



COSMOS UC San Diego

California State Summer School for Mathematics and Science

Alumni Newsletter Fall 2014

COSMOS Alumni:
Send us your updates, your accomplishments, your photos, anything you'd like to share with your fellow alumni!

Important Upcoming Dates:

COSMOS 2015 ONLINE APPLICATION

Tuesday, January 20—Friday, February 20

COSMOS 2015 SUMMER PROGRAM

UCSD, UCD, UCSC—July 5-August 1
UCI—June 28-July 24

COSMOS Alumni ~ Stay Connected!
Please take a minute and answer our short survey ~ we're measuring success, yours and ours!

<http://goo.gl/forms/fR35NQMmw1>

www.facebook.com/ucsdcosmos

<https://www.youtube.com/user/cosmosucsd>

Inside this issue:

Celebrating 10 Years of UCSD COSMOS! Alumni Survey 1

Faculty Highlight: Ryan Kastner, Cluster I; Undergraduate Research and Rubik's Cube Solving Robot 2

COSMOS Alumna Rocio Pena, COSMOS 2009 3

COSMOS Alumni Grace Chen, 2011; Kevin Crowley, 2010; COSMOlympics Alumni Judges 4

COSMOS Alumni Neil Gandhi, 2011; Danee Kenyon, 2009; Julia Yang, 2012; Grace Chen, 2011 5

Send us your photos or story for the next issue!



Contact us:
cosmos@ucsd.edu

Visit our website:
cosmos.ucsd.edu

UCSD COSMOS Celebrates 10 Years!



L to R: Ken Hess, Dan Aldrich, Gayle Wilson, Al Pisano, Charles Tu

COSMOS UCSD's 10 year celebration occurred on a beautiful July afternoon this past summer. In attendance were COSMOS Advisory Board members including COSMOS founder and former California First Lady, Gayle Wilson. Also attending were COSMOS UCSD 2014 students, RA's and staff. Students from the first summer program in 2005 were invited along with past COSMOS administrators and faculty. Dean Al Pisano of the Jacobs School of Engineering was also in attendance and very engaged in talking with the students. Special recognition was given to COSMOS faculty Nate Delson and Raymond de Callafon, who have been Cluster 2 faculty since the inception of COSMOS UCSD. Each was given a book with photos that have been taken throughout their years with COSMOS, and the books included inscriptions written by several alumni of Cluster 2.

Melina Duarte was also honored by the Advisory Board for her years of service to COSMOS at UCI and UCOP. Bryan Cassella, COSMOS RA, provided cello music to enhance the atmosphere of the event. Alan Sanchez, known as "Pollo" to many, gave an inspiring talk about how influential COSMOS was in encouraging him to continue in STEM education, particularly at UCSD. Pollo continues to give back to COSMOS UCSD by being featured in the COSMOS informational video for the second year which is available on the COSMOS YouTube channel, accessible from our website. Advisory Board members remarked that this was the first time they had been with all the students from one of the COSMOS programs at the same time and how impressive the students were. A wonderful celebration and evening for all and a great beginning to the next ten years of COSMOS UCSD!



L to R: Becky Hames, COSMOS Assistant Director; Gayle Wilson, COSMOS Advisory Board Member; Charles Tu, COSMOS Director

Faculty Highlight: Ryan Kastner, COSMOS Cluster 1



Ryan Kastner has been COSMOS Cluster 1 lead faculty for six years. He and his team are dedicated to students at all levels of the educational process as evidenced by the undergraduate student research detailed below. Dr. Kastner's research group website (<http://kastner.ucsd.edu/>), contains information

on Dr. Kastner's research, as well as highlights of research being conducted by Dr. Curt Schurgers, Cluster 1 faculty and Riley Yeakle, Cluster 1 Cluster Assistant. COSMOS 2014 students will also notice that Professors Kastner and Schurgers collaborate on research exploration with Dr. Albert Lin, who presented one of the Discovery Lectures this past summer on his research and exploration to find the Tomb of Genghis Khan. Professor Kastner is passionate about applied research, particularly projects that allow him to travel.

