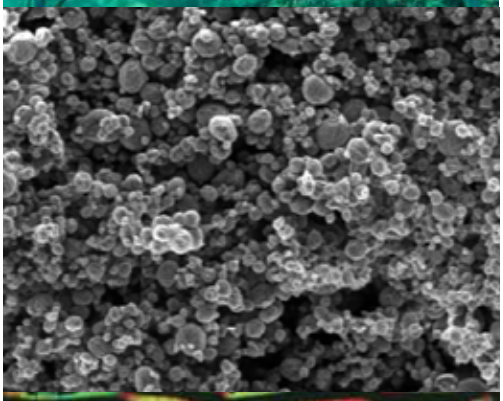
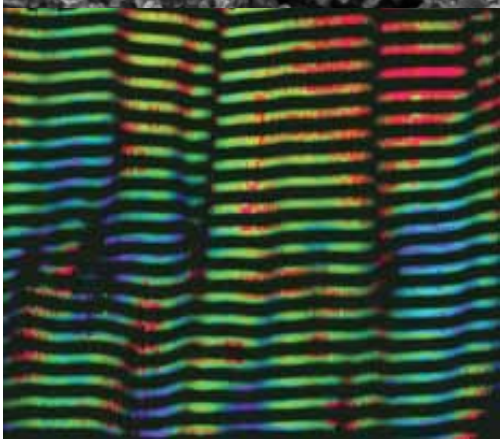
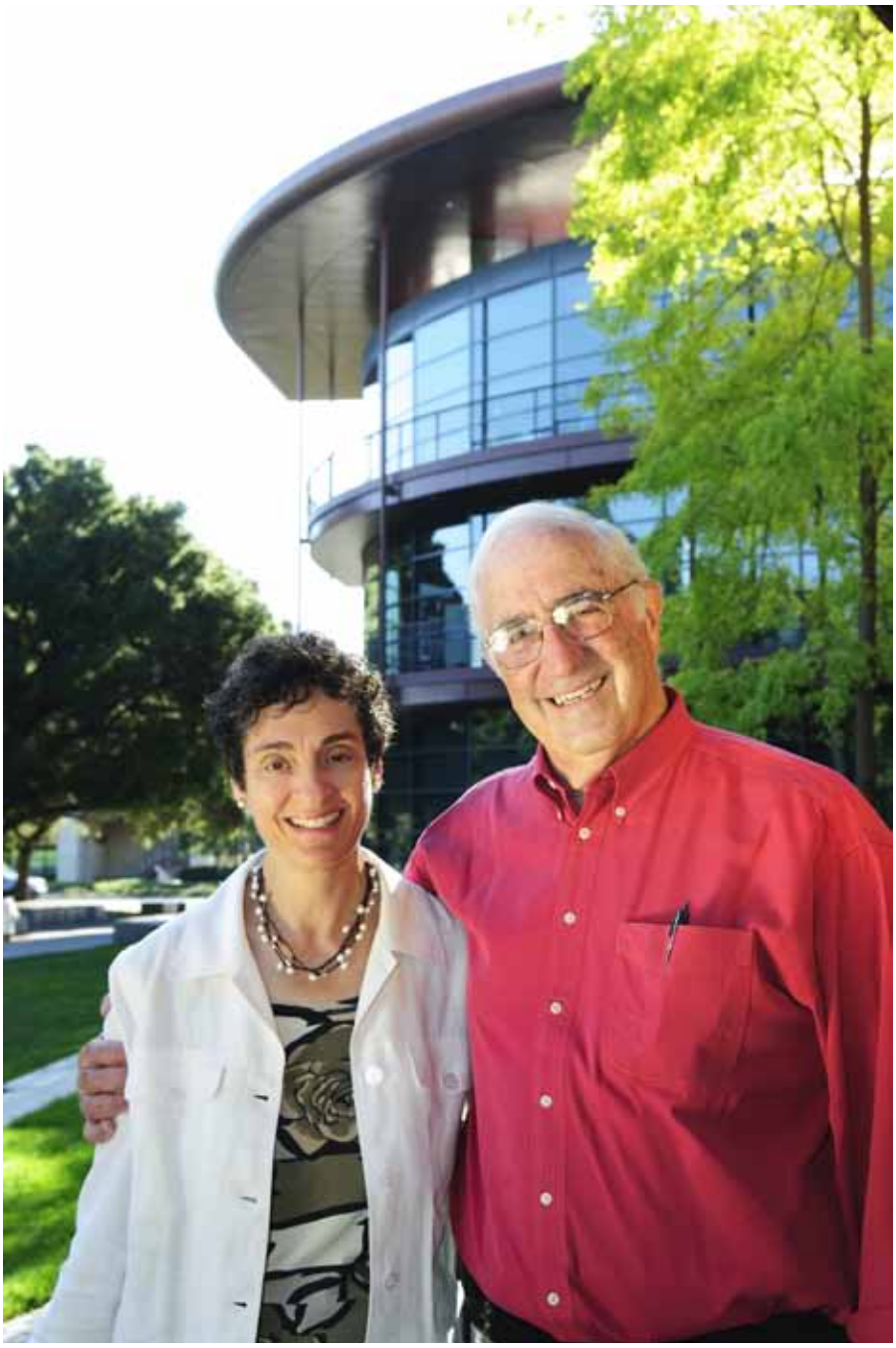






