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The Bulletin

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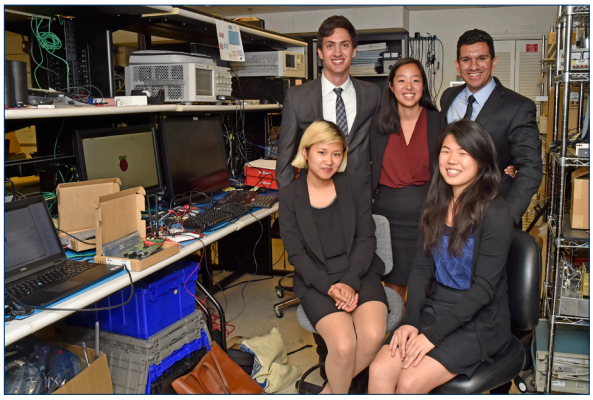
AIR, MISSILE, AND MARITIME DEFENSE TECHNOLOGY

Harvey Mudd College Students Build Model for Testing Synchronization of Wireless Networks



Harvey Mudd College students Max Waugaman, Jessica Iwamoto, Jonathan Perez, Joanna Ho, and Bonny Chen

Students from Harvey Mudd College (HMC) visited Lincoln Laboratory on 4 May to present their conclusions from a yearlong clinic. The clinic program at HMC offers students the chance to pursue a project proposed and funded by industry sponsors. Working with staff from Advanced Concepts and Technologies, Group 39, the group of five students set out to create a way to model and test synchronization of wireless systems, which require aligning the time of digital clocks down to the nanosecond level.

"I'm still in awe that this was done by undergraduate juniors and seniors," said Dr. Stephen J. Uftring, Group Leader, Group 39, at the conclusion of the students' briefing. The final presentation signified a successful collaboration both on the students' and staff's part. The students worked mainly on the project from the HMC campus in southern California, keeping in touch weekly with staff through teleconferences. A brief visit in November helped the students gain context and motivation for the project, and also was a welcome back for the student team lead, Maxwell Waugaman, who interned last summer with Group 39.

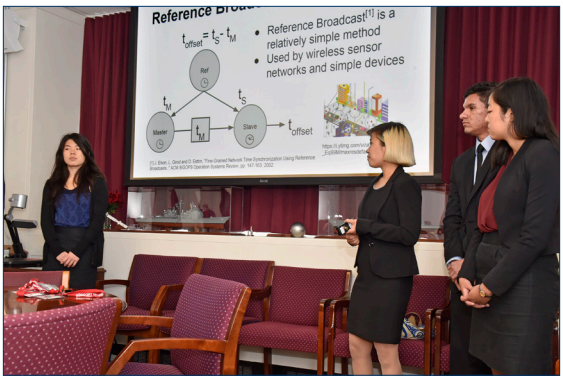
"Personally, the clinic program was hugely impactful on my education when I was a student," said Sarah J. Lichtman, Group 39, reflecting on her own experience as an HMC student. Lichtman, along with fellow HMC alumni Masato E. Kocberber and Bryan A. Teague, Group 39, organized the Laboratory-funded clinic. "As the number of Harvey Mudd alumni at the Laboratory grew, the idea for a Lincoln-funded project gained momentum," said Teague. "All the planets aligned this year, and we were able to pull it off."

Teague developed the project statement last summer, focusing on a common problem faced by systems requiring precise clock alignment. Timing synchronization—the process of aligning the time of digital clocks that are separated in space—is important in a wide range of applications, including communication networks, radar systems, and wireless sensor networks. In each of these applications, the coordination architectures often require different hardware, have different limitations, and can achieve different levels of performance in synchronization accuracy.

The HMC team presented both a software model and hardware testbed that can be used to test the various timing synchronization methods. During the fall semester, staff mentored the team as they produced a software model to compare synchronization architectures, algorithms, and hardware in terms of their synchronization accuracy. To verify their model, the students were also tasked with selecting a time synchronization system to implement. This implemented system would be measured by a testbed, and have results to compare with their model.

"Comparing modeling results with experimental data is always a fascinating problem, and in this project we had a great opportunity to build a model and validate it with a physical experiment," said Waugaman, who earned his B.S. in Engineering from HMC just last week. After creating the software model for synchronization architectures, the students set up several software-defined radios on a field, and collected data to reflect the modeling effort. "We were able to see how environmental factors, like temperature, impacted our results," he said.

Their recent visit, on top of presenting, gave the students the chance to show Laboratory staff how to use the software model and hardware testbed they built. "I really valued the opportunity to visit the Laboratory and present our project," said Jessica Iwanamoto, who also accepted her B.S. in Engineering at HMC's recent graduation. "It was great to share our work with people who may actually be using it in the future." The tool created by the students can aid in a number of programs, said Kocberber. For example, one data collection radar that Group 39 uses requires synchronization pulses between the transmit and receive sections to align the data that gets recorded. "The students' synchronization circuit would allow the transmitter and receiver to be located significantly further from each other than is currently possible, and still maintain some synchronization," Kocberber said.



The students presented a software model that can used to test methods for timing synchronization of wireless systems.

The staff organizers are looking ahead into hiring another clinic team for a project of a similar scope, but with a new topic next year. HMC has clinic teams in engineering, computer science, and physics, and Teague encourages groups interested in proposing a clinic to pursue it. “The team engaged in a challenging project throughout which they showed maturity in their mathematical modeling, as well as creativity and resolve in forging their design into a reality,” Teague said. “Their presentation was polished, thorough, and showed off the hard work they put in all year.”