One aspect that Professor Kastner appreciates about the COSMOS program is the hands-on experience that students gain. The ability for students to be involved in interesting, meaningful research is important in attracting and retaining students, particularly engineering students, throughout the educational process. He noted that most COSMOS students are within a few years of being able to conduct meaningful undergraduate research at the University level, and should seek out opportunities to do so. As founder and co-director of the Engineers for Exploration program at UCSD, Professor Kastner is able to meld his interests in undergraduate research and exploration. This program is open to undergraduate students from UCSD as well as other academic institutions. More information can be found at the Engineers for Exploration website: <http://e4e.ucsd.edu/>.

Professor Kastner presented Cluster 1 students this past summer with research being done by students in his Spring CSE 145 class involving machine solving of a Rubik's Cube. The following is excerpted from the Jacobs School CSE website:

The official directive for students in CSE's Embedded System Design course is to "learn fundamental knowledge of microcontrollers, sensors, and actuators" and other hardware and software tools to build an embedded

system. The unofficial directive for this past quarter's students? To put the 'fun' in functional. "It is important for students to take the knowledge that they learn in their classes and apply it to real-world problems," says CSE Prof. Ryan Kastner. "This not only allows the students to better understand why they need to learn sometimes seemingly obscure topics, but also gives them a view of how computer science and engineering can make a significant impact on the world.

Rubik's Cube-Solving Robot

Trial and tribulation were the modus operandi of Team Ruku, a trio of students -- Daryl Stimm (pictured below), Jonas Kabigting, and William Mutterspaugh, -- in CSE 145, who decided to improve upon a prototype of a wireless robot designed to autonomously solve a Rubik's Cube puzzle. "It was slow, it jammed, it had lots of



problems," recalls Stimm. "But we knew if we could get it right it would be fun to develop the robot as a kit that educators could use to get students interested in the STEM fields." After Stimm presented his idea to the students in the Embedded Systems course, Kabigting and Mutterspaugh signed on to help.

The original robot was controlled by a credit card-sized single-board computer known as a Raspberry Pi and had two 'arms' and servos to manipulate the cube. The team now outfitted it with an additional pair of arms and replaced the servos with stepper motors and linear rails, which sped up the process of solving the cube and reduced the number of jams. Kabigting also created Python-derived color recognition software and a motor design script that, when combined with a smartphone mounted to the top of the robot, allowed the robot to take photos of the mixed-up cube (even in varied lighting situations) and then calculate how to solve it.

"We made a giant leap in this project with the color capturing," says Mutterspaugh, who was primarily responsible for designing and wiring the device. "Before, you had to enter

each side of the cube manually with Internet-based software to be able to solve it. It required a lot of hand-holding. Now it's all done locally. You just insert the cube, press start, and the robot does everything." The team also designed an app that allows a user to take photos of a cube and then follow step-by-step instructions for how to solve it. "For us, this was more about building a robot than solving a cube," says Stimm. "No matter who I show this to, people are kind of wowed by it." After snapping photos of each of the cubes six sides, the robot takes only 25 seconds on average to solve a cube. Getting to that speed involved a lot of trial and error, says Stimm. "Everything -- even rotating the cube 90 degrees -- was more work than we expected," he admits. "These cubes, depending on the manufacturer, are different sizes, and the torque is different. If the cube was a little loose inside the arms, it wouldn't rotate a full 90 degrees, so we had to optimize that in the software. Also, a lot of the parts we'd order wouldn't work, so we had to go back and reorder things. The motors were a perfect example. We had three designs for what we wanted and we almost went to a company to have them build a casing, but right before the order for the company was about to go through, we stumbled upon a better solution: We could do it ourselves, at less cost."

The next step for the Ruku team is to get enough financial backing to market and sell the robot in educational kits, following the business model made popular by Tom's® shoes -- buy one Ruku kit, and they will donate one to education. Their goal is to design the kits so students as young as 11 can assemble a Ruku in about an hour. "We did a lot of research on this and we know that students in middle school have the highest interest in STEM-based paths," notes Stimm. "Kids are really engaged by these technologies. By capturing that age group, especially with a cool gender-neutral project like this, we hope to inspire them to be the next scientists and engineers."