LEE ABEL

Seed Grants for Success

The Stanford Bio-X Interdisciplinary Initiatives Program (IIP)

THE IMPACT OF INCREASED ATMOSPHERIC CARBON DIOXIDE ON CORAL REEF SYSTEMS

The healthy functioning of coral reefs is of great importance, not only because of their amazing beauty, but also for their global value, which is estimated at $375 billion per year. By 2065, the amount of carbon dioxide in the atmosphere is expected to be double the amount it was prior to the industrial revolution. As a result, oceans are absorbing increasing levels of atmospheric carbon dioxide, the effect of which is potentially devastating on coral reef systems. Scientists worry that the increased levels of carbon dioxide will lower oceanic pH levels, causing the coral reefs to dissolve at a higher rate. The IIP award given to Jeffrey Koseff, the Perry L. McCarty Director of the Woods Institute for the Environment, and colleagues was used for a "proof-of-concept" study in which they developed methodologies for accurately measuring the effect of carbon dioxide on coral reefs. Their experiments represent the first in-situ measurements of calcification "in the wild" that is representative of a natural and diverse community of organisms. Following the success of this work, the researchers were able to develop a number of other coral-reef projects sponsored by federal and international foundations in the Gulf of Aqaba, Moorea, the Florida Keys, the Great Barrier Reef, and Hawaii. The initial $164,000 investment by the Bio-X IIP has resulted in external grants and contracts greater than 10 times that amount.

COVER: Carla J. Shatz, Professor of Biology and Neurobiology, Director of Bio-X; Harvey Cohen, Deborah E. Addicott-John A. Kriewall and Elizabeth A. Haehl Family Professor in Pediatrics and Chair of the IIP committee

COURTESY OF BIOROBOTICS LAB

NIKOLAS BLEVINS, MD, PROFESSOR OF OTOLARYNGOLOGY INTERACTS WITH A SIMULATED SINUS PROCEDURE.

MULTI-HAND HAPTIC INTERACTION TO SIMULATE COMPLEX SURGICAL PROCEDURES

In recent years, simulation-based training has become increasingly important in medical education. However, a limitation of existing surgical simulators is that they almost invariably train only a specific psychomotor skill or task (such as suturing). However, an equally important component of a surgeon's training involves developing the cognitive processes necessary for decision-making in the course of performing a full procedure. Bio-X researchers from the Schools of Engineering and Medicine used their IIP award to develop a framework for detecting and responding to discrete events, which are used to design the control flow of complete surgical procedures. The researchers implemented this system in a simulator for ear surgery and craniofacial surgery.

THE BIO-X INTERDISCIPLINARY INITIATIVES PROGRAM (IIP): BUILDING ON SUCCESS

Bio-X aims to make Stanford University the most exciting place in the world for bioscience research, combining faculty from a broad range of scientific and engineering disciplines and giving them the tools they need to succeed. The strongest of these tools is the Bio-X Interdisciplinary Initiatives Program (IIP). The IIP awards provide seed funding for high-risk, high-reward, collaborative projects across the university, and have been highly successful in fostering transformative research.

