2006

SURF-IT

Summer Undergraduate Research Fellowship in Information Technology

Poster Session

UCI
University of California, Irvine

A Welcome from Calit2

Friday, September 1, 2006

Dear SURF-IT Fellows, Mentors, Family and Friends,

As the second SURF-IT summer draws to a close, I'd like you to know how pleased I am with the program's success and with the accomplishments of all the participants.

SURF-IT, which was developed in cooperation with UCI's Undergraduate Research Opportunities Program (UROP), has offered these undergraduate students a unique opportunity to work with faculty mentors in state-of-the-art facilities on IT-related research and applications. Like Calit2 itself, the SURF-IT program is highly interdisciplinary, covering topics from nanowire sensors to the media arts in Asia. So the students also took part in semi-monthly lunchtime seminars, to learn the broad range of research topics within the program, and were introduced to other UROP programs as well.

These 17 students were chosen from among many competitors for their excellence, based on references, written statements of intent, and GPA. They have certainly proven their enthusiasm for learning and their skill at gleaning significant information from their research.

Calit2 knows that students are essential to the future of research. I'm delighted that the Institute could play a role in encouraging the collaboration between hardworking, forward-thinking students and the faculty members who were willing to mentor them. The students who have completed this Program have gained first-hand experience that will prove invaluable as they continue on to graduate school or industry.

All of you should be very proud of what you have accomplished. Good luck to you in your future endeavors.

Sincerely,

Albert Yee
Calit2 Irvine Division Director

SURF-IT Poster Presentations

Posters will be displayed in the Atrium of the Calit2 Building during the Poster Session on Friday, September 1, 2006, from 3:00 to 6:00 p.m. They will be arranged alphabetically by student last name.

SURF-IT Fellow	*Project Title*	*Faculty Mentor*
Abhishek Amit *Computer Science*	Spatial Reference Extraction and Interpretation System	**Nalini Venkatasubramanian** *Computer Science-Systems*
Andrew Correa *Information & Computer Science*	An Interactive Museum Exhibit to Teach Restoration Ecology	**Bill Tomlinson** *Informatics*
Marissa Holmbeck *Biological Sciences*	Encouraging Altruistic Behavior Through the use of Video Games	**Kristen Monroe** *Political Science*
Bryant Hornick *Informatics*	The EcoRaft Project	**Bill Tomlinson** *Informatics*
Duy-Quoc Lai *Information & Computer Science*	Wide Area High Definition Video Streaming for Tiled Displays	**Falko Kuester** *Electrical Engineering & Computer Science*
Christopher Larson *Information & Computer Science*	Real-Time Geometric and Color Calibration for Multi-Projector Displays	**Aditi Majumder** *Computer Science-Systems*
Christopher Levins *Chemistry*	Polymer Architecture Design through Catalysis	**Zhibin Guan** *Chemistry*
Sean Li *Electrical Engineering*	Automatic Inference of Anomalous Events from (California) Traffic Patterns	**Padhraic Smyth** *Computer Science-Computing*
Colin Mann *Physics*	Electronic Circuits with Single Molecule Components	**Philip Collins** *Physics and Astronomy*
Gabriela Marcu *Informatics, Film and Media Studies*	SuperSize Me: Visualizing Parallel Workspace Activities on a Next-Generation, Massively-Tiled Display System	**André van der Hoek** *Informatics*
Tyler Moore *Asian American Studies*	Politics and Aesthetics of New Media in East Asia	**Jonathan Hall** *Comparative Literature*
Jooyoung Park *Information & Computer Science*	Project RESCUE: Undergraduate Research in Privacy Preserving Media Spaces	**Sharad Mehrotra** *Computer Science-Systems*
J. Rick Ramstetter *Computer Science & Engineering, Mechanical Engineering*	High Performance Cooperative Data Distribution	**Stephen Jenks** *Electrical Engineering & Computer Science*
Jeremy Roth *Mechanical Engineering, Materials Science Engineering*	Nanoimprinting of 2-D Graphene Nanowires	**Albert Yee** *Chemical Engineering & Materials Science*
Roger Shih *Biomedical Engineering*	Simulation of Interdigitated Electrodes for Dielectrophoretic Cell Sorting	**Abraham Lee** *Biomedical Engineering*
Chris Trezzo *Information & Computer Science*	Information Integration in Medical Databases	**Chen Li** *Computer Science-Systems*
Christina Wong *Biomedical Engineering*	System Design of a Molecular Communication Network	**Tatsuya Suda** *Computer Science-Systems*

