FROM THE LAB

Current Research at Cooper

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Energy, Environment & Fuel

Optimizing Cogeneration Heat Recovery

Soyoung Moon ME'17, Joe Viola ME'16, Jon Rodriguez MME'14
ADVISOR: PROFESSOR MELODY BAGLIONE

Abstract: Cogeneration or combined heat and power (CHP) is the use of a heat engine to simultaneously generate electricity and useful heat. Power plants produce electricity but reject waste heat to the atmosphere and have grid losses. By using on-site cogeneration instead of buying electricity from the utility, efficiency is increased from around 40 percent to 80 percent. The 250 kW and 150 kW cogeneration plants at 41 Cooper Square and the Foundation Building save Cooper Union around $130,000 annually. By analyzing sensor data and developing analysis tools, students have identified that increasing heat recovery and uptime has the potential to save an additional $200,000 annually. The goal is to work with facilities and vendors to implement changes and optimize the cogeneration systems.

Laboratory Ventilation Energy Conservation Measures

Tony Zhao ME'17, John Han MME'16
ADVISOR: PROFESSOR MELODY BAGLIONE

Abstract: Laboratory ventilation systems in academic research buildings are a significant source of energy consumption. Laboratories require extra ventilation compared to classrooms and offices to maintain a safe environment. This project analyzes the laboratory ventilation system of 41 Cooper Square and investigates opportunities for reducing energy use and costs. A study of the overall laboratory ventilation system is done to identify laboratories that are being over ventilated. Savings can come from reducing the amount of airflow while satisfying building codes and optimizing exhaust fan operation.

Building Energy Analytics

Zhengqi Xi ME'17, Alex Bush ME'16, Eric Leong ME'14, Greg Tayco ME'14

ADVISOR: PROFESSOR MELODY BAGLIONE

Buildings consume about 40 percent of total U.S. energy usage. Modern buildings utilize building management systems to control and monitor mechanical and electrical equipment, such as ventilation, lighting, and heating and cooling systems. Over time these systems do not always work as intended due to unforeseen factors such as human intervention and maintenance-related issues. The goal of this project is to design a system at 41 Cooper Square that gathers building data, such as occupancy, hourly energy consumption, and lighting usage for comparison against an energy model to highlight opportunities for saving energy.

The Live-In Living Laboratory

EID101A 2016 (+ many alumni)

ADVISOR: PROFESSOR T. J. CUMBERBATCH

A group of artists, architects and engineers is taking the first steps towards the design and construction of a series of live-in, living laboratories comprising integrated, naturally-driven, locally-resourced, closed-loop, human support systems. Ultimately spanning all five continents, these aesthetic, state-of-the-art habitats provide conduits to link those who live off the land with those in conurbations. From this reciprocal learning, a design philosophy for robust habitats and lifestyles, founded upon the principle of doing more with less, will emerge.

RAMESSES

EID101A 2011, 2014 (+ many alumni)

ADVISOR: PROFESSOR T. J. CUMBERBATCH

In 2011, wanting to do something about the appalling conditions endured by the endless streams of refugees across sub-Saharan Africa, we set out to design a biodegradable shelter kit that could be locally sourced in large quantities on short notice and be self-built by those on the move.

RAMESSES (Reuse of Available Materials, Energy, Supplies and Structures for Emergency Shelter) emerged from a series of first-year, first-semester engineering design classes—EID101A. Working with Malian refugees, we built two RAMESESS in the UNHCR Mentao Camp (on the Burkina Faso/Mali border) in July 2014. Work continues.

SociaLite

Jiaqi Shen (+ many alumni)

ADVISOR: PROFESSOR T. J. CUMBERBATCH

SociaLite started life in fall 2006 at The Cooper Union in EID101, a first year engineering class whose challenge was to design a lighting system for the poorest of the poor. The current design draws much from those roots. The first prototype system was installed in 2007 in Nambeg, Ghana; the most recent in Kamiakorfe, Ghana in July 2016.

