A Welcome from the Program Director

August 26, 2016

Dear I-SURF Fellows, Faculty Mentors, and Guests:

Research is an international pursuit, with collaborations extending beyond international borders and geographical boundaries. These wide-reaching collaborations highlight the importance of experiencing different approaches to learning, leadership, entrepreneurship and research.

This summer, the International Undergraduate Research Fellowship (I-SURF) brought 28 undergraduate researchers to UC Irvine from Kookmin University in Seoul, South Korea. They were selected to conduct software development research under the guidance of ten nationally-distinguished faculty mentors from the Donald Bren School of Information & Computer Sciences, the Henry Samueli School of Engineering, and the School of Social Sciences. Students chose from a variety of challenging and original research projects, each exploring a diverse and exciting range of topics within the field of computer sciences and related applications. Faculty mentors and their teams of graduate students and research collaborators provided personalized mentoring and training to the I-SURF Fellows, giving them the unique opportunity to explore computer science research, and to become immersed in UC Irvine's collaborative research culture.

The I-SURF Fellows dedicated themselves to full-time work on their research projects throughout the program. In addition, the students explored their own futures as well, looking into the vast array of possibilities that lie before them. They attended seminars on a wide variety of topics relevant to their research and took an intensive course to improve their English language writing and speaking skills. They engaged a number of successful Silicon Valley entrepreneurs, engineers and project managers.

Following its successful launch last year, the 2016 I-SURF Program highlighted the successful collaboration between Kookmin University and the Undergraduate Research Opportunities Program (UROP), at UC Irvine. UROP is committed to supporting faculty-mentored undergraduate research and creative activities in all disciplines. In addition to sponsoring the I-SURF program, UROP also advises undergraduate students about on- and off-campus research opportunities, and sponsors the UCI Undergraduate Research Symposium and *The UCI Undergraduate Research Journal*, an annual multidisciplinary publication. In addition, the Summer Undergraduate Research Program (SURP) provides students with the opportunity to immerse themselves into a research project or creative activity under the guidance of UC Irvine faculty members. UROP has also collaborated with other units on campus to sponsor undergraduate research programs emphasizing multidisciplinary design, as well as research in biophotonics, health promotion and disease prevention, information technology, the Internet of Things, cardiovascular research, chemistry, and micro/nano technologies.

Thank you for participating and for showing your support for the I-SURF Fellows presenting here today. I also would like to offer our thanks to Professor Sung-Soo Lim of Kookmin University, who has been a vital part of the students' UC Irvine experience. We look forward to many more years of collaborating with him and his colleagues. Finally, a special note of appreciation goes out to the faculty mentors who have devoted much time and effort mentoring these students. We look forward to following up with the continued achievement of these outstanding individuals, and hope that you leave today's program inspired by their efforts and enthusiasm.

Sincerely,

Said M. Shokair
I-SURF Director
Director, UROP

Schedule of Presentations

Group presentations are allotted 15 minutes and individual presentations are allotted 10 minutes. There will be 3 to 5 minutes for questions and answers after each presentation.

Electronic copies of Students' PowerPoint presentations and abstracts will be available on the I-SURF Web site, <http://www.urop.uci.edu/i-surf.html>. Click "Participants," then the name of an individual student.

