Computer Engineering | Cal Poly College of Engineering | Fall 2022

X

HERBIE

## **CPE Department Moves Forward**



CAL POLY Computer Engineering COLLEGE OF ENGINEERING

# **HELLO USRLD** Using technology to help people.



Cover photograph



**HERBIE TOURS CAMPUS** 

Computer Engineering Professor John Seng's robot Herbie cruises through the halls of Building 14 during a demonstration before preschool students from the Cal Poly Children's Center. Roborodentia — an annual robotics competition that pits autonomous machines against each other as they race to complete unique challenges — packs Mott Gym in 2011. For more on the legacy of Roborodentia, see Page 10.

#### Inside this issue

- **3** Note from the Chair
- 4 CPE Department Hits Its Stride
- 6 Herbie Bounces Back From a Little Adversity
- 8 The Legacy of Roborodentia

HELLO WORLD Articles by Emily Slater



E ighteen months ago, Computer Engineering became Cal Poly's newest department. Since that time, we have modified our curriculum, hired new staff members, smoothed the path for transfers and worked to expand mentoring programs — all in the name of supporting our students.

Our undergraduate Computer Engineering program also achieved the No. 1 rank among institutions whose highest engineering degree is a bachelor's or master's, according to U.S. News & World Report's Best Colleges guidebook. We are honored to serve as an example for colleges and universities across the country as we pioneer innovative ways to educate an increasingly diverse group of students.

Our staff and faculty members play an integral role in connecting students with opportunities for growth, from working with robots under Professor John Seng's expert guidance to learning about engineering on a global scale from Professor John Oliver, who is teaching at a university in Ghana while on sabbatical leave this year.

The education our students receive has the potential to change their lives, as reflected by the story of alumnus Brian Starnes, whose involvement in the long-running robotics competition Roborodentia led to a job and chance to inspire Cal Poly's future engineers.

I could not be prouder of our faculty, staff, students and alumni who in their pursuit of excellence cause us to shine. We will commemorate the formation of our new department during a two-day event slated for May 19 and 20 that will include a family-oriented picnic, reception for supporters and banquet at Hotel San Luis Obispo. Please mark your calendars and plan to spend some time with us that weekend.

We also invite you to partner with us as our department grows. Join us in supporting community, collaboration and Big Ideas through, for example:

- · Supporting student lab kits and development boards
- Sponsoring a capstone project
- · Partnering with faculty in their research
- · Helping us establish a tutoring center and support hub
- Upgrading lab facilities (everything from new power

supplies to lab facilities in security, autonomous systems, networking, IoT and advanced hardware design)

And more!

If you are interested in helping, please contact me at lslivovs@calpoly.edu or Administrative Coordinator Donna Aiken at daiken@calpoly.edu.

We are grateful for all that we've carried out over the past year and are eager to celebrate the significant milestone we've reached together.

#### Lynne Slivovsky

Computer Engineering chair



# NEW DEPARTMENT HITTOR STRUCTURE Computer Engineering Chair Lynne Slivovsky details

Computer Engineering Chair Lynne Slivovsky details developments in the department after its formation last year

omentum continues to build behind computer engineering at Cal Poly as the college's newest department empowers its students while continuing to gain national attention.

Since becoming a department 18 months ago, the College of Engineering's computer program has risen to the No. 1 program among public and private institutions in U.S. News & World Report's Best College guidebook.

"We are clear leaders in the field of computer engineering and are setting an example for other colleges and universities in the areas of research, innovation, equity and inclusion," said College of Engineering Dean Amy S. Fleischer. "Our new department allows us to provide even more support for both our students and faculty as they pursue excellence."

Once under the umbrella of the Electrical Engineering and Computer Science and Sofware Engineering departments, Computer Engineering now stands on its own, with over 450 students and 20 dedicated faculty members.

Computer Engineering Chair Lynne Slivovsky sat down recently to chat about exciting developments that include curriculum modifications, goals for learning and a big event in May to celebrate the department's formation.