Student designed Robotic Rubik's Cube solver

Rocio Peña, COSMOS 2009 UCSD Chemical Engineering

Currently attending: UCSD
 Expected Graduation: 2015
 Major: Chemical Engineering
 COSMOS Year: 2009
 Cluster 2: Engineering Design
 and Control of Kinetic Sculptures

In addition to her studies and research, Rocio will be assisting the COSMOS UCSD program this fall in community outreach events and is actively involved with the IDEA Center at the Jacobs School, UCSD.

Dr. Olivia Graeve, whose lab Rocio works in, was a Discovery Lecturer for our 2014 summer program. Dr. Graeve is an Associate Professor of Mechanical/Aerospace Engineering at the Jacobs School.

More about Dr. Graeve and her research can be found here: http://www.jacobsschool.ucsd.edu/news/news_releases/release.sfe?id=1535

Why did you choose to attend UCSD?

I chose UCSD because of the renowned engineering school, the distance away from home, the proximity to the beach—but most importantly because I had already experienced the environment through my time at COSMOS. The campus grew on me and I knew that I could definitely call UCSD home if I were to be a college student.

How did you decide on your particular major?

In high school I particularly enjoyed my chemistry class and I realized that I wanted to major in something that was chemistry related. I also had an affinity for physics so my teacher suggested that I try chemical engineering, which combines both worlds.

What kind of courses are you currently taking? Which are your favorites?

I am currently taking senior chemical engineering courses like process control and separation processes. I enjoy these classes since I am gaining valuable information that is fundamental to chemical engineers in industry. My favorite course at UCSD, however, has been organic chemistry lab where I conducted experiments that I found really exciting. For instance, one of the more memorable experiments taught about chemical extraction techniques and we extracted the caffeine from green tea. Lab courses are generally very meaningful as they allow students to apply the concepts they learn in classes into actual technical work.

What kind of research are you currently involved in, and/or what extracurricular activities and organizations do you participate in?

I am currently an undergraduate student researcher in the Graeve lab or the Nanomaterials Processing Laboratory. My research involves the fabrication and study of nanofluids, in which ceramic and metal materials in their nanopowder form are dispersed in base fluids to enhance fluid thermal conductivity. It is important to understand the behavior of nanofluids in terms of stability, types of material used, and determination of heat transfer enhancement so that they can be utilized in applications such as industrial heating/cooling, microelectronics, fuel cells, etc. I also became very involved in the Society of Hispanic Professional Engineers (SHPE) chapter at UCSD where I gained valuable skills related to professional development and leadership that I can also apply into the lab and classroom setting. I was president of the UCSD chapter last year and it



Dr. Olivia Graeve and Rocio Peña in the lab

was a very rewarding experience to have lead a team of individuals as well as learning about group dynamics and my own personal leadership style.

How did COSMOS help prepare you for your undergraduate career?

COSMOS was instrumental in helping me understand what it is that engineers do and how they think. I learned that engineering projects are about a process, initially gathering the assumed variables and the known and then working to determine the unknown through design and planning. Thus I became in love with the idea that in order to be an engineer, one has to be curious and creative as much as they are a problem solver. The cluster I was enrolled in dealt with kinetic sculptures and was heavily mechanical engineering based. I enjoyed the project but it was also helpful in guiding me in my decision of NOT choosing mechanical engineering but rather seeking another type of engineering. The important part that I did confirm, however, is that I did want to be an engineer. I later decided on pursuing chemical engineering due to my interest in chemistry.

What are your future aspirations?

Although I am still in the process of discovering what my specific research interests are, in the future I hope to be working in a research and development (R&D) department for a company developing an interesting product. Being involved in my current lab has sparked an interest in materials science—thus I would aim to be a materials engineer or researcher for the industry I choose to work in.

Do you have any advice for your fellow COSMOS alumni who are still in high school?

My advice would be to really focus and master the science and math courses that you take in high school as they will be a very important foundation for the courses offered in college. I would also advise to look into opportunities to work in laboratories or even internships that are offered to high school students. Having technical experience under your belt prior to college can help give you direction and will give you confidence moving forward. COSMOS was an excellent start to partaking in technical work, so you can use that as a stepping stone to participate in other projects.

