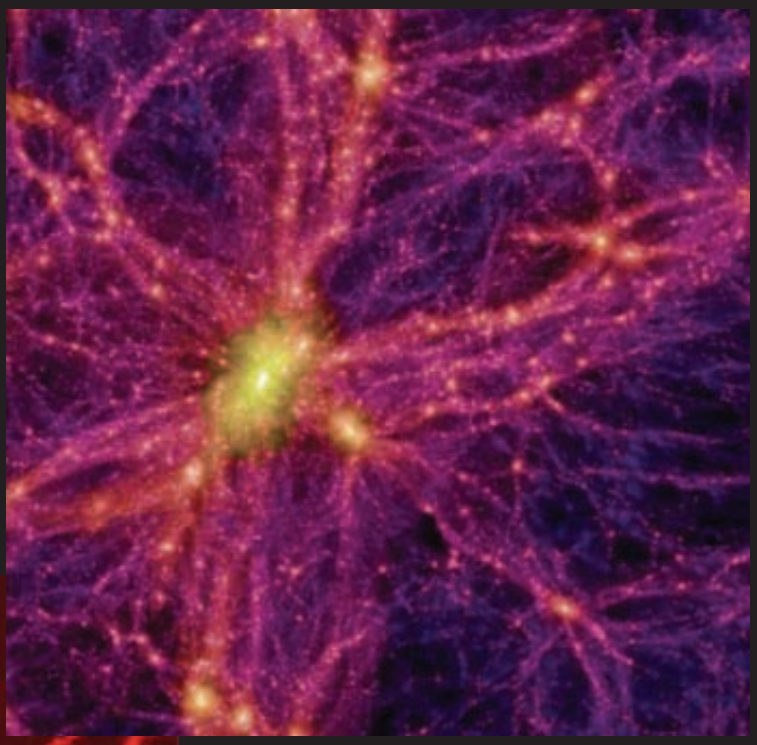
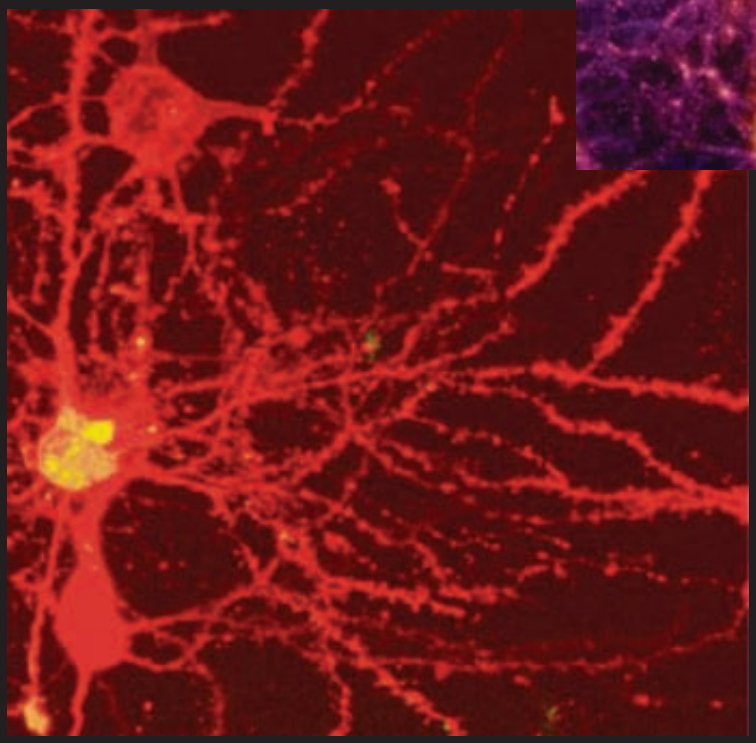
Imaging Science: Electrons to Galaxies
An NSF Science and Technology Center Proposal

100s of Billions of Stars





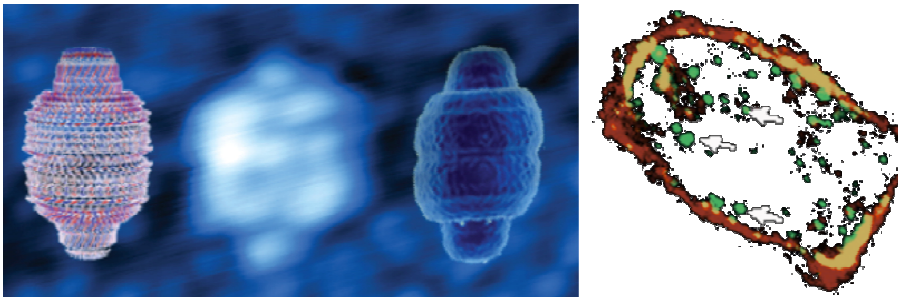
100s of Billions of Neurons

Imaging Science: Electrons to Galaxies – ISEG

Mission

Imaging is central to science, engineering, medicine, and art. The University of California, Los Angeles has a tremendous history of innovations in imaging technology and applications, with a continuous trajectory of growth. This work is distributed through multiple departments, schools, and centers, including the California NanoSystems Institute (CNSI), the Institute for Pure and Applied Math (IPAM), the Geffen School of Medicine, the Departments of Mathematics, the Staglin Center for Cognitive Neuroscience, Chemistry, Electrical Engineering, Physics & Astronomy, Psychology, the NeuroImaging Training Program, and, of course, our extraordinary resources in the visual and media arts. To date, our approach has been traditional, fostering imaging within each of these disciplines independently, separately furthering the state-of-the-art in each modality. The proposed ISEG Center will advance imaging science by breaking down these barriers, bringing the latest advances in mathematics, statistics, and computer science to astronomy, biology, chemistry, engineering, medicine, physics, and other fields. At the same time, key problems in imaging – acquisition, processing, analysis, and visualization – will be posed to and addressed by our world-leading team of mathematicians, statisticians, and computer scientists.