#### What makes computer engineering unique?

Our curriculum spans the stack from hardware to software, so our students learn

different levels of abstraction, enabling them to make connections between the various components.

In other departments, students focus more on either hardware or software, but our students take classes in both, giving them insight into circuits and electronics as well as coding.

With an education in computer engineering, our graduates can take their skills into a range of careers, from working with medical devices and autonomous vehicles to pursuing jobs in ethical computing, architecture, embedded systems and networking.

Creating a new department is rare because universities are steeped in tradition and the process of change can be slow, but the benefits outweigh the challenges since



Interim Associate Dean and Computer Engineering Professor Bridget Benson participates in a discussion with colleagues at a JEDI (Justice, Equity, Diversity and Inclusion) community lunch in late October.

we now have agency to better advocate on behalf of our students.

#### How has the change from a program to a department helped your students?

Our students have a sense that they have a place here. Not only has their identity been validated but the importance of their degree is acknowledged differently than when we were a program.

Because we are now a department, we can also take care of our students in a way we couldn't before, aiding them with their labs, senior projects and making the transfer experience the best it can be.

To better support transfers, we have removed constraints to allow students to carry over more classes and now are planning to offer an orientation class that would be geared toward them.

And for the first time, we have been able to hire our own staff and students to run and support Computer Engineering, which has proven to be another opportunity to offer more personalized care.

#### How has the curriculum evolved over the last year?

In starting a department, we gathered student input through surveys and small groups where we kept hearing about a disengagement with the circuits and electronics sequence that was taught through Electrical Engineering.

Students reported they were having challenges in seeing the link between circuits and computer engineering, so we partnered with EE faculty to design an amazing sequence for CPE students.

In talking to students now, they say they

love the circuits sequence, which is a statement you just didn't hear.

We also have two new requirements – a computer security class that focuses on privacy and ethics, and a race and culture requirement that looks at equity, interconnectedness and gender. Both of those classes are more important than ever before. In addition, we've

also made room for more

technical electives, so our students have the flexibility to explore a spectrum of courses.

Our curriculum really is innovative for CPE departments across the country; it centers students and gives them autonomy in their educational experience.

#### How are you supporting student learning as a department?

We are planning to start a tutoring center for CPE, which could be in collaboration with The Noyce School of Applied Computing, but it's a priority for us regardless.

We also are aiming to expand our mentoring program this year. We hope to pair up more senior students with members of the incoming class while broadening our view of mentoring so we can offer peer support for all CPE alumni.

Mentoring is one of the ways that as a department we can be more attentive to both students and staff, caring for them and each other.

As we work toward conversion to a semester system, our goal is to offer formal concentrations for our students, which would allow them to study more deeply and show expertise in a specific area under a structure that brings validation and verification.

#### What are your goals for CPE's physical spaces?

We are looking to refresh and redesign our labs and would love to partner with companies to make that happen.

We want to upgrade our networks lab with new security and networking devices for students, and we hope to create a new space for hardware design, where our more advanced students could work on prototyping, developing and testing.

One of our labs underwent a partial renovation four years ago, so we can take lessons we learned in that process and roll them into the improvement and creation of other labs.

We also are looking to hire a permanent lab technician for Computer Engineering.

#### How will you celebrate the milestone of becoming a department?

We are in the planning stages of a two-day event — May 19 and 20 — to commemorate the formation of our department.

On Friday, May 19, our Industrial Advisory Board will meet, and we will host a reception for donors and industry supporters. On the afternoon of Saturday, May 20, alumni, current students, industry supporters, faculty and staff will gather for a family-oriented barbecue and picnic at a local park. Then, later that night, we will host a banquet at Hotel San Luis Obispo which people can buy tickets to attend.

Follow us and look for event updates in January at <u>cpe.calpoly.edu</u>, on Instagram <u>@calpolycpe</u> and on LinkedIn at <u>Cal Poly Computer Engineering.</u>

We look forward to celebrating with all those who have come alongside us on our journey.