Friday, August 26, 2016
Calit2 Auditorium

Time	I-SURF Fellows	Project Title	Faculty Mentor(s)
9:00		**Welcome**	
9:15	**Jun Ho Choi** **Hangyul Kim** **Donguk Lee**	An Indoor Positioning System using Bluetooth Low Energy	**Aditi Majumder** *Computer Science*
9:35	**YoungHoon Kwon** **Gyeongmin Min**	Converting Digital Painting to Physical Lighting on a 3D Model	**Aditi Majumder** *Computer Science*
9:55	**Kisang Cho** **Doona Lee**	Efficient Compression of 3D Volume for Rendering and Visualization	**Shuang Zhao** *Computer Science*
10:15	**Dongmin Cha** **Young Jae Choi**	Low-Power Approach to Visualization Acceleration	**Alexandru Nicolau** *Computer Science*
10:35	**Yunho Kim** **Soryung Lee**	Finite State Machine in Verilog from Timing Diagram as VCD Format	**Ian G. Harris** *Computer Science*
10:55		**15-Minute Break**	
11:10	**HanSem Jeon** **Sung Soo Son**	Graspan: A Graph System for Analyzing Large-Scale Systems Code	**Harry Xu** *Computer Science*
11:30	**Hyungjun Lee** **ByungJun Yim**	Energy-Efficient Cooperative CPU-GPU Frequency Capping and Scaling for Mobile Games	**Nikil D. Dutt** *Computer Science*
11:50	**Chang-Hyun Lee** **Ji Hyun Park**	Optimizing OpenCL Applications for Embedded Systems	**Nikil D. Dutt** *Computer Science*
12:10	**Dong Joo Seo**	Evaluation of Task Mapping Algorithms on Heterogeneous Multicores	**Nikil D. Dutt** *Computer Science*
12:25	**Jae-Yeol Lee**	Evaluation of Task Mapping Algorithms on Heterogeneous Multicores	**Nikil D. Dutt** *Computer Science*
12:40		**Lunch**	

Time	*I-SURF Fellows*	*Project Title*	*Faculty Mentor(s)*
1:40	**Jeong Dam Hwang** **Sungpum Park**	XBee Mesh Network for Multiple Robot Communication	**Elaheh (Eli) Bozorgzadeh** *Computer Science*
2:00	**Ji-Man Jeong** **Changwoo Lee**	Sentinel: Language and Systems Support for Managed Communication	**Brian C. Demsky** *Electrical Engineering & Computer Science*
2:20	**Hanul Chae** **Han Byeol Lee**	CARLsim	**Jeffrey Krichmar** *Cognitive Science*
2:40	**Seongsil Heo**	Cartoon Transfer to a 3D Model	**Gopi Meenakshisundaram** *Computer Science*
2:55	**Minkyu Kim**	Line Drawing Vectorization	**Gopi Meenakshisundaram** *Computer Science*
3:10	**Young Hun Cho**	Mouse Brain Connectome Project	**Gopi Meenakshisundaram** *Computer Science*

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

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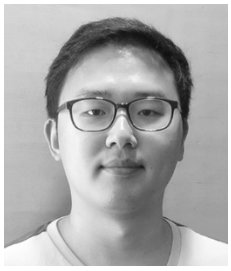
Jun Ho Choi



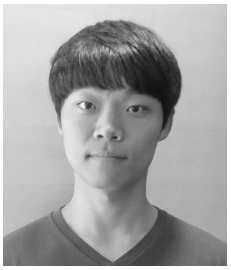
Hangyul Kim

Donguk Lee

Project Title: An Indoor Positioning System using Bluetooth Low Energy

Mentors: Aditi Majumder, Mehdi Rahimzadeh

Abstract:
Position based services have been receiving more attention in recent years. Several applications in the area of M-commerce depend on a well estimated position of customers in wireless networks. In this work, we developed an Android application to provide the estimated location of the phone as an indoor positioning system. This work aims at providing position estimation within a Bluetooth Low Energy (BLE) network. The position is estimated from the Received Signal Strength Indicator (RSSI) from each transceiver. In this experiment we performed calculations on the relationship between the RSSI and the distance from the BLE transceiver. A curve fitting method estimates the signal propagation model inside the building. The propagation model is well estimated from the signal strength when the distance between the BLE source and mobile phone is within 1.5m. Then, using triangulation methods, the position of the mobile device is estimated from the distance from each transceiver. Since the result of triangulation is highly dependent on the distance estimation, we used a Kalman filter to improve the result of the triangulation by slowly converging to reduce the error from the previous steps. This work is implemented on a BLE network running on Raspberry PI3, and a Nexus 5 phone running the Android application for position estimation.



YoungHoon Kwon

Gyeongmin Min

Project Title: Converting Digital Painting to Physical Lighting on a 3D Model

Mentor: Aditi Majumder

Abstract:
In the future, by using a converting digital painting system, we can change the colors of an object with minimal effort. This study proposes to adapt various designs of an object and make a 3D model painting system to paint the object using a projector and a camera. This is achieved when a projector takes an image from a laptop and projects it onto the actual object. Structured light is used to build a 3D-point cloud. In addition, a calibration matrix is used to calculate the relationship between them. The 3D model is created using the 3D-point cloud. The painting system is devised using OpenGL and has different colors as well as brushes of different sizes. The major result is the ability to change the color of objects using this system. However, the result of this project will yield only the front surface of the object, as this system can express only one side of the object. A successful outcome of this project will allow efficiency of space and time when viewing products.

