COSMOS Celebrates 10 Years!

The UCSD COSMOS program is turning 10 years old this summer! Although officially in existence since 2004, the first attending students arrived in summer 2005. Five clusters were offered that summer, admitting 83 students. The Clusters were: C1-The Science of Computing; C2-Kinetic Sculpture and Clocks-the Art and Science of Mechanical and Engineering Design; C3-Living Oceans and the Impacts of Climate Change; C4-Earthquakes in Action; C5-The Molecular Biology Revolution. Interestingly, the subjects of all of these original clusters are currently offered this summer. COSMOS would like to acknowledge Cluster 2 faculty, Nate Delson and Raymond de Callafon for inspiring COSMOS students every summer since 2005! If you have a favorite memory, photo or message of Dr. Delson or de Callafon, or of Cluster 2, please email it to cosmos@ucsd.edu.

Acceptance notifications for the UCSD COSMOS 2014 program were sent to anxious applicants on April 18th. 613 applications were completed for 184 student openings at UCSD. More than half of the accepted students are in 11th grade, overwhelmingly from California (one out-of-state and two international students accepted), slightly more female students and about one-third are receiving financial assistance. The most requested first choice clusters remain Clusters 1 (Computers in Everyday Life), 2 (Engineering Design and Control of Kinetic Sculptures), 7 (Bioengineering/Mechanical Engineering: The Amazing Red Blood Cell) and 8 (Tissue Engineering and Regenerative Medicine). New for this year is Cluster 9: Music and Technology with Dr. Mauricio de Oliveira as lead faculty and Dr. Shlomo Dubnov as cluster faculty. Dr. de Oliveira continues as lead faculty for Cluster 7 in addition to Cluster 9. Dr. Robert “Skip” Pomeroy will be lead faculty for Clusters 3 (Living Oceans and Global Climate Change) and 6 (Biodiesel from Renewable Sources). COSMOS Director and ECE professor Dr. Charles Tu will be lead faculty for Cluster 5 (From Lasers to LCD’s: Light at Work).

Important Upcoming Dates
COSMOS 2014 Summer Program
UCSD, UC, UCSC—July 7-August 2
UCI—June 29-July 25

COSMOLYMPICS
Friday, July 11—6:30-8:30pm — we need judges!

COSMOS 10 Year Celebration/Advisory Board Visit
Tuesday, July 22— 5:00-7:30pm

COSMOS Alumni In The News!
Send your news and updates to cosmos@ucsd.edu

UCSD Receives Record Applications for Fall 2014
UCSD has received a record 89,169 freshman and transfer applications for fall 2014. UCSD received 73,356 freshman applications for fall 2014, up 8.8 percent from last year. Transfer student applications also increased by 5.8 percent from 2013 with a total of 15,813 transfer students applying for admission. The mean high school GPA for freshmen is 3.79, up from 3.77 last year; and the average SAT Reasoning scores are 591, 644 and 607 respectively for Critical Reading, Math and Writing, (up slightly from last year’s applicant SAT scores which were 583, 635 and 595). The average GPA among transfer applicants increased from 3.35 to 3.37, compared to last year. The most popular majors chosen by freshman applicants are engineering, biology and the social sciences. Almost 50 percent of UC San Diego’s transfer applications are social science majors.
Faculty Highlight: Raymond de Callafon, Cluster 2

In this issue we hear from Raymond de Callafon, UCSD MAE Professor and COSMOS Cluster 2: Engineering Design & Control of Kinetic Sculptures faculty:

As inaugural COSMOS faculty, and celebrating your 10th summer this year, any insights or experiences you would like to share?

The last 10 years with COSMOS at UCSD during the summer have been an amazing experience. During our first year I was doubtful whether or not we would be able to keep a group of high school kids engaged and entertained for 4 full weeks during the summer. Well, that all changed after the first year. The COSMOS students were not only motivated to work in our design studio, they were thrilled to interact with professors and teaching assistants, they were excited to learn about the engineering tools we brought to our cluster and they loved the extracurricular activities outside the classroom during their 4 week stay at the UCSD campus. On top of that, I have the privilege to work with Nathan Delson. He has been instrumental in setting up many of the original ideas of our unique cluster, while Chris Cassidy has been our rock star in the design studio where our COSMOS students work. Last but not least, I was fortunate to work side-by-side with some inspiring high school teachers in our cluster. Our COSMOS Teacher Fellows gave us a lot of tips on teaching, how to inspire students and helped in creating engaging experiments and design challenges.