In the digital age, imaging, regardless of modality, shares a large and increasing common infrastructure of representation through computers, pixels, and monitors. Images are data: the objective analysis of images no longer is the domain of inspection but is instead a quantitative science in which issues of noise, accuracy (in many dimensions), and the representation of inherently non-visible targets (atoms, magnetic spins, ultrasound, etc.) are problems faced in all disciplines that include imaging and visualization. In most cases, imaging is no longer a direct tool, but rather a metaphorical presentation of abstract events into visual media. There are crucial and important issues of veridicality: pictures are consumed like photographs, but often are composed of statistics and conjecture. There are equally critical issues of semiotics, much information is conveyed in choices of layout and aesthetics.

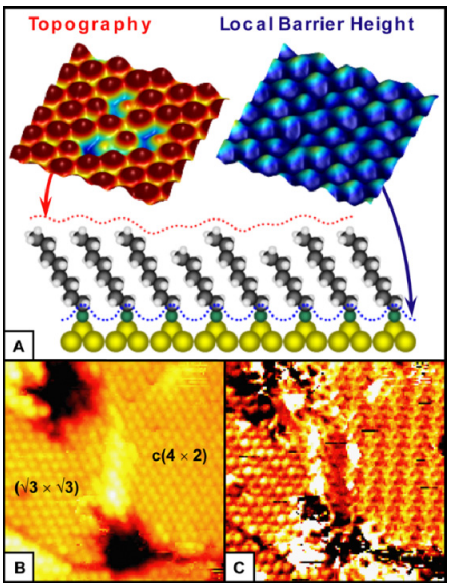


Vault nanoparticles: TEM reconstruction, atomic force microscopy image, and confocal fluorescence microscopy image. *All images used in this proposal are contributed by ISEG investigators*

The aim of ISEG is to develop a unified approach to the theory, handling, and presentation of images from acquisition, processing, and analysis to visualization. We will develop the groundwork for theoretical and analytic structures that will bring to imaging what the theories of signal processing developed in the 50's and 60's brought to engineering. The ISEG Center's training program will address these common problems and develop modality-agnostic approaches. The trainees will study the structures of acquired images from information theoretic perspectives and machine vision, and will examine the role of human neurophysiology in the processing of visual information. We will develop a common framework of study; our success will be measured by the application of that framework across disciplines.

Arts and Media will play important roles. Many research scientists are unaware of the academic investigations and advances in the visual arts that help to organize our understanding of the way that images convey information.

This vision is both innovative and unique, leveraging UCLA's strengths across campus, in science, engineering, medicine, the arts, and across imaging of all modalities. Our goal is to create a new science of imaging, responsive to the realities of a digital age and the convergence of 1) a massive growth in the production of images and 2) the theoretical advances in image understanding. The need for such an effort has been highlighted in several recent studies of the National Academies, the Keck Foundation, and others. The scope and need are sufficiently broad as to be outside of the domain of traditional university departments, such that this is a near perfect match to the goals of the NSF Science and Technology Center Program.



Multimodal imaging is common in many fields. Here, simultaneously recorded scanning tunneling microscopy modes image the tops and bottoms of molecules, thereby determining the tilt angles of single molecules with exquisite resolution.

Intellectual Merit

Imaging underlies science, engineering, medicine, and art. Advances made in the science of imaging have been limited by the silos in which different imaging modalities operate. The broad dissemination of advances in analyses and visualization has been limited by commercial packages. The Center will address these global issues by bringing together top imaging scientists with experts in mathematics, computer science, statistics, and visualization. Significant advances are anticipated in the fusion of information of different modalities, the processing and reduction of data acquired, analyses imaging data, and visualization of data and data streams.

Broader Impacts

Advances will impact communities from science, engineering, and medicine to art. The visual domain is critical to public understanding and appreciation of science. The entertainment industry will be strongly engaged to reach hundreds of millions of people

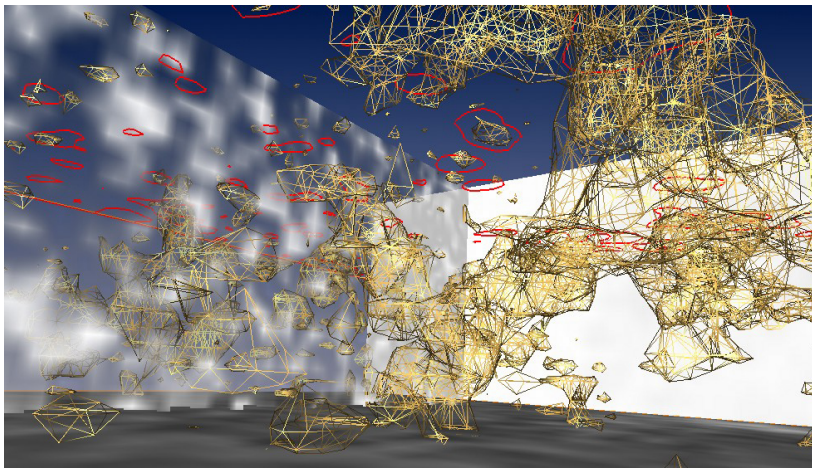
worldwide. Diversity at UCLA will be enhanced by recruiting, mentoring, and retention members of underrespresented groups at all levels in the Center.