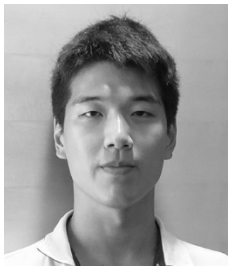
Kisang Cho

Doona Lee

Project Title: Efficient Compression of 3D Volume for Rendering and Visualization

Mentor: Shuang Zhao

Abstract:
High-resolution 3D volumes have recently been introduced to represent objects with detailed geometry in computer graphics and visualization. Although these volumes have led to unprecedented image quality, they generally use much storage and are expensive to work with. Such large files may require compression for the CPU performance and memory. In addition, repeated compression and decompression becomes increasingly time consuming and there is some loss in reconstruction quality with respect to the original data. Generally, many typical volume visualization applications can access only a portion of the volume data. Thus, efficient compression techniques are needed that provide random access and rapid decompression of arbitrary parts from the volume data. We propose a technique which includes data compression schemes that can both significantly reduce data size and maintain high efficiency for common volume lookup operations. Our main compression algorithm uses singular value decomposition (SVD), which we can use when disassembling the complex matrix. Using SVD, We can express matrix A as P*Q (P and Q are small matrices for expressing a matrix A). We report compression results and compare the performance with a Zip file. Compression and accuracy show a trade-off relation, so we found the point to minimize the loss of compression and accuracy by comparing the original file and reconstructed file. The result was obtained through changing the size of P and Q, where the P and Q are determined by the value of R. We plotted the distribution of the compressibility and the accuracy according to the change in the R value.



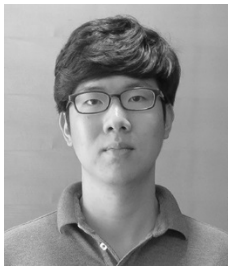
Dongmin Cha

Young Jae Choi

Project Title: Low-Power Approach to Visualization Acceleration

Mentors: Alexandru Nicolau, Sajjad Taheri

Abstract:
Machines have recently started to use vision function. For fast vision function, FPGA (Field Programmable Gate Array) guarantees fast speed. Normal vision function like openCV's target is not FPGA, so it is difficult to convert. To solve this problem, we used an OpenVX library because this library's target makes graphs easy to convert. This project's purpose is to create the SIFT (Scale Invariant Feature Transform) algorithm for FPGA using OpenVX. SIFT is an algorithm in computer vision to detect and describe local features in images. For detecting features in images, this algorithm uses special points called Key Points, which makes is use OpenVX. Vivado HLS converts this code to FPGA. To check the speed, we compared this OpenVX code with the code written by OpenCV because OpenCV works sequentially and OpenVX works in parallel. The result showed that the OpenVX code was 54% faster than the OpenCV code at Intel amplifier 2016 on Windows 7 because OpenVX handles more data than OpenCV at one time. A problem with OpenVX is that there were too many function calls; however, this can be solved when it was converted to FPGA.



Yunho Kim

Soryung Lee

Project Title: Finite State Machine in Verilog from Timing Diagram as VCD Format

Mentor: Ian G. Harris

Abstract:
Humans using Natural Languages have commanded computers using computer signals to process their tasks. However, the computers cannot understand the Natural Languages directly so they have to learn the machines' languages in order to deal with computers. Even if they know how to handle computers, it is too expensive in time and costs for them to learn the way. Therefore, the purpose of this project is to enable computers to understand the signals written in English and visualize a Finite State Machine, including matched patterns in the description, in order to help them learn. We developed a Verilog code to generate Timing Diagram as a VCD format file by using ModelSim, a visualization tool for Embedded System, then we made a program to translate the VCD format file into another Verilog code for the Finite State Machine. The VCD format file and the resulting code in Verilog are written according to the i2c protocol from a data transmission point of view. As a result, it is successful in changing the VCD format file into the resulting code obeying Verilog grammar. Natural Language can be changed into Timing Diagram and can be also changed into Finite State Machine; with this, computers understand the Finite State Machine. We accomplish the purpose of changing Timing Diagram into Finite State Machine. If we parse sentences expressive of computer signals and process them, we will be able to reveal that computers directly understand Natural Languages depicting computer signals.