Abhishek Amit

Major: Computer Science

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Project Title: Spatial Reference Extraction and Interpretation System

Faculty Mentor: Nalini Venkatasubramanian

Abstract:

The 911 system is an integral part of emergency response systems. However, it quickly becomes overloaded in disaster situations. The purpose of this project was to create a computer system to extract location references and other information from 911 calls. By looking for patterns in transcripts of a set of 911 calls from the Orange County Fire Authority we were able to extract addresses, cities, phone numbers and some victim information such as their age from past calls that had this information. Correlating these pieces of information allowed us to map all calls to precise points on a map and store them in a searchable database. We also incorporated spell-checking algorithms into our extraction software to fix errors in the transcriptions, which are fairly common. Specialized software from the National Institutes of Health was also used to extract references to medical concepts in medical calls. Extracting this information opens many possible applications, and we developed a visualization system that plots the events reported in the calls on a map and also allows for proximity-based searches. The extracted data can provide 911 operators with more knowledge about developing situations, and be shared with first responders. By extracting information from 911 calls in real time we can give a better understanding of current situations, greatly enhancing the effectiveness of the 911 system.

Andrew Correa

Major: Information & Computer Science

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Project Title: An Interactive Museum Exhibit to Teach Restoration Ecology

Faculty Mentor: Bill Tomlinson

Abstract:

The problem with learning via a computer program or simulation is that users often do not associate what is being learned with the real life situation it models. As a result, when they are confronted with that real-life situation, they react as if they had no knowledge of it. This research aims to bridge this gap by creating a software suite to facilitate rapid development of multi-device museum exhibits. In these exhibits, mobile tablet PCs are used to move embodied mobile agents (EMAs) from one desktop PC to another. The effects of the transfer can be observed and learned from. Further, we will create an exhibit using this suite with various animals (including wolves, mice, and foxes) to observe the effects of predator-prey dynamics. Construction of this system is still under way, but evaluations of working versions show that users are greatly engaged and are immediately able to make the connection to real-world predator-prey dynamics. Physically moving an EMA via tablet PC from one desktop PC to another makes the interaction explicit and physical, and hence seems to cause a fuller understanding of the underlying system. Future systems based on this concept will expand to a wider range of topics, allowing the benefits of visual EMA transfers to be reaped in other fields.

Marissa Holmbeck

Major: Biological Sciences

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Project Title: Encouraging Altruistic Behavior Through the use of Video Games

Faculty Mentor: Kristen Monroe

Abstract:

In recent years much controversy has arisen surrounding the use of violence in video games. Research suggests that repetitive exposure to explicit violence encourages aggressive behavior, but can computer games foster cooperation and morality? A game encouraging these attributes has yet to be developed, and this summer project provides background research for the construction of such a game. It aims to assess the viability of creating such a game by examining scientific research in the areas of altruism, cooperation, animal behavior, and social support. Existing games are also explored and categorized to determine the skills that are used and the behaviors that are encouraged. If altruism and cooperation are part of human nature, it may be possible to teach/ promote empathic concern through games. The literature on primate studies and evolutionary conceptual models strongly suggests that some forms of altruism are innate, and may be influenced by reciprocity, similarity, and altruistic punishment. In addition, the physical and mental health benefits provided by social support offer convincing evidence for the importance of developing games that encourage such behavior. These findings suggest the feasibility of creating a game that will promote empathic involvement and altruism. The next step is to develop a game prototype and have students test it. The game would require altruistic skills to be successful; reciprocal altruism, altruistic rewarding, and altruistic punishment could be incorporated. The potential difficulty lies in transferring what has been taught in a game into real-life situations and dilemmas. Psychological tests could be developed to measure changes in cooperative behavior and tolerance.

