School of Engineering Seminar

SAN FRANCISCO STATE UNIVERSITY

Speaker:

Dr. Alanna Cooney

PhD, Mechanical Engineering, UC Berkeley

Date:

Friday
Feb. 24, 2023
3:30-4:20 PM

Location:

Hensill Hall (HH) 803

Multi-Temperature, Multi-Module Latent Thermal Storage Ensembles with Artificial Neural Network Control

Abstract: Latent thermal energy storage (TES) systems which store energy in a phase change material (PCM) can be used to alleviate disparities in renewable energy supply and demand for applications such as concentrated solar plants and building heating and cooling systems. Performance of latent TES can be enhanced by using multiple PCMs arranged in a cascaded configuration to improve storage utilization, increase energy and exergy efficiencies, and increase rates for charging and discharging. However, because the efficiency benefits of cascaded systems currently rely on precise optimization of design parameters, there is motivation to develop technologies which can provide greater flexibility for such systems to be implemented in real world applications with dynamic and potentially unpredictable operating conditions. In this study, a new type of multiple PCM system is proposed called a multi-temperature, multi-module (MTMM) thermal energy storage ensemble which consists of multiple TES modules containing PCMs with different melt temperatures combined in series and parallel configurations. This study also demonstrates the feasibility of using an Artificial Neural Network (ANN) to dynamically select the flow path which optimizes for both operational reliability by meeting a desired outlet temperature from the ensemble and TES efficiency by minimizing the rate of exergy destruction. The results demonstrate that the MTMM ensemble with ANN controller achieves the exergy efficiency of a cascaded PCM system while also maintaining the flexibility needed to respond to dynamically changing operating conditions. This novel approach widens the potential applications of cascaded PCM by providing a means to standardize manufacturing to drive down system cost and adding flexibility for the system to adapt to dynamic operating conditions and unforeseen design parameters.

***Speaker Bio*:** Dr. Alanna Cooney is a recent PhD graduate from the University of California, Berkeley. She previously received her MS from Marquette University in 2018 and BS from Washington University in St. Louis in 2012. From 2012 to 2016, Dr. Cooney worked as a mechanical engineer designing HVAC systems for data centers, electronic trading firms, and financial institutions. She received a Certificate of Teaching and Learning in Higher Education at UC Berkeley and has taught courses on Thermodynamics and Experimentation and Measurements. Her research interests include thermal energy storage, phase change heat transfer, machine learning, exergy analyses, and HVAC electrification and decarbonization. She has received multiple awards including the Art Rosenfeld Award for Energy Efficiency, an ARCS Foundation Fellowship, and the Outstanding Graduate Student Instructor Award.

For more information, please contact Dr. Ed Cheng, ascheng@sfsu.edu