. Virginia will also study children with severe movement disorders in order to learn more about the missing pieces that leads to various motor learning deficits. Using this information, she will study "correction" methods to compensate for the missing pieces in light of the model. With a greater understanding of the motor learning deficits, Virginia hopes to develop medical devices and training paradigms to help children with movement disorders learn and further develop their motor skills.

Mindy Chang

Professor T. Moore

I am interested in using signal processing and computational modeling approaches to understand neural circuits. My current project involves population analysis of neurons in the visual cortex that encode color and orientation information. Future research will focus on mechanisms of visual attention in modulating neural representations of sensory input.

Stephen Lee

Professor J.R. Cochran

The Cochran lab uses directed evolution and yeast display to create novel protein mutants for therapeutics in wound healing and cancer applications. Stephen's current project investigates mutants of human epidermal growth factor (EGF), a protein involved in both of these pathways. *In vitro* assays are being used to study the migratory and proliferative effects of EGF on murine and human fibroblasts. His goal is to demonstrate an EGF mutant with improved migration and proliferation over wildtype to ultimately test in mice *in vivo*. Stephen holds a bachelor's of science degree in biology from MIT.

Prasheel Lillaney

Professor R. Fahrig

The goal of my project is to build a hybrid X-Ray/MRI system that will allow Interventional Radiologists more versatility in how they approach various procedures that require MR or X-Ray guidance, while still maintaining the image quality and performance offered by a conventional MRI or X-ray system. Prasheel is currently modeling the electron beam optics in X-ray tubes and determining how the electron beam is affected by the presence of the strong MR fringe field. He is also developing different X-ray tube motor designs that would allow for better tube performance in the hybrid system.

Bio-X Bioengineering Graduate Fellowships 2006

Angela Wu

Angela graduated from the University of California, Berkeley with a major in bioengineering with an emphasis in Computational and Biomedical Systems Engineering, and a minor in electrical engineering and computer science. During her undergraduate years, she mostly worked in the Lee BioPOEMS Lab at UC Berkeley, testing and characterizing a BioMEMs microfluidic patch clamp device that was developed by the group. She also spent a summer at the Hong Kong University of Science and Technology. At Stanford, Angela plans to further her knowledge of bioengineering principles and applications, and she hopes to do her PhD research on microfluidic and bio-electronic devices for medical applications.

Murtaza Mogri

Murtaza graduated with a double major in Bioengineering/Biotechnology and Math/Computer Science from UC San Diego, where he focused on bioinformatics and systems biology. Since he had a budding interest in neuroscience, he spent a year at the NIH studying the mechanism of rhythm generation in the respiratory control system and developing software to analyze neuronal activity. His current research interest is in neuroengineering, specifically the study of neural circuit dynamics using computational and experimental techniques.

Bio-X Bioengineering Graduate Fellowships 2007

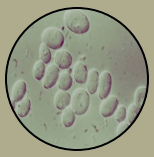
Sheng Ding
(1 year award)

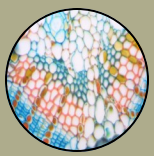
Sheng Ding is currently working on enzymatically crosslinked protein polymer hydrogels. She has successfully created a novel family of genetically engineered 'protein polymers' that are crosslinked into hydrogels by trasnglutaminase enzymes (TGs). Advanced genetic engineering technology will be used to develop protein-based 'block copolymers', and thus special blocks of peptide sequences can be incorporated to further modify structures, mechanical properties and bioactivities of the protein hydrogels. This novel kind of hydrogels will have broad applications in tissue engineering.

Jacob Hughey

While at Vanderbilt, I worked for three years under the guidance of John Wikswo at the Vanderbilt Institute for Integrative Biosystems Research and Education. My research as well as my senior design project centered around helping to develop a microfluidic platform to study T cell signaling pathways. At Stanford, I hope to use microfluidics to contribute to our understanding of complex biological systems.

Bio-X Bioengineering Graduate Fellowships 2007





Jayodita Sanghvi

As an undergraduate, Jayodita strived to get a broad range of research experiences, which eventually led her to a PhD program in bioengineering. At MIT, Jayodita worked in Prof. William Thilly's lab for four years where she analyzed Japanese and American pancreatic cancer mortality data to gain an understanding of environmental risk. She also worked in Prof. Robert Langer's lab for two years trying to develop a universal system for binding proteins to micropatterned hydrogels that could be used for tissue engineering and to improve various experimental techniques. Currently, she is doing a summer rotation at Stanford in Prof. Markus Covert's lab, studying the oscillations of the transcription factor, NF-kB in and out of cells' nuclei.

