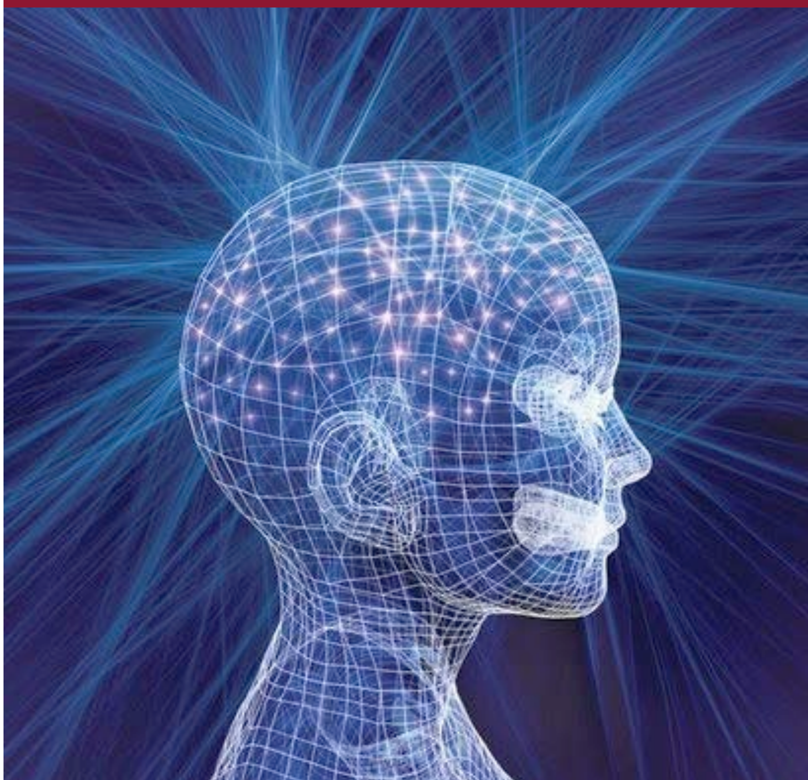
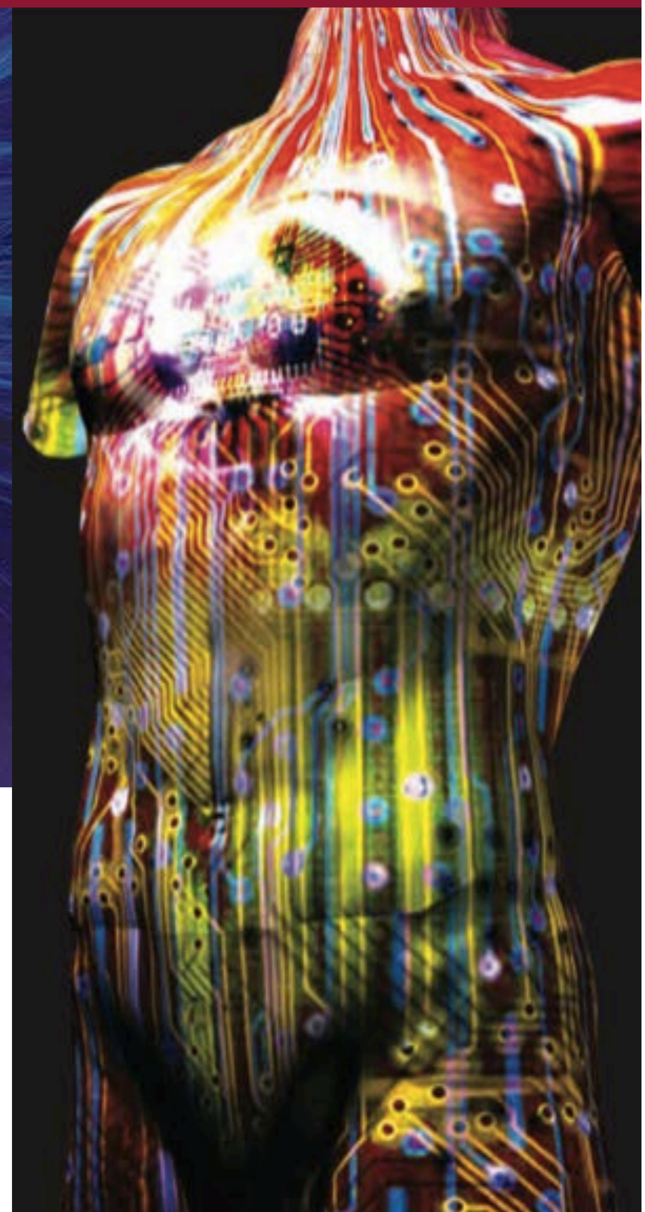
Institute for Biomedical Therapeutics at USC