Leadership

Consistent with its interdisciplinary focus, directorship of the center will be shared:

Mark S. Cohen's research is in the development and use of imaging for the study of human cognition. He is the field chair in Biological Signal and Image Processing in the department of biomedical engineering and is the director of the federally-sponsored NeuroImaging Training Program (NITP). Cohen's primary appointment is in Psychiatry, with joint appointments in biomedical physics, radiology, neurology, psychology, and biomedical engineering. He is the technical director of the Staglin Center for Cognitive Neuroscience.

Paul S. Weiss studies materials and processes at the nanoscale such as single-molecule and single-bond motion, using a variety of precision imaging devices including atomic force and scanning tunneling microscopy. He holds the Fred Kavli Chair in NanoSystems Sciences. Weiss is the director of the California NanoSystems Institute and a distinguished professor of chemistry and biochemistry, materials science and engineering.



Seeing beauty. Brain activity associated with aesthetic perception. Active brain regions are represented by spaces enclosed in wireframe.

Investigators

We have attracted an outstanding list of investigators who share the vision of a multi-disciplinary and collaborative project. At this time, from UCLA we include:

Paul Weiss	Chemistry & Biochemistry, Materials Science & Engineering

Mark Cohen	Psychiatry & Biobehavioral Sciences, Neurology, Biomedical Physics, Biomedical Engineering, Radiological Sciences, Psychology, Neurology
Anne Andrews	Psychiatry & Biobehavioral Sciences, Chemistry & Biochemistry
Katsushi Arisaka	Physics & Astronomy
Andrea Bertozzi	Mathematics
Giovanni Coppola	Neurology
Felice Frankel	Materials Science and Engineering, Systems Biology
Jim Gimzewski	Chemistry & Biochemistry
Warren Grundfest	Bioengineering, Electrical Engineering
Bahram Jalali	Electrical Engineering
James Larkin	Physics & Astronomy
Jin Hyung Lee	Electrical Engineering, Psychiatry & Biobehavioral Sciences, Radiology, Biomedical Engineering IDP
Stan Osher	Mathematics
Mayank Mehta	Physics & Astronomy, Neuroscience IDP
Marcos Novak	Art, Media Art and Technology
Dario Ringach	Neurobiology & Psychology, Biomedical Engineering IDP
Ladan Shams	Psychology
Stefano Soatto	Computer Science, Electrical Engineering
Joey Teran	Mathematics
Demetri Terzopoulos	Computer Science
Paul Thompson	Neurology
Victoria Vesna	Media Arts
Shimon Weiss	Chemistry & Biochemistry, Physiology

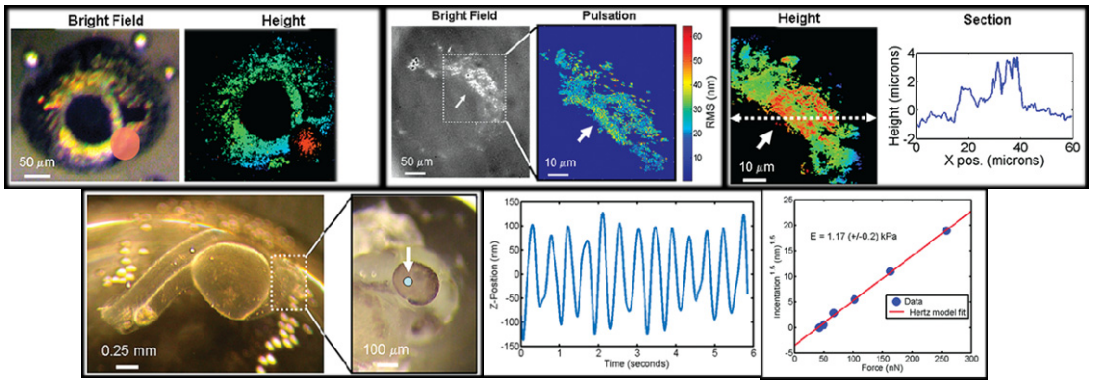
Alan Yuille	Statistics
Hong Zhou	Microbiology, Immunology & Molecular Genetics

Participating Institutions

Responding to the NSF multi-institutional mandate, we also have attracted investigators from outside UCLA, as well as international institutions and individuals:

Davis Baird – Clark College
Bristol nanoCenter (UK)
Karl Friston – University College of London (UK)
Felice Frankel – Harvard/MIT
iNano, Åarhus (Denmark)
Kevin Kelly – Rice University
Denis Le Bihan – Neurospin, CEA-Saclay Center (France)
MESA+, University of Twente (The Netherlands)
Marcos Novak – UCSB
C. Paresh Ray – Jackson State University (HBCU)
Steven Smith – Oxford University (UK)
Robert Turner – Max Planck, Leipzig (Germany)
Pedro Valdes-Sosa - Cuban Neuroscience Center (Cuba) (if NSF allows)

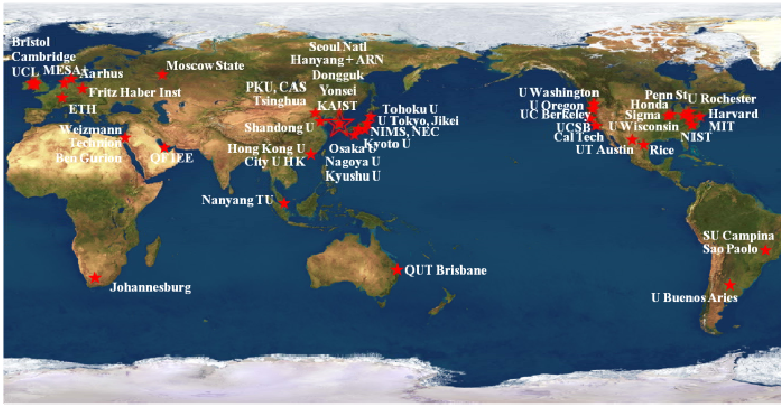
See also the diversity section for other partner institutions.