HanSem Jeon

Sung Soo Son

Project Title: Graspan: A Graph System for Analyzing Large-Scale Systems Code

Mentors: Harry Xu, Khanh Nguyen

Abstract:
Software bugs are costly. According to a 2013 study conducted by Cambridge University, buggy software costs the global economy $312 billion annually. It is also found that, on average, developers spend 50% of their programming time finding and fixing bugs. In practice, static analyses are often employed to detect software defects due to their simplicity and acceptable runtime cost. Most of the existing static analyses developed are simple checkers that find bugs based on certain patterns. Despite more than a decade-long history of researching, static analyses still cannot work on real-world codebases with satisfactory results: they either miss the bugs or report a large number of false warnings. Graspan has been developed to improve the precision of existing bug checkers. With the heavy workload of analyzing millions lines of codes shifted to Graspan, bug checkers remain simple yet have richer information to consult and can thus significantly reduce the number of false positives and negatives. The system has been evaluated in many large-scale systems such as Linux, demonstrating its scalability and efficiency. Moreover, using the results of Graspan, existing bug checkers have discovered 85 new bugs and reported 218 fewer false warnings in Linux version 4.4.0-rc5. Graspan has been developed and optimized using Java by two UCI Ph.D. students. As part of the I-SURF program, we implemented a version of this system using C++. Comparing two versions, ours significantly outperforms the Java implementation in both execution time and memory consumption.

Hyungjun Lee

ByungJun Yim

Project Title: Energy-Efficient Cooperative CPU-GPU Frequency Capping and Scaling for Mobile Games

Mentor: Nikil D. Dutt

Abstract:
Smart phones are becoming increasingly popular, with almost 200 million users in 2016. Among the many available applications, mobile games have become one of the most popular applications on mobile platforms. Game applications consume much more power than the other applications. This study aims to solve this problem. Our project goal is to implement efficient power management strategies. The latest power manager for mobile games oversimplifies the complex relationship between CPU frequency, GPU frequency and frames per second. This project developed an algorithm for reducing power better than the latest power manager. In order to achieve this, two approaches were used. The first is to develop a new policy based on power-performance modeling. The second approach is to find the saturated capping frequency of different types of graphics workloads. We expect that the new power manager will provide on average a 15% increase in performance per watt when compared to the latest power manager.

Chang-Hyun Lee

Ji Hyun Park

Project Title: Optimizing OpenCL Applications for Embedded Systems

Mentors: Nikil D. Dutt, Roger Chenying Hsieh, Kasra Moazzemi

Abstract:
A mobile platform has a constraint that it should have high performance in less space and weight. To get better performance, mounting hardware devices with improved technology is common, but another way is by improving software. Most mobile platform are mounting displays, so they have GPUs. GPUs have SIMD units (Single Instruction Multiple Data) for performing the same operation on several pixels at the same time. Because of SIMD units, a GPU system has an advantage over Data Parallel. Multicore CPU is superior for Task Parallel and GPU is good at Data Parallel. So if they are used properly, they will be get higher performance. OpenCL is a library that uses CPUs on general operating systems as well as different devices like GPUs and FPGA. OpenCL has good portability that is better than CUDA's original system using GPUs. If the performance on Odroid, which is one of the mobile platform is improved by using OpenCL, it can be applied to other mobile platforms like smartphones, game machines and robots. This goal of this project is not only to use the GPU simply on general computing, but also to find the method that makes higher performance by separating the workload for the GPU and CPU.