Bryant Hornick

Major: Informatics

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Project Title: The EcoRaft Project

Faculty Mentor: Bill Tomlinson

Abstract:

Transfer describes the ability for individuals to take skills learned within one context and apply those skills to similar problems in a different context. Achieving transfer has proven to be a great challenge, particularly in the realm of computer games. The EcoRaft project addresses the issue of using games to support learning through a novel application in restoration ecology. The EcoRaft project is an interactive educational simulation that combines computer animation, embodied interactions, and innovative gameplay to teach children the principles and processes behind ecological restoration. An evaluation plan was created involving a variety of qualitative techniques, including non-interactive observation, participant observation, and semi-structured open-ended interviews, to establish the project's efficacy in conveying these principles and processes to participants. The execution of the evaluation plan depended on the successful implementation of the project's core framework and initial prototype. During the implementation process, there were several technological setbacks that forced a delay of the evaluations. Throughout development, however, several informal demonstrations were given showcasing work-in-progress versions of the system. These informal demonstrations showed promising results and elicited positive feedback from participants. Without the results from the evaluation, it is difficult to form concrete conclusions about the efficacy of the EcoRaft project as an educational tool, and further research and development is necessary to address the issue of transfer within

Duy-Quoc Lai

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Project Title: Wide Area High Definition Video Streaming for Tiled Displays

Faculty Mentor: Falko Kuester

Abstract:

Streaming high-definition (HD) video over wide area networks to show on tiled displays presents several research problems. The HD video has to be captured, streamed and displayed at interactive rates, while being subjected to bandwidth and latency limitations. Since the size of an HD stream exceeds the capabilities of commodity gigabit interconnects, data compression is required. It must also be possible to deliver the appropriate portions of the video frames to the corresponding display tiles, while retaining the ability to freely and smoothly scale and move the video across the display wall. The project goal is to demonstrate the feasibility of high-definition video streaming in support of distributed collaborative digital workspaces.

Christopher Larson

Major: Information & Computer Science

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Project Title: Real-Time Geometric and Color Calibration for Multi-Projector Displays

Faculty Mentor: Aditi Majumder

Abstract:

No single display exists that can display over a large area and still maintain a high resolution. By creating a multi-projector display with overlapping projections and correcting the image for misalignment and color variation, one large-area high-resolution continuous image can be formed. The goal of our project was to implement the corrections for geometric misalignment and color variation to display 3D applications and videos under real-time constraints. We implemented the geometric and color corrections using fragment shaders (small programs that run on a graphics card rather than on a CPU). We found that fragment shaders could be used to correct the displayed images in post-processing quickly enough to meet our constraints. These results show that real-time corrections are possible; however, the corrections still must be generated beforehand.

Christopher Levins

Major: Chemistry

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Project Title: Polymer Architecture Design through Catalysis

Faculty Mentor: Zhibin Guan

Abstract:

Recent research has shown great success with cyclophane based palladium catalysts in the area of olefin polymerization. Similar palladium catalysts have shown different reactivity when the environment around the metal center is altered by electronic effects. This project further investigates the scope of the cyclophane catalyst by determining how catalysts bearing electron-donating and withdrawing groups effect the polymerization of olefins, and by finding which type of catalyst will produce the desired polymer. The catalysts were prepared from a number of different organic synthesis schemes, and required characterization through ^{1}H and ^{13}C NMR. The results of this research show a definite relationship between electron density of the catalyst, and the type of polymer they produce. The electron-poor metal centers yield more branched polymers while the electron-rich metal centers yield more linear polymers. These results show that the factors that control branching of polymers are suppressed in an electron-rich environment, while the electron-poor environment supports branching. This research will allow catalysts to be produced with specific control over the topologies of the polymers they produce. These catalysts will be able to create polymers that have so far been very difficult, expensive, and time consuming to synthesize.