What courses do you teach at UCSD? Are you involved with any other academic or student organizations on campus other than COSMOS?

My background is in the area of control systems and in particular in dynamic modeling from time-series data. I teach both undergraduate and graduate courses in this area of control systems and dynamic modeling of time-series data. My graduate courses focus mainly on my main research topics in time-series analysis and include two System Identification courses and a Robust Control course. At the undergraduate level, I teach basic linear control at a junior level. In addition, I like hands-on experiments and I am responsible for most of the senior level laboratory experiments in our department that are being used in special laboratory courses that focus on control, linear circuits and dynamic vibration analysis.

What are your current research topics and initiatives? With my background in the area of dynamic modeling from time-series data, I am in the ‘business’ of measuring time-dependent signals from a dynamic system and use these signals to either formulate models or update control algorithms to describe or alter the dynamic behavior of that system. I apply these techniques to model the dynamics of intricate small mechanical components found in a hard disk, magnetic tape or an optical disk drive, but also to model the behavior of large complex systems such as aircraft dynamics, electric (micro)grids, ocean flow and wildfire behavior. Our effort in modeling the dynamics of electric grids is based on time-series data measurements with Phasor Measurement Units (PMUs) and has unleashed new methodologies to control and safeguard our electric grid that we hope to develop more into the future. Furthermore, our latest project on observing wildfire behavior and predicting the dynamics and the rate of spread of a wildfire in collaboration with the San Diego Supercomputer Center the Qualcomm Institute and the University of Maryland is very important here in Southern California, where we recently have seen many wildfires.

Can you talk a little about your unique lab facilities and the research that goes on there?

My laboratory holds experimental facilities on which we can test new algorithms that process time-dependent signals to either formulate models or update control algorithms to alter the dynamic behavior of that system. The experiments include sound equipment to model sound propagation and embedded systems to implement noise cancellation. We also have several intricate mechanical systems such as a small hard disk and magnetic tape drives to test out new (adaptive) control algorithms to improve the data storage capabilities of these systems. Our latest experimental facility runs outside our lab: in collaboration with Lou Shrinkle from Pacific Battery Management Systems we have developed a prototype Electric Vehicle (EV) that runs on user-exchangeable battery modules. The main idea of this experiment is that one could easily swap out parts of a complete battery of an EV to extend the range of an EV, while allowing the mixing of partial charged battery modules. This would provide an extreme flexibility in EV charging and refueling that has not been seen before and we are planning to demonstrate this approach to keep it strong by continuing to participate in outside school activities that promote science, math and engineering education and research. Collaborative work demonstrates that you are a team player, but make sure you can always identify your specific contributions in a team effort. Extracurricular activities that demonstrate your interesting hobbies, your unique team spirit and your special qualifications always make your file stronger.

Do you keep in contact with any of your cluster alumni?

Many of the COSMOS students in our cluster keep in touch with me via email. I am, unfortunately, not a fan of Facebook, but keep my LinkedIn active for students to connect to me, as I am often ‘buried under papers’. The positive outcomes of COSMOS is that I have a fairly good idea on the academic skills and level of the students. This knowledge is extremely helpful when students ask for recommendation letters for their college application.

Do you have a favorite COSMOS memory or impression?

One of the most wonderful experiences for me is still the last day of the program when students are suddenly all dressed up to give their presentations and demonstrate the projects to their parents. You can see, but mostly, hear the cheers when everything seems to work as planned, while their parents stand in awe and affirm to the instructors how amazed they are with the design completed by their son or daughter. Partly because I became a parent myself during these last 10 years, I have come to appreciate the amount of time and effort parents put into teaching and motivating their children. It is wonderful to see how our COSMOS student demonstrate their appreciation to their parents during their COSMOS summer.

How do you feel COSMOS prepares students for UCSD, or for college in general?

COSMOS provides a rare opportunity for high school students to study one of their favorite topics. At the same time, it allows students to figure out what is their favorite discipline to study and experience life at a university for four weeks in a row. Surrounded by other students who are just as eager to learn more about what it is like to live, work and study at a university. Do you have any advice for COSMOS alumni that are still in high school? Applying to college?