In the intervening years, over 80 students from The Cooper Union have worked with others to develop a lighting system that can be assembled under a mango tree by end users, many of whom have never seen a flashlight.

Design Strategies for Improved Fuel Economy and Performance in Automobiles

Formula SAE Members
ADVISOR: PROFESSOR GEORGE DELAGRAMMATIKAS
This extensive tour of the Automotive Laboratory highlights the breadth and depth of automotive-based engineering projects that parallel the dominant industry trends toward improved fuel efficiency and performance. Among the projects that will be discussed include: 1) the use of custom-fabricated, lightweight composite materials; 2) advanced combustion techniques for reduced emissions; 3) dynamic, vehicle-level simulation; 4) real-time, wireless, on-board data acquisition systems; 5) numerical and experimental aerodynamics studies; 6) material testing for enhanced crash safety; 7) engine-boosting technologies; 8) progress toward an in-house chassis dynamometer; and 9) an electric racecar powertrain.

Useable Electricity from Waste Heat

Independent Study and Iceland Study Abroad students
ADVISORS: PROFESSOR ROBERT DELL, PROFESSOR C. S. WEI, WILLIAM FOLEY
The Cooper Union's Center for Innovation and Applied Technology (CIAT) has deployed its thermally-enhanced open field heating agricultural system using waste steam in New York City and waste geothermal hot water in Iceland. Plant growth is enhanced by up to 30 percent and out-of-region cultivars are able to grow outside in climates that are normally too cold. Our students have grown banana plants in the Icelandic summer and produced a small cotton harvest on the roof of the Foundation Building while reducing thermal pollution. The Center has published numerous International award-winning conference papers about this ongoing research.

Alex Livermore MME'17, Iceland Study Abroad students
ADVISORS: PROFESSOR ROBERT DELL, PROFESSOR C. S. WEI, NICHOLAS MITCHELL
The Center for Innovation and Applied Technology (CIAT) at The Cooper Union is continuing to develop new uses for its thermoelectric-based point-of-use generator with no moving parts that produces more than 6W of steady state power when attached to the outside of a steam pipe. The system has powered LED lights, a web-interfaced video surveillance system and mobile monitoring robots. NASA has filed a notice of interest in this invention because it appears to "have significant utility in the conduct of aeronautical and space activities." The generator has just been awarded its sixth patent.

Low Temperature Actuators

Mamdouh Eldaly
ADVISORS: PROFESSOR ROBERT DELL, PROFESSOR C. S. WEI
Self-regulating control systems for waste heat and low temperature fluids often demand an additional power source, thereby needlessly increasing system complexity while reducing reliability. Cooper's Center for Innovation and Applied Technology (CIAT) has developed a number of innovative and patented answers to this problem using the available waste energy.

Algae Growth Enhancement in High Rate Algal Ponds Using Embedded LEDs

Russell Sternlicht, J.D. Bonnet, Kevin Kim, et al.
ADVISOR: PROFESSOR CONSTANTINE YAPIJAKIS
A comparative study is being conducted (vs. a pilot tank) with various arrangements of LED strips in tanks on a continuous basis, not limited by a light/dark cycle, to study algal growth enhancement in a factory-type setup. The algae harvested are a best source of lipids for the production of biodiesel. So far, results are promising.

Enhanced Photo-oxidation Using Fresnel Lenses and Metals for Detoxification of Wastewater

J.D. Bonnet, Nicole Yapijakis, Trenton Marquette, et al.
ADVISOR: PROFESSOR CONSTANTINE YAPIJAKIS
Inexpensive Fresnel lenses are being used to concentrate sunlight on various metal strips (coated with mat black paint for enhanced light absorption) in wastewater samples to enhance photo-oxidation of toxic organics for detoxification, and raise the wastewater temperature to levels that will kill pathogenic bacteria. Evaporated water from the samples can be collected as a source of fresh water, while the residual is safe for disposal. The various metals are compared for their efficiency in the process.

Tests are being conducted in the new plaza in Cooper Square Park.