The Bio-X Interdisciplinary Initiatives Program represents a key Stanford initiative to address challenges in human health, acting in concert with other interdisciplinary grant-making programs across the university. The IIP awards approximately $3 million every other year in the form of two-year grants averaging about $150,000 each. From inception in 2000 through the fifth round in 2010, the program has provided critical early-stage funding to 113 interdisciplinary projects involving more than 300 faculty representing five Stanford Schools and dozens of departments.

The IIP awards have stimulated a striking increase in the number and diversity of collaborations between faculty across Stanford University.

LEE ABEL

SARAH SHERLOCK AND JOSH ROBINSON, GRADUATE STUDENTS IN CHEMISTRY, HONGJIE DAI LABORATORY

CARBON NANOTUBE MEDIATED THERAPY OF LYMPHOMA

Cancer researchers have long faced a serious challenge with chemotherapy: how to get the most medication into the cells of a tumor without the drug adversely affecting healthy cells in a patient's body. With the support of an IIP award, Hongjie Dai, professor of chemistry, and Dean Felsher, professor of medicine, worked together to address this problem using single-walled carbon nanotubes as delivery vehicles. This new method enables the researchers to get a higher proportion of a given dose of medication into the tumor cells than is possible with the "free" drug—that is, the one not bound to nanotubes—thereby reducing the amount of medication that they need to inject into a subject to achieve the desired therapeutic effect. This also means that less of the drug reaches normal tissue, greatly reducing the side effects of the medication. This work has generated significant intellectual property and widespread attention in the popular and scientific press.

IIP awards are given to teams of faculty with early-stage, high-risk ideas that couldn't be funded by traditional sources. By providing Stanford faculty with the seed funding necessary to demonstrate the feasibility of their ideas, the IIP awards catalyze intellectual property and start-up companies, in addition to making the faculty much more competitive for federal grants, which contribute valuable resources to the university.

The first five rounds of IIP awards resulted over $170 million in external funding awarded to the university. This tenfold return on investment by the IIP awards has supported hundreds of graduate students and post-doctoral fellows, resulted in hundreds of publications and dozens of patents filed, and accelerated the pace of scientific discovery and innovation.

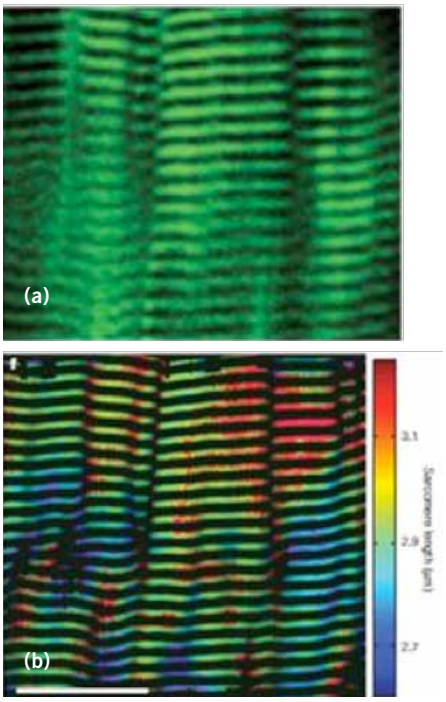
One example of the type of interdisciplinary research these IIP awards enable is a collaboration between faculty representing four different departments in three different schools who developed an alternative to muscle biopsy. (see sidebar) Their microendoscope allows them to view sarcomeres – the micro-machines that drive muscle movement – in real-time, with minimal discomfort to the patient. This technology, made possible by bringing together experts from across the university, will improve understanding of how muscles are altered by spinal cord injuries, strokes, or muscular diseases.

GEORGE NIKITIN/AP, ©HHMI

MARK SCHNITZER, ASSISTANT PROFESSOR OF BIOLOGY AND APPLIED PHYSICS

INVENTING A MICRO-ENDOSCOPE TO MEASURE SARCOMERE LENGTHS IN HUMANS

Using a microscope with a tip the size of a needle (in fact, the world's smallest two-photon microscope!), Mark Schnitzer, assistant professor of biology and applied physics, and his colleagues in the Schools of Medicine and Engineering are able to look at tiny fibers of working muscles in live humans, with minimum discomfort to the patient. The work supported by this IIP award went on to receive a Stanford-Coulter Translational Research Grant, which aims to address unmet clinical needs, improve health care, and lead to commercially available products.