Dong Joo Seo

Project Title: Evaluation of Task Mapping Algorithms on Heterogeneous Multicores

Mentors: Nikil D. Dutt, Hossein Tajik

Abstract:
When running Super Mario on your computer, there are number of ways to convey your thoughts, such as pushing the button for jumping or going forward. These actions can re-occur many times, and researchers have tried to track these re-occurring behaviors in applications. While the primary focus has been on program instructions, we want to extract the re-occurring memory accesses too. This paper presents a way to extract and compare repetitive program and memory behavior, commonly known as program phases and memory phases. We created an infrastructure to extract memory and program phases. Memory and instruction traces are obtained by running programs on a Gem5 simulator (ARM architecture, X86 architecture). Some scripts analyze these traces and extract memory and program phases. We used applications from Mibench benchmark to test our method. Our results show a significant difference between program and memory phases.

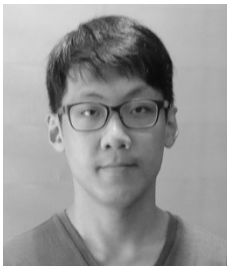
Jae-Yeol Lee

Project Title: Evaluation of Task Mapping Algorithms on Heterogeneous Multicores

Mentors: Nikil D. Dutt, Tiago Mück

Abstract:
Current Smartphones have heterogeneous multi-cores: a set of cores, each of which has different a capacity, that are very energy efficient but require more advanced task scheduling algorithms in order to map thread to core. In a previous work, called Run-DMC (Runtime Dynamic Multi-Cores), a task scheduling algorithm was proposed to exploit the energy efficiency of heterogeneous architectures. The Run-DMC algorithm uses techniques similar to machine learning and therefore needs to be trained on the target platform. The purpose of this project is evaluate the efficacy of micro benchmarks for training Run-DMC algorithms on the Odroid (Open Android) platform. This evaluation includes: 1) running the various micro benchmarks on the Odroid platform, and 2) finding the correlation between metrics like IPS (Instruction per Second) versus cache miss rate. When IPS is increasing, the number of DTLB (Data Translation Lookaside Buffer) refills and cache miss rates are increased proportionally. But between IPS and branch prediction misses, there is no correlation between the two metrics. Using these facts, a micro benchmark can be made with an adapted variable. As a result of this project, we expect to identify the best metrics to use in the learning process within Run-DMC, thus improving the energy efficiency of the system. Essentially, we will enable people to use devices longer by just updating the operating system.

Jeong Dam Hwang



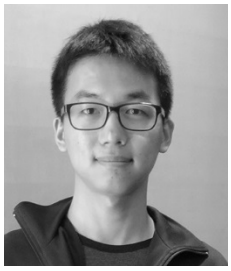
Sungpum Park

Project Title: XBee Mesh Network for Multiple Robot Communication

Mentors: Elaheh (Eli) Bozorgzadeh, Kanghee Kim, Sung-Soo Lim, Seyyed Ahmad Razavi Majomard

Abstract:
This project implements an ROS—an open source robot operating system—package for an XBee mesh network on a POSIX environment. While building a self-healing and low-power consuming network is one of the most important challenges for cooperative robots, ROS does not provide a package for a ZigBee mesh network. This project, performed on IFC 6410Plus board in the linaro operating system with XBee XB24 modules, focuses on implementing a package and analyzing the time delay between a requesting frame and corresponding acknowledgement frame. To handle the fault-tolerance and the spontaneity of a multi-robot communication, the task of the ROS package was separated into a node for writing (sending) frames and a node for reading (receiving) frames. The measurement of the round-trip delay of a single frame shows that there is at least a 40% improvement in speed, compared with a python script which Digi company provides for a transmit request frame. Also, as the size of the frame grows, the speed is advanced compared with the python script. This result is appropriate as the C and C++ languages are considered 100 times faster than python. Furthermore, there are some factors which cause overhead, like file-IO or ROS-communication. Future work will look to improve on these results.