Sean Li

Major: Electrical Engineering

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Project Title: Automatic Inference of Anomalous Events from (California) Traffic Patterns

Faculty Mentor: Padhraic Smyth

Abstract:

Automated detection of unusual events from sensor data has many practical applications in daily life. Examples include detection of unusual traffic conditions from loop-sensor data and computer network security monitoring based on detection of anomalous computer network traffic. A traditional approach to this problem is to detect unusual events by performing threshold tests based on Poisson models for each time period. More recent work has shown that time-varying Poisson models, combined with a hidden Markov event model, can provide much more accurate detection capabilities than the traditional threshold-based methods. This project builds on this time-varying Poisson framework to create a real-time Web-based software system that automatically identifies anomalous events, with a focus on traffic monitoring of California freeways. Software was developed to obtain and store loop-sensor data in real-time (every five minutes for over 5000 sensors from California freeways). A real-time version of the time-varying Poisson-Markov model was developed to interpret the loop sensor data in real time and produce a probability of an unusual event for each sensor every five minutes. Finally, a Web-based graphical display was developed that overlays the model output (event probabilities) on a freeway map. The project demonstrated that the theoretical framework for event detection (based on Poisson-Markov models) could be successfully implemented in real time with real data.

Colin Mann

Major: Physics

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Project Title: Electronic Circuits with Single Molecule Components

Faculty Mentor: Philip Collins

Abstract:

The use of carbon nanotube field-effect transistors (CNTFETs) as chemical or biological sensors is the focus of many research groups in nanotechnology. CNTFET sensors have been demonstrated with extraordinary sensitivities ranging from parts per million down to parts per trillion. These high sensitivities could allow for a broad range of new applications in the detection of, for example, toxins, regulated substances, industrial gas leaks, and chemical warfare agents. The immediate goal of this project is to fabricate devices with a particular architecture in order to study the mechanisms of CNTFET sensors. We would like to determine whether CNTFET chemical response is a result of the interaction between the nanotube and the test chemical or the junction between the nanotube and electrodes and the test chemical. My role in the project has been centered around the fabrication of devices for such an experiment, specifically, the creation of "windows" over portions of nanotubes using electron beam lithography.

Gabriela Marcu

Major: Informatics

Minor: Film and Media Studies

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Project Title: SuperSize Me: Visualizing Parallel Workspace Activities on a Next-Generation, Massively-Tiled Display System

Faculty Mentor: André van der Hoek

Abstract:

The workspace activity viewer is a 3D visualization that presents a snapshot of all ongoing changes taking place in a set of workspaces at a particular time. However, we do not have the ability to interpret the visualization into useful patterns for large projects with many activities. The HIPerWall, a massively-tiled display system, not only allows for a larger scale visualization, but, as a high-resolution 200 mega-pixel display, it can show all details of the visualization. The HIPerWall has been designed specifically for OpenGL visualizations that are single, non-changing pictures, while we have a Java program that is a single, continuously-changing picture. No Java-based middleware was available to support our goals in this project. We began altering the system's architecture by reimplementing the drawing of the visualizations in OpenGL and C, leaving the back end which handles the workspace activity data from the database in the original Java code. The Java Native Interface (JNI) is being used to enable the existing Java code to pass to the new OpenGL code the information it needs to display the visualization. We are currently finalizing this implementation to complete the port and begin testing usage of the workspace activity viewer on the HIPerWall.