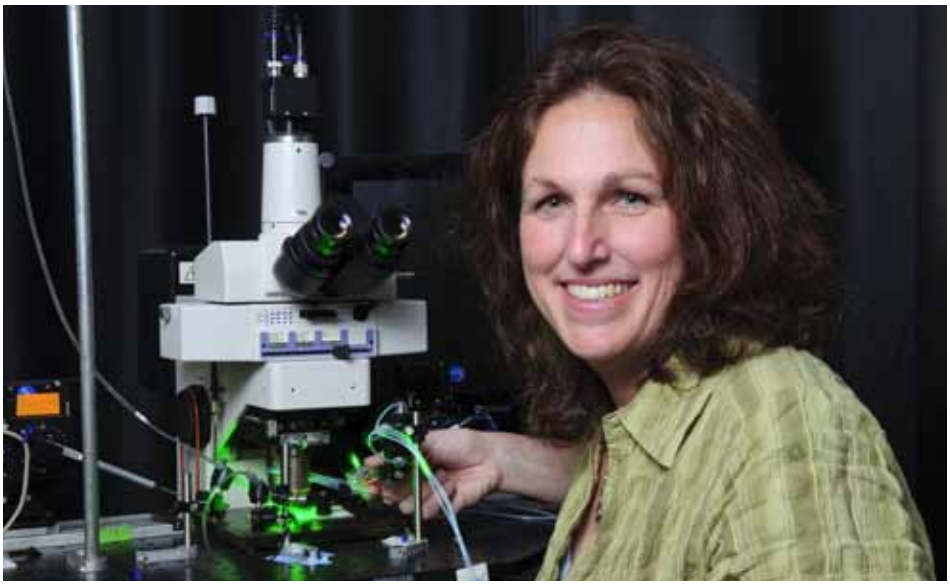


Static imaging of individual sarcomeres. (a) raw SHG images acquired using a 350-mm-diameter microendoscope inserted into the lateral gastrocnemius of an anaesthetized mouse. (b) Map of sarcomere length variations within (a).

GATING MECHANISMS OF METAZOAN SENSORY MECHANOTRANSDUCTION CHANNELS

The sense of touch is an important, but neglected, part of how humans communicate. For example, long-term health and mental development in infants is greatly enhanced by extensive skin-to-skin contact just after birth. Touch-sensitive nerve cells in our skin are filled with long microtubules, whose role in amplifying the mechanical forces applied to the skin is still unknown.

By bringing together expertise in neurobiology, computer science and engineering disciplines, Bio-X investigators used an IIP award to generate new mechanical models of these microtubules. What is learned from this study has the potential to enhance understanding not only of our sense of touch, but also of related nerve cells that monitor the function of internal organs and our muscles. The work enabled by this IIP award went on to receive over $18 million in federal funding.



LEE ABEL

MIRIAM GOODMAN, ASSISTANT PROFESSOR OF MOLECULAR & CELLULAR PHYSIOLOGY

The IIP awards work hand in hand with other efforts at Bio-X to promote interdisciplinary research and training. One example is the Bio-X fellowships program. Bio-X fellowships give Stanford graduate students freedom to take the risks necessary for innovation. Bio-X workshops, seminars, and symposia also foster a sense of community and encourage discussion across disciplines that is critical to the success of our mission.

By enabling scientists involved in technology development to work in highly collaborative ways with discovery scientists across a broad array of disciplines, the Bio-X program accelerates the pace of innovation. Bio-X is a fertile environment for visionaries, and the IIP awards give them the seed-funding they need to allow high-risk ideas to germinate and grow. In this way, the IIP awards have a unique purpose and profound rewards.

BIO-X
STANFORD UNIVERSITY

GIVING OPPORTUNITIES

In the first five rounds of funding, recipients of IIP awards have leveraged their initial seed grants tenfold—earning more than $170 million in external funding for their projects.

IIP awards vary in amount; gifts in the form of expendable funds, term endowment, and endowment are welcome.

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