"We are clear leaders in the field of computer engineering and are setting an example for other colleges and universities in the areas of research, innovation, equity and inclusion."

> Amy S. Fleischer, College of Engineering dean

# BOUNCES BACK

Computer Engineering Professor John Seng's robot Herbie cruises through the halls of Building 14 during a demonstration before preschool students from the Cal Poly Children's Center in early October. Below: Herbie can be followed on Instagram @hey\_herbie.

John Seng's robot proves his mettle after fortuitous fall

hen Professor John Seng's colleagues discovered he was planning a Halloween visit between his robot Herbie and a group of preschoolers, they launched into a debate. Who would win, Herbie or the preschoolers?

Cover Story

"They all said the preschoolers would win," Seng said.

The professors' hypothesis was tested when a group of preschoolers converged on Building 14 to meet and learn about the friendly robot as a Halloween treat. They eagerly gathered behind Herbie as the autonomous robot began rolling down passageways, following him along his programmed path until the moment Seng got his answer.

In the blink of an eye, a pair of little hands shot out of the crowd in the hallway and



toppled Herbie who crashed onto his face as Seng ran to the robot's rescue.

"Herbie was doing what he was supposed to do ... but then he got pushed," said Seng, adding, "Now I need to go back and tell my colleagues they were right."

In the immediate aftermath, teachers calmed the children and regrouped for a question-and-answer session with Seng and Herbie, who was carefully carted to the gathering spot. Naturally, many of the queries revolved around the mishap.

"Herbie got an owie. Is he going to be OK?" a concerned preschooler asked.

"He's going to need a rest," Seng said, "but his lights are still on, so that's good."

"What happens if Herbie breaks?" another preschooler wondered.

"Well, I think we saw what happens," said Seng, who added that he had been planning to give Herbie front wheels for more stability but now would expedite that project.

During a visit debrief, Seng said Herbie's

fateful encounter on Halloween could end up proving fortunate.

"Learn by Doing is the ideal way to learn, and I learned a lot," said Seng, chuckling. "You have to test it with the best, and preschoolers are the best."

#### HERBIE ROLLS ON

When Seng examined Herbie after his head-on crash, he discovered the frontfacing camera that serves as the robot's eyes had been damaged.

Luckily, Seng found spare parts to replace the device, reanimating the robot.

Further reflecting on the incident, Seng said he's now planning to apply for grant funding so he and his students can build a trailer that will attach to the back of Herbie.

"The trailer will stabilize Herbie and also prevent kids from touching him," Seng said. "I'm actually glad this (incident) happened."

Herbie arrived on the scene in 2019, about 20 years after Seng built his first robot, Herbert, while an undergraduate student at Northwestern University.

With his trademark smile and googly eyes, Herbie slowly navigates the area around Building 14, avoiding hallways, walls and passersby. The autonomous robot was programmed to recognize the geography of the area so he can travel solo.

"Our department should have a robot rolling around," Seng said. "It's a visible sign of what we are up to."

Herbie also serves as a goodwill ambassador, usually carrying stickers or candy pieces in the basket that attaches to the back of his head.

Computer Engineering Chair Lynne Slivovsky said Herbie's impact on the students in her department has been immeasurable.

"Herbie has been an amazing platform for students to expand their CPE skills and expertise," she said.

#### **DEXTER LAWN: THE FINAL FRONTIER**

The first version of Herbie couldn't operate during sunny times, but the current version which was upgraded during the pandemic can run at all hours.

The makeover gave Herbie a body, arms, hands and head which also made him more top-heavy and likely contributed to his fall.



Besides adding a trailer in the back, a pair of wheels in the front could result in more stability, Seng said.

On campus, Herbie has been carted to classrooms, dorms and gathering spots, where greetings can sound like, "I follow you on Instagram, but I haven't seen you in real life yet!"