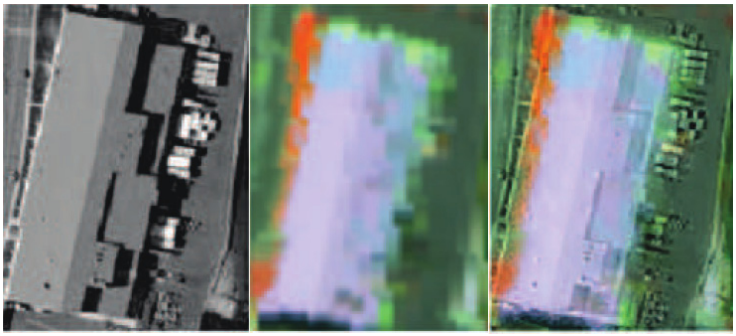
Living zebrafish embryos imaged by optical microscopy, interferometry, and atomic force microscopy.

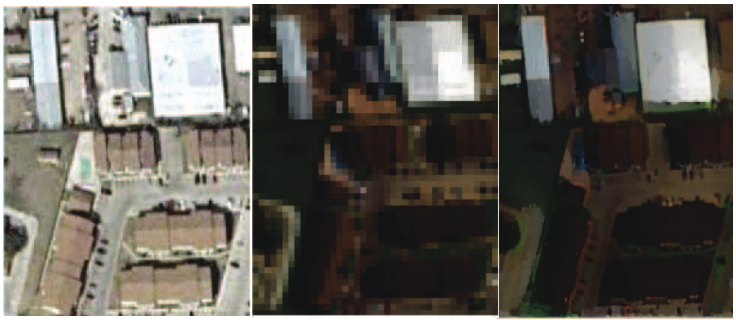
International Partners

The Center will leverage the strong international linkages and collaborations developed by CNSI and our PIs. The range of universities and research institutions is shown in the figure to left (*partial*). Of particular significance is the Materials Architectonics (MANA) program based at the National Institute of Materials Sciences in Tsukuba, Japan. A satellite of MANA, located at CNSI under the guidance of Professor Gimzewski, represents an excellent model for international collaboration in terms of global mentoring, setting research priorities, educational programs, and developing frequent faculty and student exchanges. We plan a similar approach by having Center students and postdocs spend time carrying out specific experiments and analyses with our international partners at their institutions. The Center will reciprocate by hosting students and faculty from collaborating overseas groups. Another collaboration worth noting is with the Chinese Academy of Sciences (CAS), Peking University (PKU), Tsinghua University, and their jointly run Beijing nanoCenter (NCNST). Our Center will leverage a joint institute with the CAS being announced by the Chancellor next month, the existing Joint Research Institute with PKU, and strong collaborations and a jointly run summer school between NCNST, CNSI, and iNano Aarhus, Denmark. Research, educational, and cultural benefits can be realized from the collaboration. The international collaborations to be developed will be those that benefit the individual CRTs by providing either complementary expertise and/or capabilities not available at UCLA.



International center collaborations





Hyperspectral images incorporate information from hundreds of bands within the electromagnetic spectrum, often with variable levels of resolution, creating a challenge for representation and fusion. Shown here is are the results of a variational approach to the sharpening of hyperspectral images

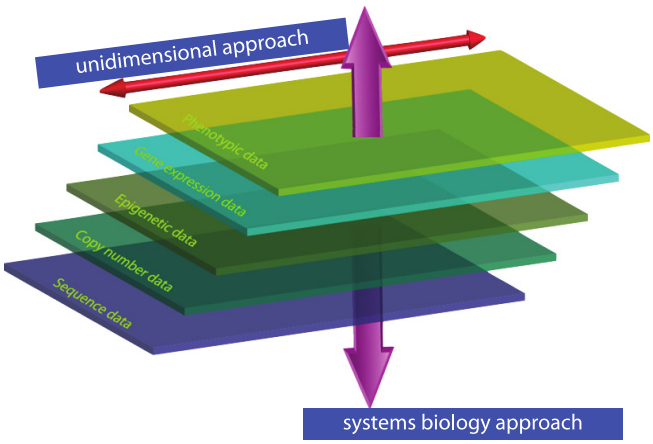
Organizational Structure

The goal of the center is to consider a *unified* approach to imaging science, with emphases on:

1. New cross-disciplinary collaborations bridging acquisition, processing, analysis, visualization and presentation. We will do so by investing in research projects that conform to the mission of the center and engage researchers across a range of domain knowledge;
2. Developing and maintaining cross-disciplinary data sets;
3. Developing computing and code resources for image research;
4. Collecting multimodal, multispectral and other challenging data sets to foster unified and integrated processing across domain spaces;
5. Sponsoring teaching, research seminars and workshops; and
6. Sponsoring in-residence fellowships for theoretical development, in the form or internal sabbaticals, visiting fellowships.