Tyler Moore

Major: Asian American Studies

Minor: Education

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Project Title: Politics and Aesthetics of New Media in East Asia

Faculty Mentor: Jonathan Hall

Abstract:

The ever-increasing speeds of information transfer have transformed the way we interact in our daily lives. This can be seen in the context of new media experimentalism and information arts. While studies have been done in this area, little work has been done that focused extensively on East Asia. This project began focusing exclusively on East Asian artists working among new media and information arts, later focusing on primarily Japanese artists and movements, especially those pertaining to issues in the acoustic medium. The work began in Tokyo, Japan, where the notions of an information state and bisecting media interaction were observed first hand in the case of multimedia artist Nam June Paik and the Information Communication Center sponsored by Nippon Telephone and Telegraph. When the research resumed Irvine, Japanese artists experimenting with the acoustic register were focused upon, and their works were further analyzed. Certain themes of Japanese aural experimentalism were found to share more global aspects of a rejection of conventional western music construction, in a search to find more accurate terms of aural expression to match the current pace of modern living in an information based society. Mapping out these seemingly East Asian and Japanese exclusive traits to a larger globalized picture of the world proved that the basic characteristics seemed to overlap. Understanding these factors and their implications in both an East Asian and Japanese context provides greater insight to the interconnected nature of aural experimentalism and display in a globally connected society.

Jooyoung Park

Major: Information & Computer Science

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Project Title: Project RESCUE: Undergraduate Research in Privacy Preserving Media Spaces

Faculty Mentor: Sharad Mehrotra

Abstract:

An automated triggering mechanism with privacy preserving technologies that could monitor multi-media sensing environments would have many real-life applications. This integrated approach is applicable to any field that has means to monitor and detect events through multi-sensing infrastructure. The research in privacy preserving media spaces distinguishes itself from similar projects by its multidisciplinary nature, including combining information technology and social sciences. Successfully combining software integration of multi-media equipment, including heat sensors, wireless cameras, and smoke sensors, with privacy-preserving policies and computer vision processing technology results in an automated media controller with the capacity to protect individuals' privacy rights. This project builds on video systems integration using Java programming and image processing technology including openCV and JAI. Datasets tested for this project were obtained from live streaming video of a coffee room on the 4th floor of the Calit2 building, which is equipped with Web cameras with audio, and from recorded video files from UCI Rescue Team's Biohazard drill. Software that coordinates multiple video systems has been integrated with a system that detects high-level events acquired from cameras in real-time. Events detection involving human interaction has been implemented using openCV library. Java source code for obstructing images of human subjects in the monitored system has been also been implemented. The results of this project can be used to develop an automated voice alarm system or Web-based system that logs detected events along with more rigorous vision processing.

J. Rick Ramstetter

Majors: Computer Science & Engineering/ Mechanical Engineering

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Project Title: High Performance Cooperative Data Distribution

Faculty Mentor: Stephen Jenks

Abstract:

Current large file transfer approaches used in high performance cluster computing are point-to-point, normally based on GridFTP or Secure Copy. If a file is to be disseminated to local disks on cluster nodes, either each transfer happens separately or the connection to the front end becomes a bottleneck. In either case, the overall distribution time is proportional to the number of destinations times a single transfer time. With files in the tens becoming common, this time becomes quite long. Peer-to-peer filesharing offers a solution in the form of BitTorrent, which allows receivers to send data as well, thus multiplying the available bandwidth and decreasing download time of all participants. However, BitTorrent was designed for unreliable, shared, slow home Internet connections and does not perform as well in high-performance environments with gigabit or faster networks. Using concepts from the BitTorrent protocol, a high performance cooperative file distribution method has been developed in C++, allowing data transfer times to multiple destinations to come significantly closer to the data transfer time for a single destination. With continued work on the project, the transfer time to multiple destinations will continue to drop.

Jeremy Roth

Majors: Mechanical Engineering/ Materials Science Engineering

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Project Title: Nanoimprinting of 2-D Graphene Nanowires

Faculty Mentor: Albert Yee

Abstract:

Graphene and nano-imprint lithography (NIL) present two unique, cutting-edge areas of research. This project combines graphene and NIL in an effort to establish graphene as a viable new material for carbon-based electronics. Several polymer materials are known to graphitize upon heat treatment, including some already used in the NIL process. NIL-compatible polymers polyacrylonitrile (PAN), polyvinyl alcohol (PVA) and polystyrene (PS), were heat treated to evaluate their ability to graphitize. PAN was also heat treated with nickel in a catalytic graphitization process in an effort to lower its graphitization temperature. Resulting materials were evaluated using scanning electron microscopy and raman spectroscopy.