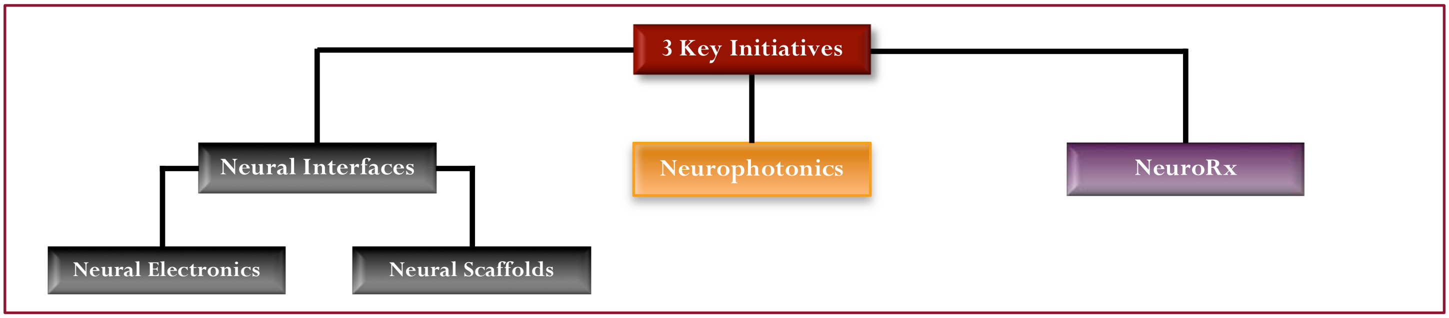




Discovery at the intersection of medicine, engineering and imagination

The mission of the Institute for Biomedical Therapeutics (IBT) at the University of Southern California (USC) is to research bioengineered neural interfaces with the goal of developing treatments for patients for whom there is no foreseeable cure. Through an interdisciplinary approach, IBT strives to revolutionize the medical field as we continue to enhance our understanding of debilitating neurological conditions.

IBT Initiatives



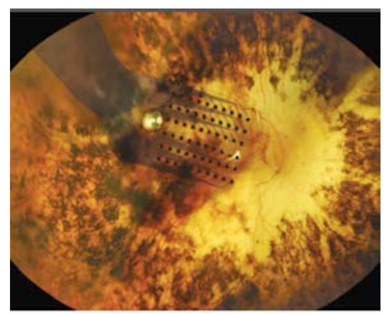
The Inspiration – IBT Director, Mark S. Humayun MD, PhD, devoted his career to developing treatments for eye diseases, after having watched his grandmother lose her vision to diabetes. But developing cures for vision loss is no easy feat, as visual processing involves both the complex and intricate machinery of the eye, and approximately 30% of the cerebral cortex of the brain. The process of developing vision restoration treatments has provided a foundation upon which IBT can expand to also create a new generation of therapies for neurological conditions.

Neural Interfaces- Bioengineering of Synthetic Interfaces for Neurological Diseases

Neural Electronics – A team of world experts, led by Humayun and James D. Weiland, PhD, developed a revolutionary treatment for Retinitis Pigmentosa (RP) through integrating electronics and the brain. *Argus II*, the bionic eye, is the first FDA approved retinal prosthesis, which combines an eyeglass-mounted camera with a 60 electrode retinal stimulator. The stimulator is implanted onto the eye and interfaces directly with the retina. Once stimulated, the electrodes relay signals from the external camera to the retina via small electrical impulses, which triggers neural signals in the retina that are passed to the brain via the optic nerve. The brain is then able to process the signals into a visual picture.