Collaborative Research Teams

To forward the mission of cross-disciplinary research, the scientific projects of the center will be the responsibility of Collaborative Research Teams (CRT's) developed by the center faculty. The CRTs together will make up the overwhelming majority of the overall budget. We anticipate that five CRT projects will be active initially, with new seed CRTs constantly renewing and updating the efforts of the Center. New project funding will be awarded according to their consistency with the ISEG Center mission:



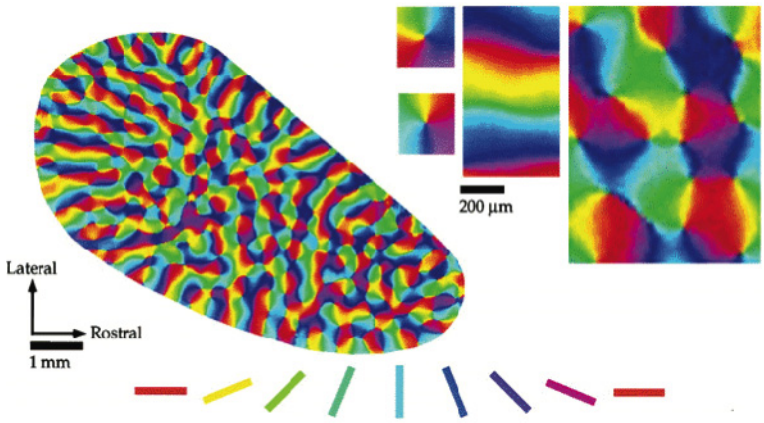
Gene arrays have dimensions and characteristics of other data images. The ISEG will incorporate the analysis of genetic data into the developing theory of feature extraction, analysis and image information sharing.

- Developing a unified conceptual and analytic approach to imaging
- Multidisciplinary contribution and interaction
- Advancing the state-of-the-art of imaging
- Advancing the means of communication of, and through, scientific images
- Detection of information containing features in high density and multidimensional data arrays: Computational, physiological, etc…
- Projection of higher dimensional and multispectral spaces onto visualizable images
- Providing strong educational opportunities
- Enhancing the diversity of the research teams

Further, CRTs will be evaluated on their potential for continuing public or private sector funding from agencies including NSF, DoD, DoE, NIH, industry, or foundation support. Funding for CRT projects will be competitively renewed annually, based on project success. New seed CRT proposals will be evaluated by a research committee whose

members include representatives with expertise in the core areas of mathematics, image processing, engineering, visual arts, physics and physiology.

In addition to the large-scale CRTs, a separate budget will be dedicated to seed funding for the development of new CRT projects. Seed projects will be used to augment and update existing CRTs and to create new CRTs, ultimately replacing those that have run their course. They will emphasize early stage investigators and diversity recruitment. Seeds are expected are expected to carry high-risk investigations. Successful seeds both add to the Center, and create new funded efforts in this area for UCLA (*vide supra*).



Multimodal imaging can be used to determine how large populations of individually "dumb" neurons can join forces to do incredibly complex calculations. The methods used here include optical imaging and two photon imaging to study neural orientation maps in V1.

The CRTs have been developed around the central problems of imaging science: fusing information from image modalities, access beyond principal component analyses for imaging scientists, visualization and interpretation of image data and presentation.

Computing Infrastructure

Computation is ubiquitous across the disciplines that make up the center. We will establish and manage a computing infrastructure supporting the research underway within the ISEG. The computing core will have both service and research missions: file and data management for imaging research is a major challenge to the field. Compressive storage, efficient data transfer and information extraction will be the domains of one or more CRT. Thus, the scientific results of the research program may have impact on the Center operations. The principal mission of the computing core, however is to provide the ISEG with high-quality information technology, professional storage and backup services, and state-of-the-art networking.

Seminars and Workshops

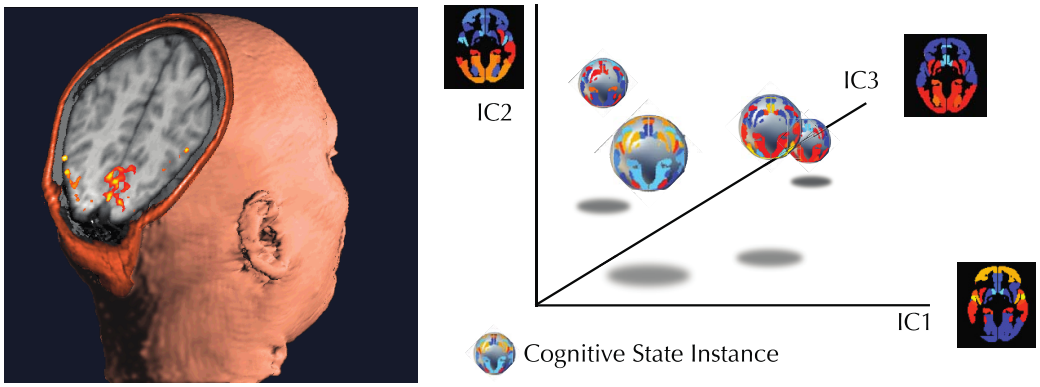
An important feature of an interdisciplinary program of this scope is the communication and mutual education of the investigators. To foster these interactions, the Center will run a weekly seminar series for students, faculty, staff, and visitors. The CRTs will present on a rotating basis, with visitors interspersed. These will be run through the CNSI member lunch series.

The Center will organize and sponsor problem-centered workshops, in partnership with CNSI and IPAM. We will leverage these workshops to bring in outside investigators, to help consider immediate challenges, and to engage the community with broader multi-domain questions that define the ISEG's research mission. These are a part of the Center's dissemination plan.