With so many students applying to college it is important to diversify yourself and show that you have an extra edge over the other students applying. The fact that you participated in COSMOS already gives you some of that edge, but it is important to keep it strong by continuing to participate in outside school activities that promote science, math and engineering education and research. Collaborative work demonstrates that you are a team player, but make sure you can always identify your specific contributions in a team effort. Extracurricular activities that demonstrate your interesting hobbies, your unique team spirit and your special qualifications always make your file stronger.
Jack Takahashi, COSMOS 2011, Intel STS 2013 Finalist

Currently attending: Stanford University; Expected Graduation: 2017; Major: Undecided; COSMOS Year: 2011; Cluster 8: The Molecular Biology Revolution

What kind of research are you currently involved in, and/or what extracurricular activities and organizations do you participate in?
I'm currently working in the de Jesus Perez lab in the Pulmonary and Critical Care department of the Stanford School of Medicine. My research is on PDGF-related beta catenin activation in idiopathic pulmonary arterial hypertension (IPAH). On the side, I'm learning ballroom dance and writing for the Stanford Flipside, a satirical newspaper.

Did you participate in any science/engineering competitions or fairs after COSMOS? How did you do?
Intel STS 2013 Finalist; I-SWEEP 2012 Gold Medal; Synopsys Championship 2012, 1st Place Microbiology

How did COSMOS help prepare you for your undergraduate journey?
My COSMOS cluster gave me a solid foundation in molecular biology that allowed me to work with advanced techniques like qRT-PCR and western blots comfortably. This gave me a leg up when I started research in high school and continues to help me with my research at Stanford. At the same time, COSMOS introduced me to dorm life, so college wasn't a shock for me.

What are your future aspirations?
I plan on earning an MD or MD PhD. I'm not sure whether I want to work clinically or as a physician researcher, but I'm confident I want to be in the medical field.

Do you have any advice for your fellow COSMOS alumni who are still in high school?
Don't stress about where you end up going to college. What you do in college matters more than where you go.

Because of my participation in COSMOS, I am encouraged/inspired to... explore the sciences an inch wide and a mile deep. COSMOS was great because it allowed me to learn at a high-level while my high school courses were still teaching the basics.

Connor Worley, COSMOS 2013, Macy’s Thanksgiving Day Parade—FIRST Robotics

The Macy’s Thanksgiving Day Parade® is the beginning of the American holiday season. More than 3.5 million people in New York and 50 million people around the country watch this holiday tradition. This year, there was something never before seen in the parade — ROBOTS! Five award-winning FIRST Robotics Competition (FRC) teams opened the 87th annual event on November 28, 2013 in New York City, cutting the ribbon to signal the official start of the parade. The teams spent many hours retro-fitting their competition robot from shooting discs to showering confetti, and operating the scissors to cut the ribbon. One of the participating teams, The Holy Cows from San Diego, included COSMOS alum Connor Worley. Following are his impressions:

This Thanksgiving break, I helped lead the Macy’s Day parade with my FIRST robotics team, The Holy Cows. Along with four other teams we were selected to cut the ribbon and shower confetti, then drive two and a half mile-long parade route. When I first heard the news that our team was selected I was thrilled, but the team quickly realized that we would need to make some modifications to the robot before Thanksgiving. We decided to use three batteries connected in parallel, and were satisfied after some testing. To shower confetti, we purchased a confetti launcher, mounted it to the robot, and rewired it to use our robot’s power distribution system rather than an internal battery. After more testing we were ready to crate up the robot for New York.

We arrived on Tuesday evening and went to bed right after dinner. On Wednesday we woke up at three in the morning to make an appearance on Fox & Friends and hype up the parade. Later that day we did some sightseeing with a tour of Yankee Stadium and a visit to the 9/11 memorial. We woke up at three again, and drove to the parade with the other teams. After one last systems check we waited for the parade to start. It was freezing cold, but I knew the experience would be worth it. When the parade started, and the crowd the cold seemed to disappear. Overall, I had a great time in New York. Not only was it a blast to be there, but I’m also glad to have helped promote FIRST, a program that has given so much to me. I hope they’ll be invited back next year!
My Journey to Silicon Valley: How one individual got into the CODE2040 Fellows Program

By: Alex Rodriguez, COSMOS 2010

Sophomore Year

It was my sophomore year of college and like many Computer Science students, I was looking...
Engineering students use hands-on approach to teach sixth graders fundamentals of earthquake engineering

Over the past seven years, more than 7,000 sixth graders from 26 schools in San Diego County have visited the Jacobs School of Engineering to build model structures and test them on small shake tables. It’s all part of the Earthquake Engineering with K’NEX Outreach Program run by the UC San Diego chapter of the Society of Civil and Structural Engineers. On a recent Monday morning, nearly 50 of these sixth-grade students dotted the lawn outside of Jacobs Hall en route to test their toy structures. Headed by third-year structural engineering major Kayse Sheppard, the student-run program educates local students in the fundamentals of earthquake engineering.