Argus II

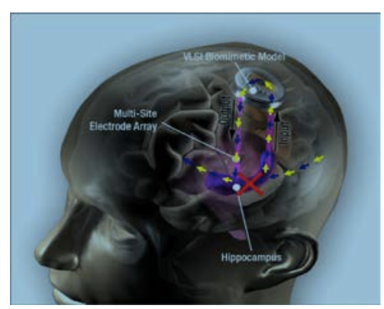
Real Life Impact – L.K., diagnosed with RP, began losing her sight at the age of 21. She was the first person to be implanted with Argus II at Keck School of Medicine by Lisa Olmos de Koo, MD, MBA and Humayun. L.K. was able to regain partial vision after decades of complete darkness. Remarkably she saw patterns of light on her first day of activation. Currently researchers are working towards the next generation of the device, developing more sophisticated interfaces that can provide a richer sense of vision.



Electrode retinal stimulator

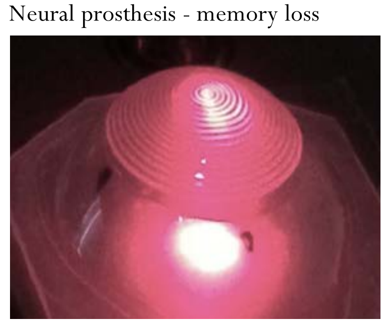
"I'm confident that there will be a cure down the road and it starts here," -L.K. Argus II Patient

Beyond the Eye: Brain Injury and Neural Dysfunction – IBT aims to take the knowledge and best practices used to develop the Argus II, and apply them towards exploring and developing other therapeutics to treat neurological disorders. Examples of conditions that IBT is targeting include: severe cognitive loss as a result of Alzheimer's disease, or dementia; damage caused by stroke, head trauma or epilepsy. Great strides have been made in developing synthetic neurological interfaces, such as a neural prosthesis, which will help restore regions of the brain known as the hippocampus and limbic cortical system which is largely responsible for memory, learning and emotion (Theodore Berger, PhD).



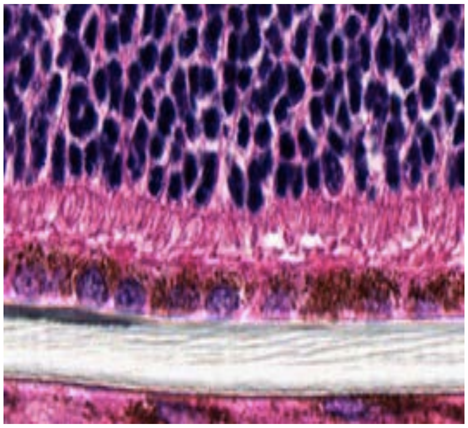
Neural prosthesis - memory loss

Beyond addressing neurological disorders, IBT is also developing biomaterials-based solutions to prevent neurological degradation in the eye caused by trauma. Penetrating injuries to the eye can lead to retinal detachment and blindness if left untreated for days. IBT is currently collaborating with industry and U.S. Army to develop different "patch" technologies to temporarily seal penetrations of the cornea or sclera. These biomaterials may give patients time to see a specialist without risk of vision loss (Jack Whalen, PhD).



Novel biomaterial for trauma

Neural Scaffolds



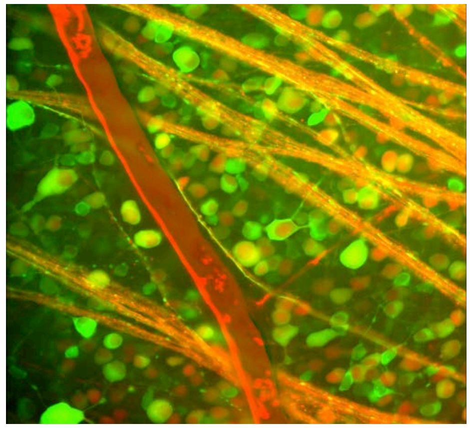
RPE seeded scaffold (white) implanted in the subretinal space of a rat

Synthetic Cellular Stem Cell–based Scaffolds

Age related macular degeneration (AMD) is a retinal disease that can lead to catastrophic vision loss and currently affects over 2 million in the U.S. AMD affects central vision that results in the inability to read, recognize faces, or even drive. The disease leads to the death of photoreceptors caused by the loss of crucial retinal pigment epithelial (RPE) cells, which provide support and nutrition.

David Hinton, MD, Humayun and their team are leading a stem cell-based initiative for the treatment of AMD, awarded nearly $38 Million through California Institute for Regenerative Medicine. A unique procedure was developed by which stem cell derived RPE cells are grown onto a synthetic scaffold implant. Thus, the critical photoreceptors needed for vision may be replenished by replacing diseased RPE tissue. Phase I clinical trials for the synthetic cellular scaffolds are expected to commence in 2015.

