Hawaiʻi Natural Energy Institute Research Highlights

Energy Efficiency & Transportation

Adaptive Lighting and Energy Efficient Security Strategy

OBJECTIVE AND SIGNIFICANCE: The objective of this project is to develop and test an adaptive lighting system, based on novel Light Detection and Ranging (LIDAR) sensor, that has the potential to significantly enhance security and dramatically reduce energy use and maintenance costs in high-security Naval installations.

BACKGROUND: The adaptive lighting project is a collaboration between HNEI, the California Lighting and Technology Center (CLTC) at University of California, Davis, and the Navy Facilities Engineering Command (NAVFAC) Hawaiʻi. Adaptive Lighting is the term describing a wide range of lighting solutions that adjust to changing environmental conditions, indoor or out. Adaptive lighting intensity can rise and fall with ambient light and occupancy while color rendering index and temperature can be adjusted to conditions defined by the end-use criteria.

In order to provide proof-of-concept and gain wider acceptance, this demonstration project will study the design, deployment, and impact of a unique wireless networked adaptive lighting solution for exterior lighting. Traditional security lighting, with long hours of uniformity, wastes energy unnecessarily and may reduce the security effectiveness in some applications. Sensor-based dynamic lighting adds conspicuous visual cues to enhance security effectiveness. Adaptive lighting can save from 50-70% of exterior lighting energy and has the potential to become an effective security measure as well.

PROJECT STATUS/RESULTS: In this research project, an adaptive lighting strategy is being piloted with exterior lighting fixtures on four Oʻahu buildings – two NAVFAC buildings located on the Joint Base Pearl Harbor Hickam and two stand-alone classrooms at the University of Hawaiʻi at Mānoa (UHM). The exterior lighting levels will be variable, operating at full intensity when there is activity detected near the structures at night. With no motion detected, the fixtures will dim down to 30%, providing enough light for security purposes. LIDAR sensors send out laser signals that when reflected back trigger an action, specifically a signal to ramp the fixtures up to 100%. Sensors are positioned on these buildings to create a 360 degree horizontal detection zone, sensitive to any motion that crosses the beam's path.

The second significant goal of this project is to test a wireless networking system that will synchronize the ramping up of all the fixtures simultaneously. When one sensor is triggered, all of the fixtures connected to the network will activate simultaneously. Not only does this prevent a visually annoying checkerboard effect with fixtures triggering at different times, but site security is improved with the visual "announcement" made when motion is detected and the lights ramp immediately up from dim to 100%.

Figure 1. UH Mānoa FROGs with LIDAR sensor (left) and exterior lighting fixtures (right).

The sensors and monitoring equipment collected data between January and July 2020. The project was originally contracted from January 2019 to June 2020, however, delays due to the coronavirus resulted in a no-cost extension to June 2021. The analyses of the data resulting from this work is available at in the project report: "**Adaptive Sensor-Based Lighting for Security Applications: Exploring Emerging Design Strategies**."

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