Ji-Man Jeong



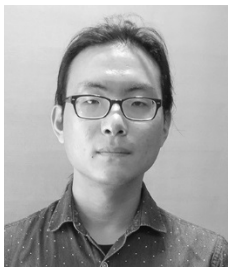
Changwoo Lee

Project Title: Sentinel: Language and Systems Support for Managed Communication

Mentors: Brian C. Demsky, Rahmadi Trimananda

Abstract:
The Internet of Things (IoT) has been proposed as a way to make everyday items smarter. While IoT devices promise a comfortable life, they also bring significant security challenges. Sentinel is a new software system designed to minimize the attack surface of the smart home class of Internet of Things systems. This project is in charge of connecting new devices to the smart home network in order to make new connections for using the device. We operate two devices: one is Xbee, which runs python code as the coordinator that makes a network and helps computer to connect to the Zigbee sensors. The second is the Zigbee sensor, which can communicate with the computer with a special wireless protocol named Zigbee. The computer commands what the user wants via a JAVA object, and Xbee interprets and passes this command to the sensor. The sensor responds to the command, then Xbee catches the response and returns it to the computer. Thus, the connection between the computer and the sensor can be made. The result of this project suggests that a new device can be joined to a smart home network.

Hanul Chae



Han Byeol Lee

Project Title: CARLsim

Mentors: Jeffrey Krichmar, Ting-Shuo Chou

Abstract:
CARLsim is an efficient, easy-to-use, GPU-accelerated library for simulating large-scale spiking neural network models with a high degree of biological detail. It is required to partition algorithms to balance the workload across nodes in a cluster to execute a giant spiking neural network. This project is to increase knowledge about spiking neural networks and gain hands-on experience with CUDA and MPI programming. A standard neural network was formed and then tested on the HPC Cluster at UCI. A total number of 100,385 synapses were created, confirming the attempted number of 100 synapses per neuron. The network was simulated for 10 seconds. Its execution time is only 2.59 seconds of wall-clock-time, which means the network was running 3.86 times faster than real time. This indicates that the spiking neural network can learn faster. The study shows that automatic cars, cameras and other devices can recognize objects faster.

Seongsil Heo

Project Title: Cartoon Transfer to a 3D Model

Mentors: Gopi Meenakshisundaram, Jia Chen

Abstract:
Many people like watching 3D movies and playing 3D games. However, it is difficult for non-professionals to create 3D objects. This project attempts to explain how to make a 3D model by transferring 2D to 3D automatically. Because it is important for 3D to be expressed in a more active way, the goal of this project is to make a more active 3D model by giving it lifelike qualities. This will be done by extracting pieces of video of poses and movement, and tracking those parts in real time using the TLD (tracking learning detection) algorithm in the opencv library. The result of this project will be a near total collection of human movement in 3D, thereby offering the non-professional the opportunity to use 3D in everyday life.

Minkyu Kim

Project Title: Line Drawing Vectorization

Mentor: Gopi Meenakshisundaram

Abstract:
Vector graphics are widely used for high quality 2D drawings and figures; for example, in logos, cartoons, fonts and posters. Because it is composed of parametric curves, precision, editability and compactness are primary features of Vector Drawing. There are many tools to make vector graphics, but they are more suitable for experts than novices. This project explores the idea of building a system to automate the vectorization process, and to convert a photograph or line drawing into vector graphics. This program is implemented by the Qt creator and the program language is C++. This system is built in three steps: Feed point extraction, curve fitting using Bezier curves, and quality measurement. The Line Drawing Vectorization system offered several results. First, this program can make vector curves from feed points and measure fidelity from the original image. Second, vector drawings made by this program can be edited easily. Finally, vector drawings are composed of compact curves. This program's main idea is a balance between simplicity and fidelity. This project focused on making it possible to control the balance. Using this system, people can easily get vector graphics from a photograph or line drawing.

Young Hun Cho

Project Title: Mouse Brain Connectome Project

Mentor: Gopi Meenakshisundaram

Abstract:
It is widely acknowledged that understanding neuronal connections in the brain is the required next level for understanding how the brain works and treating various human neurological and psychiatric diseases. The ability to automatically visualize and explore the connectome data in a standardized brain space (like a common atlas) is crucial for brain circuit mapping. In this work we try to automatically connect neurons across mouse brain slices which are registered to each other. Neurons are shown for each mouse brain slice. We first perform segmentation where all the neurons present in the slices are extracted. This is followed by a Hopcroft Karf algorithm where neurons from one slice are matched to their corresponding neurons in the adjacent slices. Finally, we create a 3D visualization graph where we show the segmented neurons and their connectivity overlaid on top of the mouse brain slices. We can see overall neurons through 3D visualization graph. We hope a visualization such as this will help neuroscience researchers to further study the connectivity of neurons in mouse brains.