Grace Chen, COSMOS 2011, Perfect ACT Score,

Grace attended the COSMOS 2011 program in Cluster 1, Computers in Everyday Life. She is in her senior year at Torrey Pines, and said she took the ACT twice and the SAT three times to get the scores she wanted (2290 out of 2400). “Doing well is often largely a matter of test-taking skills rather than actual skills,” Grace said. “Even a brilliant student can get a lower score than someone who’s used to taking the tests. If you want to improve those last few points, take the practice tests and focus on overcoming your weaknesses.” Her focus this fall is on college applications. ACT and SAT test

scores are a key factor in the admissions process. Last year 0.001 percent of students earned a perfect ACT score, while 0.33 percent of 1.6 million students earned a perfect SAT. Her two passions are science and art, and she’s an illustrator for her school newspaper and well known for her anime and video-game style art. She’s also one of four student coordinators for Torrey Pines’ Science Olympiad. While she does very well in school, Chen said she’s not nearly as competitive or motivated as some of her peers. Her goal is to become less introverted and more social in the coming



Grace with her father at the Science Olympiad year. “I love talking to new people,” she said. *UT San Diego*

Kevin Crowley, COSMOS 2010, UCSD Undergrad,



Name: Kevin Crowley
 Major: Physics w/ Specialization in Computational Physics; Graduation 2016
 Minor: Chemistry
 COSMOS Cluster 7: Biological Motivations for Tensegrity Structures

This past summer, Kevin participated in the UCSD Summer Research Conference at the Price Center. His topic was “The Effect of Quantum Dot Volume Fraction on the Stretchability of Organic Solar Cells” and his mentor is Professor Darren Lipomi. Kevin graciously submitted the following regarding his COSMOS experience and current academic pursuits:

The summer I spent as a yellow lanyard-wearing, tensegrity structure-building, phospholipid bilayer-isolating COSMopolitan was undoubtedly the best of my life; never before had I been so immersed in an environment of passionate, curious, and intelligent people. The academic opportunities offered by COSMOS are reason enough to attend; as a high school student I glimpsed the frontier of cell membrane engineering under the instruction of professors with more degrees than I have fingers, using instruments with price tags containing more zeroes than I have toes.

However, the appeal of COSMOS was hardly limited to the time spent in class and lab. After the day was done, I would come home to a suite of some of the best friends I have ever had; we learned from each other, challenged each other to be better, and laughed with each other more than I’ve ever laughed with anyone else. And though it was hard to leave, I left COSMOS a more confident and driven person; I did better in my senior year than any other year of high school and gained acceptance to UCSD, my number one choice of college.

As an undergraduate, I spend most of my time outside of class volunteering in Professor Darren Lipomi’s research group in the Nanoengineering department here at UCSD. Professor Lipomi explores the stretchability and flexibility of solar cells made out of organic semiconducting materials, and as a volunteer my job is to study the effect that different nanoparticles have on these mechanical properties. More specifically, my duties involve synthesizing and purifying different compounds for use in device fabrication, building solar cells for photovoltaic performance tests, and mechanically deforming different materials to study the magnitude of tension and compression they can accommodate before permanently stretching and cracking. This allows me to see which compounds offer an optimized mixture of solar cell efficiency and device stretchability and, with this in mind, design better solar cells.

All of this is in the pursuit of a dream device that we in the lab refer to as a “solar tarp”; such a device could be balled up to the size of a grapefruit, unfurled to the size of a backyard swimming pool and capture the energy of the sun’s rays all the while. It is not hard to imagine just a few of the almost limitless



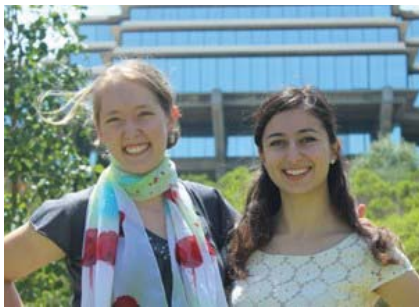
applications of such a device. Aid workers could drape a solar tarp over houses, villages, and disaster relief camps to provide clean energy to those beneath. Soldiers in the harshest environments could pitch solar tents that not only protect them from the elements, but also power their equipment. Architects could use thin solar coatings to make the very walls of our skyscrapers capable of capturing solar energy, turning our city skylines into concrete forests that bear electrochemical fruit. Whatever the future of my research holds, simply considering the possibilities leaves me excited to be a part of such a wonderful project and grateful to COSMOS for inspiring me to pursue science and engineering after high school.

