

Talk #141, 3/6/24

141st meeting of The Lyncean Group of San Diego

Date: Wednesday, 6 March 2024

Location: Southwestern Yacht Club
2702 Qualtrough Street, San Diego, CA 92106 (Point Loma)

Speaker: Dr. Ryan Kastner, Professor, Computer Science & Engineering, Jacobs School of Engineering, University of California, San Diego (UCSD)



Source: Ryan Kastner

Topic: Creating a Digital Twin of the El Zotz Mayan Archaeological Site

Speaker bio: Dr. Kastner is a professor in the Department of Computer Science and Engineering in the Jacobs School of Engineering at the University of California, San Diego (UCSD).

He received Bachelor's degrees (BS) in both Electrical Engineering and Computer Engineering in 1999, followed by a Master's degree in

engineering in 2000 from Northwestern University. He received a PhD in Computer Science in 2002 at UCLA.

He spent the first five years after his PhD as a professor in the Department of Electrical and Computer Engineering at the University of California, Santa Barbara.

At UCSD, Professor Kastner leads the Kastner Research Group (<http://kastner.ucsd.edu>) whose current interests largely fall into three areas: hardware acceleration, hardware security, and remote sensing. He is a co-director of the UCSD Engineers for Exploration (E4E) Program, which pairs undergraduates in research experiences with domain scientists in archaeology, conservation, and cultural heritage. He also is a co-director of the Wireless Embedded Systems Graduate Program, which is a specialized Master's degree targeting individuals working in local industries.

Dr. Kastner has published over 200 technical articles and has authored four books.

Abstract: The El Zotz Archaeological Project aimed to understand how an ancient dynasty established itself as a seat of power within close proximity to the Tikal and other ancient Maya city-states. Archaeologists explored that site for over a decade, focusing on two of the largest temples, including El Diablo, the home of one of the Top Archaeological Discoveries from National Geographic in 2010.

To uncover the past, Maya archaeologists carefully tunneled into the El Diablo temples, slowly and meticulously uncovering evidence of its use and purpose as they laboriously pick-axed through the dense jungle that has long overgrown these structures and then eventually into centuries-old limestone structures, built by the Maya over decades. As the archaeologists tunnel further, they uncovered past mysteries — masks, paintings, sacrifice sites, royal tombs, and other aspects of the temple. The tunnel systems have grown over the years, fueled by archeological hypotheses about the purpose of the structure with the hopes of finding the next major clue that will unlock the history and mysteries of the temple and the site. The excavations resulted in hundreds of meters of complex tunnels — full of bats, snakes, rats, and spiders – alongside the ancient artifacts.

To document these archeological finds, UCSD Engineers for Exploration undertook in a multiyear effort to create a digital twin of the site. The end goal was a large-scale 3D model of the site, its tunnels, and its artifacts. We used cutting-edge technologies, including lidar, stereo cameras, and drones. The drones captured the site at a large scale, while lidar and 3D cameras were painstakingly used to digitally recreate the tunnels and their artifacts at millimeter-scale resolutions.

The talk will describe these efforts, provide some intuition into the technologies, and demonstrate the 3D models that allow the world to see this important Maya site without enduring a day-long trek into the jungle on muddy, dirt roads that take hours to go kilometers. Since the site is no longer actively maintained and often looted, these tunnels have been backfilled, hiding all of these discoveries again. Thus, these 3D models provide the best way for present and future archaeologists to study and understand this ancient city.



Inside El Zotz. Source: Ryan Kastner

Meeting photos:



Dr. Kastner describes the detail available in a color 3-D model created using photogrammetry. Off-site processing was required.



Lidar is another key tool for building a high-resolution (mm-scale) 3-D model, even in the confined spaces of the Mayan tunnels. Off-site processing was required.



Simultaneous Location and Mapping (SLAM) is a less accurate tool than photogrammetry and lidar, but provides real-time results for the onsite team



Dr. Kastner also discussed several of the activities of his UCSD Engineers For Exploration organization. Find more information on E4E here: <https://e4e.ucsd.edu>

You can view Dr. Kastner's presentation slides [here](#).



Pete Lobner presents Dr. Kastner with a Lyncean coin.



Pete Lobner's meeting slides are available for download [here](#).

Dr. Kastner provided Lyncean members with an opportunity to view the El Zotz digital twin using a Oculus VR headset, which gave a realistic impression of being in confined tunnels with irregular walls and ceilings. Outcroppings that could have provided useful support in the real tunnels were not actually there in the VR tunnels. It was a bit disorienting, but at least there were no spiders, snakes or bats. You can view a short video of Pete Lobner visiting the VR El Zotz [here](#).