Administration
The Center will follow NSF guidelines for administration, with its day-to-day activities led by the Director (Cohen) who reports directly to the Vice Chancellor for Research (Economou). Policies of the Center, to be carried out by the Director and other leaders, are set by the Executive Committee, composed of the Director, Associate Director, CRT coordinators, and education & outreach coordinator. Scientific directions are set by the CRT and Seed Program members. The Executive Committee allocates resources and reviews Center programs.

Industrial Partners and External Advisory Board
Industrial partners will include Bruker, Disney Research, FEI, HP, IBM, Leica, Mathworks, Photron, and Sony. The following will be amongst those invited to the external advisory board (EAB): Disney Research Chief Scientist Joseph Marks, IBM Head of Physical Sciences Supratik Guha, and Mathworks CEO Jack Little. In addition, we will invite the heads of sister centers, including Stanford STC Director Katherine Moler, as well as the heads of national laboratory imaging centers at Lawrence Berkeley Laboratory and Oak Ridge National Laboratory (these positions are currently in flux, but co-PI Weiss is on the board of each). The EAB will be brought together annually, as noted in the timeline.

Entrepreneurship and Intellectual Property
Entrepreneurship programs at CNSI, including business school and law office hours, venture community events, will be used to lead a new culture of entrepreneurship to our diverse group of faculty, staff, and students.

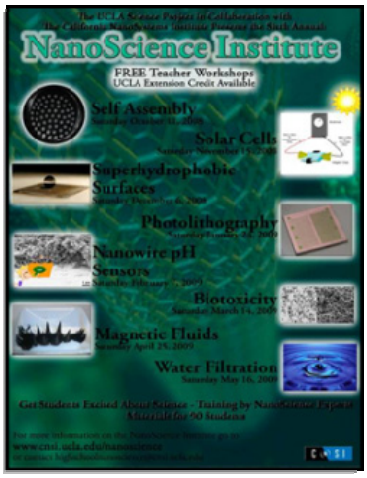


The brain sees itself. The human brain separates the incoming visual stream into components such as topology, color motion and texture that are processed by distinct brain regions. Magnetic resonance imaging and electroencephalography can capture this activity. Automated feature extraction, coupled to machine learning, can be used to decode the cognitive states associated with seeing in real time.

Education, Outreach and Diversity

The ISEG will heavily leverage the existing successful outreach programs of the California NanoSystems Institute. Utilizing the infrastructure of a center, our goals in education and outreach are to impact the lives of many hundreds of individuals reached directly, and a wide segment of the US and world population reached through popular media. Regular seminars, workshops, and conferences on the science of imaging will rapidly disseminate new innovations from our center to researchers across the world. At the same time, our center's In-Residence Scholar programs will attract international talent to stimulate cross-disciplinary research collaborations. The CNSI high school teacher program connects to over 100 high schools and will be both shared and expanded with the new center.

We will exploit our proximity and connections to the entertainment industry to reach millions of citizens who are not involved in science. We will also reach individuals with the diverse, creative programs described below. Center students, faculty, and staff are committed to these efforts; each member will participate in at least 15 hours of community outreach annually.



Teacher Training. We run a highly successful and fully subscribed High School Nanoscience Program at CNSI that trains science teachers from 110 high schools across 29 public school districts in Southern California. We have built this program to its present level over the past six years through internal funding and the active participation of the IGERT fellows. In the program, we will identify places where the science of imaging can be used to teach elements of the required public school curriculum so that integrating these tools into the classroom alleviates rather than adds to the burden of the teachers. The program will be led by Paul Weiss at CNSI and its effectiveness will be assessed by at the UCLA School of Education. Our work will be disseminated by publication in the science education and imaging literature and on-line through our web site, and through new media, such as YouTube, which are particularly appropriate outlets for imaging results.

Graduate and Postdoctoral Training. In the spirit of its highly interdisciplniary mission, students and postdoctoral fellows of the Center will not be assigned to individual PI's but rather to the CRT and Seed projects. We anticipate that Center students will typically be co-advised; most of the Center faculty already have co-advised graduate students and postdocs across departments, colleges, and schools. In addition, all Center graduate students and postdocs will be formally mentored in all aspects of their careers through the career development programs developed together by CNSI, the UCLA Graduate Division, Society for Postdoctoral Scholars, and the School of Medicine's Postdoctoral Scholars Office. These regular series of mentoring sessions and workshops, specifically developed for PhDs, provide practical information regarding career paths, leadership skills, resume and interviewing skills, and networking.

Undergraduate Research. The Center will organize a 10-week summer Research Experience for Undergraduates (REU) program on imaging science to undergraduates from outside UCLA. All REU students will participate in outreach. To promote under-represented minority (URM) participation, priority will be given to URM students from local and national minority-serving institutions, including the ***Cal State*** and ***Cal Poly*** systems, ***Jackson State***, and the ***University of Puerto Rico***, where we already have strong bridges through collaborations and alumni on the

faculty. In parallel, we will recruit through national organizations that support minorities (see Diversity Strategic Plan).

K-12 Outreach. The Center will offer summer camps annually, devoted to the interface of art and science, and will follow on successful programs we have run at CNSI the last three years. High school students and their mentors (faculty, staff, and graduate students) are immersed in a creative mix of art and science at our renowned Art|Sci center, led by faculty members Victoria Vesna and Jim Gimzewski. Young science/artist teams explore the science underlying art, the beauty of the natural world and our interpretation of visual and other data. An important goal for the students is to develop deeper, thought-provoking understanding of images and representation.

Center faculty, staff, and students serve as mentors. In each program, scholarships will be offered to underrepresented minorities, particularly targeting southern California and New York City schools with predominantly URM populations. Scholarships will be based on financial need, academic performance, and submitted essays.