Neurophotonics



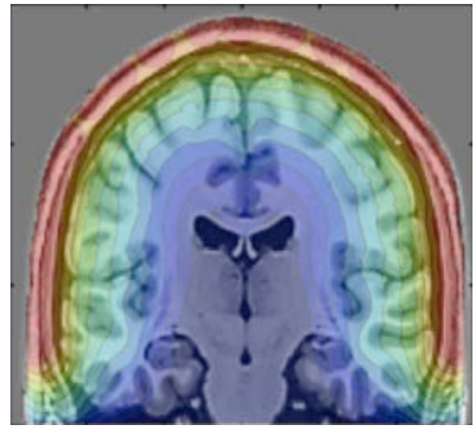
Ganglion cells in rat retina labeled with fluorescent green and red probes

Treatments through Light Activation

In certain eye diseases, neurons that are responsible for vision, such as light sensitive photoreceptors and retinal ganglion cells, may become damaged and inactive. The creation of neurophotonic systems that act as nano-photoswitches, or tiny devices implanted in the eye, have been developed to treat these eye diseases by inducing normally non-photosensitive neurons to be able to respond to light. The novel photoswitches have the potential to significantly expand the power of neuroprosthetics.

In one example, in tandem with the NeuroRx group, IBT researchers have designed a new class of optically activated compounds. These "caged" compounds may be released once activated by infrared light. The novel caged compounds will augment the power of prosthetic devices, which may be used to restore vision to patients who are blind.

NeuroRx



Light activation of the brain

Drug Delivery Systems

This area focuses on novel drug delivery systems and bioelectronic implants that may deliver drugs across the blood-brain barrier in a highly selective manner. Novel micro and nano-eletromechanical systems, known as MEMS or NEMS, have been developed. The technology has been applied to MEMS based drug delivery systems.

These innovative bioengineered inventions, in addition to the photoactivatable cage compounds, offer drug delivery systems that will revolutionize the field of neuro-pharmaceuticals.

The implementation of NeuroRx Therapies can be used to treat conditions such as dry and wet AMD, uveitis, glaucoma, traumatic brain injury, and neurodegenerative diseases (e.g. multiple sclerosis).

Innovation at the Interface of Academia and Industry

The relationship between IBT and its partners propels research forward, bringing us one step closer to translating our basic science discoveries into real clinical applications.

- Approximately $14 million in additional collaborative grants and sponsored programs have been captured
- 199 patents have been filed
- 25 licensing agreements have been issued
- 10 new start-up companies have been founded

Education and Outreach

The IBT strives to engage and inspire our students of tomorrow.

- Establish programs and courses in neuro-engineering and medical device development
- Provide opportunities for our students to collaborate with our partners in industry
- Committed to improving diversity with the aim of providing opportunities for relatively underrepresented women and minorities
- Creating high school outreach programs
- Mentoring our leaders of tomorrow

Leadership

Mark S. Humayun, MD, PhD
Director of IBT

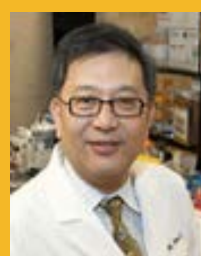
James D. Weiland, PhD
Co-Director of IBT

David Hinton, MD

Theordore Berger, PhD

Robert Chow, MD, PhD

Amir Kashani, MD, PhD



Stan Louie, PhD

Nicos Petasis, PhD

John Whalen, PhD
Director of industrial relations

Our Medical Breakthroughs come from your support

We are fortunate to have received an enormous amount of support: federal and state funding- NSF, CIRM, and NIH among others as well as philanthropic contributions-*WM Keck and Windsong Foundation.*

IBT is indebted to generous federal, state and industrial support, providing us with a strong foundation to build upon. However, our cutting edge and non-conventional research and development platform requires external funding to seed new ideas that will transform how we think of today's problems and tomorrow's solutions. To help us continue making medical breakthroughs, we depend on your philanthropic support as we forge ahead to the next frontier of scientific discovery.

For more information please contact:
Debbie Mitra, PhD, Director of Science and Technology at 323-865-0342