Photos from Herbie's travels are posted to his Instagram page — @hey\_herbie — which also documents his off-campus trips.

Herbie has gone to see students at Teach Elementary School and Laguna Middle School, as well as tourists at Downtown Disney and Knott's Berry Farm. He even relayed his Christmas wish for a new battery and sensors while visiting Santa at Mission Plaza one year.

Slivovsky still remembers the day she discovered Herbie was on social media. "It was definitely a memorable experience for me, learning that our robot had his own Instagram account," she said.

Seng's goal is to expand Herbie's route to Dexter Lawn, which would put him in contact with more passersby.

The move will entail training him to navigate in that space and will require the addition of flashing lights and sounds to alert pedestrians to his presence. But Seng is excited about the prospect and said Herbie still has more to discover.

"When I build a robot, the point is not what it can do but for the response it evokes," Seng said. "People think that it's cool, which leads them to think of other opportunities for invention."

# THE LON OF CONTROL OF

#### al Poly engineering alumnus Brian Starnes credits a robot with changing the course of his life.

In his final year studying computer engineering, Starnes registered for robotics classes after witnessing the fervor of Roborodentia – an annual robotics competition that pits autonomous machines against each other as they race to complete unique challenges.

"Something really clicked with me," said Starnes who was inspired by the creativity, skill and passion he observed.

Starnes decided to construct his own robot for the 2005 contest which proved so rewarding that he shifted his focus from the field of web design to one that would involve both hardware and software.

"Making something tangible that I could automate was not only fun but eye-opening when I realized it was something I could do as a job," he said.

The problem was Starnes didn't know how he'd find employment after early academic challenges led to a 2.8 GPA.

"Most recruiters would have thrown out my resume," he said.

With graduation looming, however, Starnes took a chance and visited a career fair at Chu-



D. Fassio, the robot that helped land Cal Poly alumnus Brian Starnes his job at General Atomics, is under construction in 2005. The robot now sits in his office.

mash Auditorium with his Roborodentia robot in hand, having just left Professor John Seng's robotics class.

A recruiter with General Atomics – a leading manufacturer of unmanned aircraft based in San Diego – spotted Starnes and beckoned him to his table.

"'You have a robot. You could probably code," said Starnes, recounting the recruiter's words to him.

Starnes explained that his robot was programmed to follow a line, so the recruiter grabbed a piece of butcher paper, covered his table and drew a long, crooked line with a black Sharpie pen.

"He said, 'If your robot can follow this line, I will get you an interview," Starnes said.

The recruiter made good on his promise, and the next day Starnes landed an interview to become one of the company's software engineers.

#### **'A REAL HIGHLIGHT'**

The roots of Roborodentia were planted in the late 1980s, when students organized robot demonstrations during Poly Royal, the precursor to Open House.

Those exhibitions evolved into competitions, with the inaugural Roborodentia held in 1996.

In the early days, autonomous robots would have to navigate a maze while searching for three randomly placed balls, collect them and then deposit them into a "nest" at the end of the maze. The robot with the most points would win a cash prize, according to Professor Joe Grimes, who served as the contest's adviser for 10 years.

Initially, the event drew around seven students, then 20, then upwards of 15 to 20 teams, according to Grimes. Participants included



Cal Poly students, industry members, alumni and teams from other universities, including one in South America.

"The contest became more and more popular," Grimes said. "And it created tremendous excitement."

Spectators began overflowing out of the competition's view area in the lobby of Building 20A, so Roborodentia moved to a side room off Chumash Auditorium.

But that room also filled beyond capacity, flagging fire marshals to clear out the crowd, so the event alternated between Crandall Gym and the Recreation Center, where it has drawn upwards of 1,000 spectators.

"A lot of people have participated over the years and it's a real highlight for them," said Computer Engineering Department Chair Lynne Slivovsky.

Grimes believes Roborodentia was a capstone project for so many students because their investment went well beyond time spent.