Roger Shih

Major: Biomedical Engineering

Minor: Information and Computer Science

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Project Title: Simulation of Interdigitated Electrodes for Dielectrophoretic Cell Sorting

Faculty Mentor: Abraham Lee

Abstract:

Dielectrophoresis (DEP), a phenomenon wherein a nonuniform AC electric field exerts a force on a particle by polarizing it, shows promise as a possible method for separating different cell types. Our group hopes to use DEP to separate neural stem cells from possibly nonhomogeneous samples by running them through electrode-lined microchannels. The configuration of these electrodes (their width and spacing) has an effect on DEP force produced, and we wish to optimize the geometry for efficient cell separation. To this end, I constructed computer models of several electrode configurations in CFD-GEOM, and ran simulations on them using CFD-ACE-GUI. I first simulated the distribution of electric field squared (proportional to DEP force) in the models, then simulated particle injection and trapping directly. From these trials I found that electric field squared increases with narrowing electrode and gap width, but that simulated particles are trapped best with medium-width electrodes and narrow gaps. Overall, gap width seems to have more influence on DEP force than electrode width. It makes sense that decreasing gap width improves DEP, since the fields of adjacent electrode edges can overlap and produce a stronger field. Keeping electrodes at a medium width, on the other hand, may be effective because DEP depends on field nonuniformity, and wider electrodes space out the more intense fields around the gaps. The results of these simulations may save some effort that might otherwise have gone into manufacturing thinner electrodes.

Chris Trezzo

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Project Title: Information Integration in Medical Databases

Faculty Mentor: Chen Li

Abstract:

A major problem in the medical industry is the lag between the acquisition of knowledge in the basic sciences, and the creation of new clinical treatments. The fact that a costly clinical study is required to demonstrate the effectiveness of a new treatment is attributed to this lag. A large amount of this cost comes from managing clinical data from multiple medical centers. A pilot project has been started to address this issue. Using data integration techniques, clinical data from multiple medical centers will be organized so that doctors at one medical center can have access to data from all medical centers. For the pilot project, a mediator-based architecture was chosen for the integrated system. A first iteration of the integrated schema is complete;however, the project is still in its early phases. A large effort is being made to understand the needs and requirements of the doctors using the system.

Christina Wong

Major: Biomedical Engineering

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Project Title: System Design of a Molecular Communication Network

Faculty Mentor: Tatsuya Suda

Abstract:

Existing research in the field of nanotechnology has greatly spurred the development of nanomachine counterparts, but very few studies have focused on overcoming the communication limitations of these devices. Molecular communication offers a solution for nanomachine communication using molecules as information carriers. The purpose of this project is to develop a design for the control and manipulation of a molecular-scale communication system. To achieve this, a HeLa (human epithelial carcinoma) cell network was established by using chemical means to construct specific patterns of cells on gold and glass (Au/SiO_2) substrates. The HeLa cells were genetically engineered to have different gap-junction communication channels, so that the characteristics of communication between cells in a patterned network could be studied. Au/SiO_2 substrate surfaces were modified with one of three different chemicals: octadecyltrichlorosilane (OTS, hydrophobic); hexadecanethiol (HDT, hydrophobic); or PEG-5000' thiol (hydrophilic). ECM proteins, which enable cells to attach to surfaces, generally adhere to hydrophobic regions and cannot adhere to hydrophilic areas. Patterns of cells can be designed using this principle, as cells should adhere only on regions where ECM proteins are attached. The hydrophilic PEG-5000' thiol effectively designated specific areas of the substrate as cell-resistant, governing HeLa cell adhesion on the substrates so that a network of cells could be established. After long incubation times, cells on the pattern edges began to migrate collectively into cell-resistant areas. This indicates the presence of cell-cell communication between patterned cells, which will be further studied through a confocal microscope.

Faculty Mentors and Program Contacts

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Comparative Literature

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If you would like further information on the SURF-IT Program, please contact the Program Directors:

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