Sheppard was one of seven volunteers that went out to local elementary schools to teach students about earthquakes and how good design can prevent buildings from collapsing. The volunteers then provide students with K’Nex building blocks, so they can create model buildings to be tested on UC San Diego’s miniature shake table – a tool used to simulate earthquakes—worth $30,000 commercially. Built by teams of five students, the designs are judged by UC San Diego seismic outreach volunteers for how well they held up on the shake table, creativity and cost effectiveness. The best designs are awarded a certificate of achievement.

“I think in elementary schools, science is sometimes put on the backburner,” program faculty advisor Lelli Van Den Einde said. “I think the program is a great opportunity to get kids engaged and excited in science. Some of these kids have never had the chance to come to a college campus, and it’s amazing to see the energy and excitement they bring to the project.” Van Den Einde – a UC San Diego lecturer teaching the Conceptual Structural Design course — says the program now in its eighth year, is looking to expand. The effort is spearheaded by two Jacobs School Ph.D. students, Scott Ouellette and Colin Haynes, who are also Gordon Center scholars. “I believe that it’s very important for engineers to reach out in our communities and educate kids about what we do,” Haynes said. “We not only inspire kids to choose engineering careers, but also develop young engineers into more effective communicators and more engaged citizens.”
In the movie “Her,” the smart phone operating system, “Samantha,” is so powerful it can carry on conversations that seem to tap into everything Theodore sees, thinks and feels. Gary Robbins, U-T San Diego, interviewed Rajesh Gupta, chair of CSE at UCSD, a leader in machine learning and artificial intelligence to ask the question: will smartphones soon become sentient?

What is the scope of the information that smartphones, apps and wearable devices can collect on us now? It’s quite significant. Your smartphone knows who you are, where you are, where you’ve been, and a lot about what you’re doing. Its sensors can tell if you’re walking, running or sitting. Some phones also can sense air pressure, temperature, light, humidity and your proximity to objects. What the smartphone can’t do is sense your mood, like your pets can do.

Mood?

Computers are beginning to elicit emotional responses from users. But they can’t sense mood, which you need to know to have a conversation. That will change as sensors are developed to give computers ‘people skills,’ like being able to detect when you’re annoyed or frustrated. There are already applications in automobiles that look for distraction in drivers. Most of the advances will be tied to wellness, an area where there’s a lot of sensors and apps. Your smartphone can determine your heart rate by using its camera to see changes in the color of your skin. That information can help reveal if you’re excited or anxious, or not. Advances are being made in learning algorithms that navigate this data and make sense of it. Javier Movellan from UCSD’s Machine Perception Lab, along with others, is beginning to fuse information from voice (things like vocal tone), images (the frequency and length of frowns and smiles), skin (conductance, heart rate, temperature, breathing rate), and device usage patterns. The problem is, smartphones don’t have the processing power or the energy to pull all of this together to determine your mood in real time. Without that, your computer wouldn’t be able to engage you in a realistic conversation, like Samantha does.

I dislike Siri’s computer-generated voice on the iPhone. I know others who feel the same. Will scientists need to give these operating systems natural voices, like Samantha’s? The OS is able to convey surprise, empathy and curiosity. The problem is more difficult than it sounds. There’s the issue of creepiness; some people don’t like it when a machine becomes too life-like. But the operating systems will have to behave more like people if they’re going to be widely accepted and used. That means scientists will have to improve the computer’s ability to synthesize verbal and non-verbal emotional cues, like a person’s laughter or a shrug, or their posture. So smartphones will need better voice recognition?

Yes. This is not a well researched area. Machines are not good at knowing whether they’re hearing things like sarcasm, or a sentence that actually means the opposite of what’s being said, or whether a sentence is simply filler in a conversation. The smartphone can’t make inferences about what a person is saying. The phone needs to do that, and analyze how a person is interacting with other people, or other things. For example, the machine could pick up on mood if it knows that a person is yelling at another driver in traffic, or whether a person is listening to a certain type of music for a long period of time.

What about facial and gesture recognition?

We are beginning to build a pretty rich vocabulary of facial and hand gestures. That’s being used to build better computer games and music players. Advances in this area are moving rapidly with innovative startups such as Flutter, whose app lets you control music players with hand gestures, and PointGrab, which does the same with home appliances and electronics.

In other words, an operating system like Samantha could read your body language and determine mood?

Yes, automatic mood assessment from gestures is possible.