"They put so much of their life into their robots," said Grimes, who each year was wowed by the ingenuity and problem-solving skills he witnessed.

After graduating, many Roborodentia participants said competing or managing logistics of the student-run contest shaped their careers.

Including Starnes.

The Roborodentia robot he once took to the fortuitous career fair now sits in his office at General Atomics Aeronautical Systems in San Diego, where he designs "robots on a larger scale that fly around the sky."

Starnes works a few doors down from fellow Cal Poly grad Adam Grenier, who incidentally partnered with Starnes in 2005 to build the robot.

Starnes recalled how the pair printed circuit boards and reused a piece of sheet metal stamped with "D. Fassio" – likely In 2011, Roborodentia competitors battled for the championship in Cal Poly's Mott Gym.

the name of the student who had tossed the metal into the trash after a project blunder - to construct the robot who became

known as D. Fassio.

D. Fassio took third after navigating the maze and collecting golf balls, losing to a team from the University of Colombia whose South American students had spent three years perfecting the machine.

Seng, who succeeded Grimes as the faculty adviser for Roborodentia in 2004, remembers D. Fassio well.

So well that fourteen years after watching D. Fassio navigate the maze, Seng spied him while on a visit to General Atomics, a company that has hired countless Cal Poly graduates.

Seng chuckled about recognizing the ro-

bot in Starnes' office as he recalled other robots from the past, programmed to collect balls, or in later years, stack rings and colored cat food cans.

A student committee with Seng's guidance have designed various tasks over the years, ensuring teams don't repeat with the same robot.

While the committee planned the 2011 challenge – shooting Ping-Pong balls into a small, soccer-

style goal – Starnes and three of his General Atomics co-workers in San Diego joked about returning to compete.

But joking soon turned to planning as Starnes, Nick Hebner, Patrick McCarty and Antonio Hernandez found themselves brainstorming battle-ready robots.

This time instead of scrap metal, Starnes used high-tech materials and tools to help his team construct a robot that would separate into three machines on the competition floor to score maximum points.

"We made it way cooler," Starnes said. They named their robot Ball Reaper after their company's MQ-9 Reaper — the primary offensive strike unmanned aerial vehicle for the U.S. Air Force – and just like its namesake, Ball Reaper carried out a successful strike at Roborodentia, earning the grads a first-place win.

#### 'DON'T GIVE UP'

Coming full circle, Starnes now recruits for General Atomics, reaching out to students with an interest in robotics just like him.

"I have hired a bunch of kids who have competed at Roborodentia," Starnes said. "They are some of our top engineers."

Cal Poly ranks in the top two or three schools from which the company recruits because of its Learn by Doing education, he added.

"The Cal Poly grads hit the ground running; they have not only learned theory but have applied it," Starnes said. "There is so



Cal Poly alumni, from left, Patrick McCarty, Antonio Hernandez, Brian Starnes and Nick Hebner, returned in 2011 to compete at Roborodentia. They worked together at General Atomics at the time.

much to be learned while trying and you don't get that unless you do projects and apply the theory."

As a recruiter, Starnes has attended many career fairs at Cal Poly, where he shares his story of perseverance to inspire the future engineers.

"I tell them not to give up," he said. "I didn't have the greatest GPA but sometimes it's more about showing what you can do."



College of Engineering Computer Engineering Program 1 Grand Avenue San Luis Obispo, CA 93407-0350

#### **SAVE THE DATE** Join us for our CPE Department Celebration San Luis Obispo, CA • May 19-20, 2023



Cal Poly Computer Engineering Department faculty and staff gather for a meeting out on the Cal Poly Research Pier in September.

# EMPOWER THE FUTURE MAKE A GIFT TO SUPPORT COMPUTER ENGINEERING LABS, PROJECTS AND CLUBS

<u>CLICK HERE</u> to donate now. For more information, please contact Amy Blosser Spikes, assistant dean of advancement, at spikes@calpoly.edu or (805) 756-2163