Linking Science and the Arts. The Art|Sci program at CNSI (Victoria Vesna, Digital Media Arts, Lead; Jim Gimzewski) brings together science, engineering, medicine, the arts, film, and technology in a creative blend that makes us think deeply about the how and why of what we do. The Art|Sci program has had a number of exhibitions (LA County Museum of Art, Beijing, Marseille, New York, Paris, Santa Barbara, Seoul, Shanghai, Singapore, and Tokyo), which are coupled to scientific symposia in the host cities and countries. The Center will expand current activities to have quarterly student exhibitions in the presentation space at CNSI, and to produce annual exhibitions related to CRT topics such as the imaging of the brain, cells, and nanomaterials. A feasible goal here is to develop an exhibition entirely on our center's content. Art|Sci represents one significant way in which we make science accessible and attractive to the public at many levels.

Science in the Movies and Television. Many families would never consider sending their children to a science camp or taking them to a science museum; they nonetheless vote in popular elections and use technology every day. This cohort makes up the majority of the US population. We are in a unique position to reach this important community through the movies and television, leveraging two partnerships with the Motion Picture Academy of Arts & Sciences (MPAAS).

In the first, which involves the National Academy of Sciences and the Directors Guild, we host the Science Entertainment Exchange (SEE) at CNSI. These events, which often take place in the Directors' Guild theatre in Hollywood, generally involve two short talks by experts who can communicate at a public level on a key science topic. The presentations are moderated by a noted director and followed by hours of discussion amongst scientists, writers, directors, and actors, with months of follow-up. We have capacity audiences; real science, vetted by scientists, is making it into the movies as a result. The Center will host and support one such event focused on the science of imaging each year; we will supply or invite the scientists and use these events in a larger context to mentor our students, staff, and faculty on how to speak to the public about science.

In the second, we work with the Science & Technology Council and the Technical Guilds of the MPAAS. We will leverage UCLA's film collection (second in size only to the Library of Congress). One or two movies on a theme will be shown alongside short science presentations, then followed by an evening's discussion. We will have public events once a year at either the Billy Wilder Theatre in the Hammer Museum (owned by UCLA and adjacent to campus, 300 seats) or if the topic warrants, at the Kodak Theatre of the Academy (3300 seats, home of the Oscars).

Diversity Strategic Plan

Aligned with the UC value system and the demographics of Los Angeles, the Center is committed to promoting equity and inclusion at all levels of Center participation. Our diversity plan establishes two aggressive goals: 1) to increase the base of women and underrepresented groups (URMs) at

all levels and 2) to maintain a “continuum of mentorship” with particular emphasis on career development. Given that our Center directors and participating faculty are highly involved in building diversity in medicine, the sciences, and engineering at UCLA, a cornerstone of our plan is to leverage key successful programs and coordinate their success with ***a focus on URM recruiting, retention and mentoring***. Dr. Enrique Ainsworth, Center for Excellence in Engineering Diversity (CEED), will lead as the Diversity Director to promote inclusion in all Center decisions and to help develop our mentoring program. We will collaborate with the UCLA Graduate School of Education and Information Studies to design and to conduct formative evaluation and metrics.

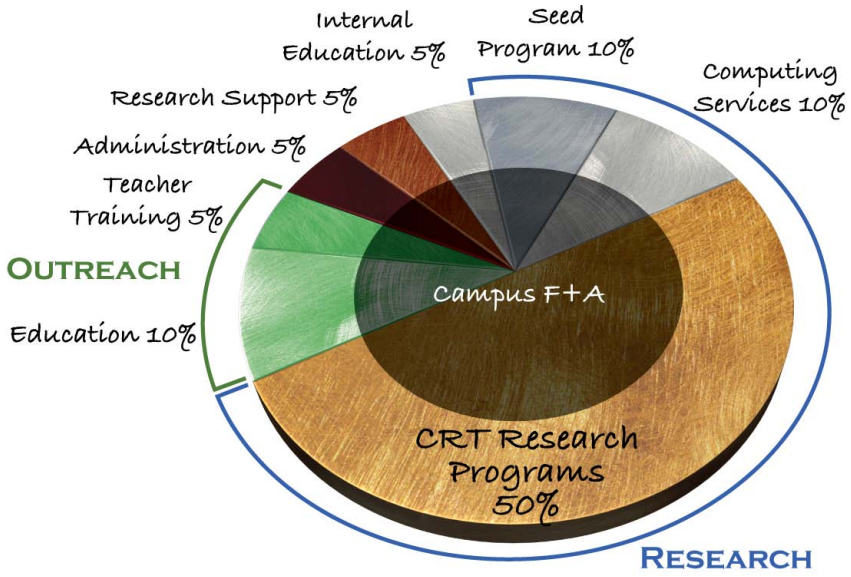
The UCLA administration has demonstrated strong commitment to diversity at all levels and is a key partner in our diversity plan. In the past five years, UCLA has significantly increased the female faculty representation in engineering and sciences. Our Vice-Chancellor for Graduate Affairs has introduced 16 different fellowship funds to encourage URM recruiting efforts. Given the collective experience and committed involvement of participants and administration, our Center is primed to change the URM experience in science and engineering at UCLA permanently.

