THE HAWKINS LECTURE

VAN P. CAREY

THURSDAY, SEPTEMBER 19

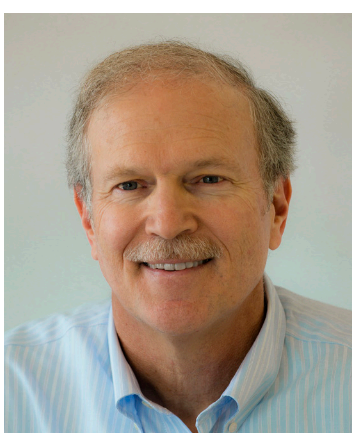
2:30PM-3:30PM
MRGN 121

This lecture will provide an overview of features and application strategies of AI and Machine learning that can enhance research and development of energy conversion and heat transfer technologies. The discussion will describe the spectrum of energy and heat transfer research topics and applications in which these tools have been used in innovative ways. The broad eGects of AI and machine learning on energy and heat transfer technology research will be discussed, including how they are driving evolutionary technology changes, and how they are changing the nature of engineering professional practice. The lecture will also describe more deeply some of the speaker's work on use of machine learning tools to enhance heat transfer and energy conversion research. These will include use of genetic algorithms to enhance research on boiling heat transfer in aqueous mixtures under reduced gravity, and predicting performance of thermionic energy conversion, and use of neural network models for predicting flame speed for burning of the insulation layer covering wires in electrical systems, and creation of adaptive thermal energy storage designs. Use of a specialized convolution neural network for analysis of combined digital data and images from boiling experiments will also be presented.

FRIDAY, SEPTEMBER 20

10:30PM-11:30PM
POTR 234

This lecture will discuss research exploring nanoscale thermophysics of vaporization at heated surfaces where machine learning tools have been used to enhance definition of parametric trends in data, and develop models to predict heat transfer performance. The first research area explored Marangoni eHects in boiling of surfactant/aqueous mixtures near heated metal surfaces under variable gravity conditions. Although mechanism interactions in this system can be complex, results of our recent studies demonstrate that training a physics-inspired machine learning model with experimental data can illuminate parametric trends and provide an accurate heat transfer performance model. This lecture will also describe the use of machine learning to enhance research into nucleation and bubble growth features of vaporization and boiling at heated nanostructured surfaces that exhibit enhanced wetting and wicking. This led us to explore a specialized convolution neural network model that can be trained to predict two-phase morphology, boiling regime, and heat transfer performance from a combination of digital operating condition measurements and one or more high speed video images of the process. . The lecture will conclude with a discussion of how our experiences using machine learning tools to enhance our research may evolve and how they could be extrapolated to other types of heat transfer processes.



Prof. Van P. Carey, a Distinguished Professor in the Mechanical Engineering Department, holds the A. Richard Newton Chair in Engineering at the University of California at Berkeley. Carey's research has included fundamentals studies in the areas of micro- and nanoscale thermophysics, interfacial phenomena, and transport in liquid-vapor phase-change processes. His research interests also include development of new methods for computa1onal modeling and simula1on of energy conversion and transport processes in applica1ons such as industrial waste heat recovery, building and vehicle air condi1oning, high heat flux cooling of electronics, energy efficiency of informa1on processing systems, and microgravity boiling in spacecraft thermal management. His recent research has focused on the physics of water vaporization processes on surfaces with nanoporous coatings, adaptive thermal energy storage, and use of machine learning tools in phase change heat transfer research. Carey is a Fellow of the American Society of Mechanical Engineers (ASME) and the American Association for the Advancement of Science, and he is a former Chair of the Heat Transfer Division of ASME. Carey has received the ASME James Harry Potter Gold Medal in 2004 for eminent achievement in thermodynamics, and the Heat Transfer Memorial Award in the Science category (2007) from ASME. Carey is also a three-time recipient of the Hewlett Packard Research Innovation Award for his research on electronics thermal management and energy efficiency (2008, 2009, and 2010), and Carey received the 2014 Thermophysics Award from the American Ins1tute of Aeronautics and Astronautics.

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