Min-Sun Son

At Washington University, I worked with Dr. Frank Yin on uniaxial stretching of human aortic endothelial cells on a silicon membrane. My main project involved working out a protocol in order to investigate the effects of cyclical stretching in real time on the cell orientation and shape index. I also helped in the research of studying the mechanical and chemical response to stretching of alpha actinin knockout and rescued cells. Through my research and studies as an undergrad, biomechanics has become an area of great interest for me and I would like to continue in this field

Nan Xiao

During my undergrad years, I developed computational tools for neuroscience research at Rice University and Baylor College of Medicine. I helped implement an indirect method to deduce the distributions of ion channels based on calcium fluorescence data from neurons in /in vitro /slices. The tools I worked on make this process possible by using simulations involving morphologically realistic neurons.

BIO-X

Bio-X Bioengineering Graduate Fellowships 2008

Mihalis Kariolis

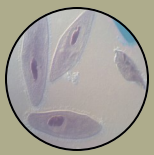
As the field of bioengineering is becoming more interdisciplinary, medical and engineering research are converging to produce some truly exciting advancements. I plan to join the BioX team in furthering this important field, particularly in the areas of tissue engineering and regenerative medicine. My research to date has been aimed at improving the scaffolding used in tissue engineering applications. I hope to continue along these lines, applying the principles and methodologies of engineering to practical biological problems, in an effort to understand some of the pressing clinical problems. My overall goal is to take work that is being done in the lab, and bring it to the clinic where patients can benefit.

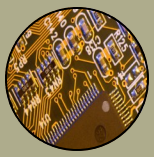
Grace Wang

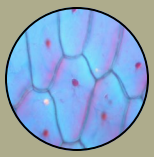
Medical drug usage has grown increasingly prominent, yet the spectrum of effects is not necessarily well understood. In terms of drug response, there exists a relationship between some genotypes and certain phenotypes. From a computational perspective, I hope to study genotypic differences that can lead to altered drug efficacy. I also wish to characterize the resulting differences at the protein level for a biochemical understanding. I am an engineer with a penchant for basic science who hopes to transition freely between the computer and the bench. This fusion of disciplines is becoming increasingly important, which I hope to foster in my research as well as encourage in others.

Pakpoom Subsoontorn

To engineer a living form as we wish, it is essential to understand how its building blocks—genes, proteins and biochemical pathways—functions and how these components connect to one another. My research interest expands from high-throughput experiment to system biology and synthetic biology. It would cover diverse areas including: instrumentation (microscopy, microfluidics, etc.) for developing tools that enable faster and cheaper experiment, informatics for integrating large-scale data, and, of course, molecular biology: for approaching the challenges of studying the living system.





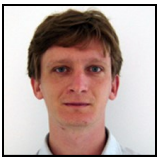


Bio-X Postdoctoral Fellowships 2005

Tiffany Chung

Professors J. Rao and S. Gambhir

Tiffany designed small molecule probes for *in vivo* imaging of apoptosis. Because apoptosis takes place through activation of caspases, she will develop a bioluminescence imaging system that can directly image the activation of the caspases *in vivo*.



Sergey Solomatin

Professors S. Chu and D. Herschlag

Sergey's research will involve the use of single-molecule Fluorescence Resonance Energy Transfer (sm-FRET) to explore the folding dynamics of RNA. In the Herschlag and Chu labs, Sergey is using synthetic and characterization techniques to determine distance changes between labeled sites on a ribozyme molecule.

Bio-X Postdoctoral Fellowships 2008

Genentech Fellowship

Shilpa Sambashivan

Professor A. Brunger

Endoplasmic Reticulum Associated Degradation is an important quality control mechanism in the ER that regulates the clearance of misfolded proteins. Both over-regulation and under-regulation by the ERAD pathway can result in disease (e.g.: Cystic Fibrosis and Parkinson's disease, respectively). We are interested in examining two key enzymes in the ERAD pathway, using x-ray crystallography, electron and atomic force microscopy and single-molecule studies.

Elena Rykhlevskiai

Professors V. Menon and B. Wandell

Approximately 10% of Americans over age 65 and closer to 40% of Americans over age 85 develop AD. The risk for developing the disease increases with age. Early detection of AD is an important challenge exacerbated by the current lack of biological markers suitable for in-vivo diagnostics. There have been a number of brain imaging studies suggesting a variety of potential biomarkers using structural MRI, functional MRI (fMRI), and PET, but none have yet proven sufficiently sensitive and specific. The proposed research program is aimed at the development of data-driven statistical methods for detecting and quantifying distinct large-scale brain networks implicated in Alzheimer's disease (AD).

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Bio-X Program

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http://biox.stanford.edu

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