2014 COSMOlympics Alumni Judges—Thank You!



Neil Gandhi, COSMOS 2011, Serial Entrepreneur

Neil Gandhi, COSMOS 2011 Cluster 2, is a University Innovation Fellow at UCSD, working to expand Innovation and Entrepreneurship at UCSD. He is the Founder and CEO of Audograph.com, a site which allows users to stream and share music from SoundCloud over video chat. As a Thiel Fellowship finalist, he has two patents and placed third at the UCSD Zahn Prize competition. Entrepreneurship has been the focus of Neil's career since he started college. His current undertaking, Audograph, launched in September of 2014, and has already formed partnerships with major DJ's and record labels. In building the site, Neil recruited students not only from UCSD, but also from other UC Schools. He believes that knowledge in computer science is absolutely critical in any sort of business and wants to help pave the way for students to launch their own startups. Neil can be seen on the COSMOS YouTube channel (<https://www.youtube.com/user/cosmosucsd>) discussing his previous idea, Call Meh, which is patent pending. (Source: *University Innovation*)



L to R: Danee Kenyon, Delara Fadavi
(Source: *Next Shark, Waylae Gregoire*)

Danee Kenyon, COSMOS 2009, Entrepreneur

Danee Kenyon, COSMOS 2009, Cluster 2, and Delara Fadavi are entrepreneurs at heart. Danee is a UCSD mechanical engineering major, while Delara is a bioengineering major. Together, with their team and resources from the Gordon, Moxie and von Liebig Centers at JSOE, UCSD, they are negotiating the field of taking an idea to market. Their product, USKey, is a motion-activated USB plug-in alarm with an on-board speaker. If you leave your laptop unattended for a few moments, you plug the USB in and activate it through a password. If the laptop is moved, the alarm sounds, alerting everyone in the area. It works when the computer hibernates and only you can disable the alarm through a password. They have begun to raise venture capital and participated in pitchfests at UCSD and Las Vegas, learning skills and making valuable networking contacts along the way. Danee was a cluster assistant for Cluster 2 in 2012, giving back to the COSMOS community.

About 60 high school and college-age women participated in the 2014 International Women's Hackathon, a computer programming competition, held on the campus of Cal State San Marcos this October. Two of the participants were Julia Yang, COSMOS 2012 and Grace Chen, COSMOS 2011. Their official challenge was to work in teams to create, in one day, a website, app or video game that addressed either disaster response or climate data. What they were really working toward was encouraging other young women, and themselves, to break down walls in computer science. The tech industry has come under scrutiny for its lack of gender (and racial) diversity, with Google, Apple, Facebook, Twitter, Yahoo and Microsoft releasing data in recent months showing that women make up only about 30 percent of their workforces. Additionally, Microsoft CEO Satya Nadella, has apologized for his recent statements regarding women not asking for raises in the computing industry, but rather to rely on karma.

Grace, a senior at Torrey Pines High School, envisioned a karmic workplace like this: "Even if you work very hard and let your skills be shown, that doesn't mean your boss and CEO and will recognize that and give you a raise. Then they could say, 'Well, I didn't give you a raise because you didn't ask for one.'" Learning in a nurturing environment that promotes creativity is why all-female events are important, said Youwen Ouyang, a professor of computer science at CSUSM, and organizer of Saturday's event. Cutthroat competition at most larger, multiday hackathons, which can culminate in a cash prize upward of \$10,000, intimidates or turns off many female programmers, Ouyang said. Julia, also a senior at Torrey Pines High, who was clearly the leader of her six-person team, agreed. "We're here to promote women in this field," she said, "so it's all about working together, and not being so competitive with others." Julia was recognized by her teammates for her exceptional organizational and leadership skills. This event was open to female students, 16 and older, working in groups of 4-6 students. Julia's project team during COSMOS was recognized with the Gordon Leadership Center award for Cluster 5. (Source: *Michele Parente, San Diego U-T*)

Julia Yang, COSMOS 2012; Grace Chen, COSMOS 2011, Hackathon Participants



Julia Yang (at right) with teammate
(photo by Justin Van Bibber, San Diego U-T)