Key UCLA programs will serve as foundation for our diversity plan. Our vision is to take a leadership position in coordinating efforts among academic Departments, REUs, IGERTs, CEED, and UCLA/CS Summer Bridges, all of which address similar issues. By coordinating resources to support workshops, seminars, and research opportunities, we will form a comprehensive, effective recruitment effort. *Bridges* and CEED are noteworthy. *Bridges* links UCLA with Cal State and Cal Polytechnic State Universities that are predominantly minority-serving, high-quality science/engineering institutions through annual summer advanced materials instrumentation workshops. CEED is highly effective at both undergraduate and graduate levels providing academic community, workshops, and summer lab opportunities for URMs. In addition, CEED has established excellent visibility at annual meetings of national professional organizations (SBE, SOLES, SWE). We will leverage and build on these programs to engage and to recruit top URM talent to our center. Likewise, we will use pipelines from other URM-serving institutions, such as Jackson State and the University of Puerto Rico, at which collaborators and former students are on the faculty, to recruit REU and graduate students, as well as faculty visitors.

A “continuum of mentorship” will support professional growth, career development and leadership opportunities at all levels. To start, pre-college and undergraduate participants in the center will be paired with a Center graduate student mentor. This mentor/mentee relationship is mutually beneficial and creates direct leadership training for Center students. At the graduate and post-graduate levels, each Center student will be closely mentored not only by faculty advisors, but also by an industrial mentor. Industrial mentorships will be rigorous to include internships for meaningful exposure to potential career paths. For faculty, we will expand the existing CNSI mentoring program developed by co-PI Weiss. This program pairs junior faculty with highly successful senior faculty to further career development in research and teaching as well as to target leadership opportunities at UCLA and within our Center. While in the current financial climate, faculty hiring at UCLA is limited, the strategic areas of Center research do have openings; searches will be coordinated to help diversify our faculty, and to bring new faculty into Center and university leadership roles through mentoring.

Budget

The figure below outlines the budget priorities of the ISEG. The chief aims are the support of the Collaborative Research Teams, which account for approximately 70% of the total, and the outreach program, for which we allocated 15%.



Collaborative Research Teams

The CRTs are the scientific core of the ISEG, but the majority of the project expenditures within the CRTs be for the support of the graduate or post-graduate training program; The budget for the CRTs – core and seed – will support approximately 30 graduate fellows and 10 post-doctoral fellows. However, capital equipment purchases and infrastructural support will be allowable if they are add-ons consistent with the center mission. We intend that 50% of the overall center budget will be assigned to the core CRTs, and 10% to the seed program.

Five percent of the overall budget will be allocated to research support of the CRTs in the form scientific administration and research management.

Computing Infrastructure

Up to 10% of the total project budget will be used to support the computing services. Much of the computing hardware will be purchased year one, with a continuing annual set aside for the later project years to ensure that the facilities are up to date and have the capacity to meet the center needs.

Internal Education

As noted, continued interchange plays a crucial role in interdisciplinary research. We propose to allocate 5% of the overall budget to fostering such communication in the form of seminars, workshops and conferences.

Administration

Approximately 5% of the overall budget will be allocated to administrative overhead, to support the reporting, budgeting and other needs of a large NSF center, including partial salaries of the PIs.

Timeline

Year 1

Kickoff Workshop
Begin CRT efforts
Set up computation core
Begin weekly seminar series
Call for and selection of Seed Proposals

Year 2

CRT and seed research continue
Review CRTs, Add/augment/delete/reduce efforts as per reviews
Consider seed efforts for merge into CRTs
Workshop(s) on topics selected competitively from Center members
EAB review of Center

Year 3

CRT and seed research continue
Review CRTs and leadership, Add/augment/delete/reduce efforts as per reviews
Consider seed efforts for merge into CRTs and new CRTs
Workshop(s) on topics selected competitively from Center members
EAB review of Center to prepare for NSF site visit
NSF site visit

Year 4

CRT and seed research continue
Review CRTs, Add/augment/delete/reduce efforts as per reviews
Consider seed efforts for merge into CRTs and new CRTs
Workshop(s) on topics selected competitively from Center members
EAB review of Center

Year 5

CRT and seed research continue
Preparation of renewal package including full review of CRTs
EAB review of plans for renewal + External review of proposal sections
Workshop(s) on topics selected competitively from Center members
Submission of renewal proposal

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C. Research Support.

Ongoing Research Support

1R01GM071940 Z. Hong Zhou (PI) 5/1/06-4/30/10 2.4 cal mos
NIH/NIGMS
High-Resolution CryoEM Reconstruction of Large Complexes
The major goal of this project is to improve methods for near atomic resolution structure determination of large complexes by cryo-electron microscopy and apply these methods to reconstruction dsRNA viruses to near-atomic resolution.
Role: PI

1R01AI069015-01A1 Z. Hong Zhou (PI) 3/15/07-2/29/12 2.4 cal mos
NIH/NIAID
HCMV Envelope and Tegument Structures: Mechanisms of Viral Entry and Assembly
The major goal of this project is to determine the 3D structures of human cytomegalovirus (HCMV) tegument and envelope and to visualize molecular interactions during HCMV entry.
Role: PI

Completed Research Support

1S10 RR023057 PI: Z. Hong Zhou 7/1/06 – 6/30/07
NIH/NCRR
High-End CryoEM Instrument for the UCLA Electron Imaging Center for Nanomachines
This is a shared instrument grant for supplemental funds needed to purchase a high-resolution cryo-electron microscope for UCLA. This instrument has been purchased.
Role: PI

R01CA94809 PI: Z. Hong Zhou 4/1/02-3/31/08 2.4 cal mos
NIH/NCI
Structure and assembly of KSHV capsids and virions
The major goals of this project are to study the assembly mechanisms of wild-type Kaposi's sarcoma–associated herpesvirus (KSHV), and to determine the structure of a protease-minus KSHV capsid.
Role: PI