Towards More Sustainable and Energy Efficient Thermal Systems: Research on Waste Heat Recovery (WHR) and HVAC&R Equipment

Abstract:
Energy demand, finite fossil fuel resources, and environmental concerns are among the main drivers of the fast growing research on high efficiency and sustainable technologies for power generation, heating, cooling, and refrigeration in residential, commercial, industrial, and transport applications. At least three major aspects need to be tackled to partially address the aforementioned issues: improve the efficiency of existing technologies, increase the utilization of waste energy, and develop “smarter” systems. In this seminar, we will discuss the research I have conducted on the first two aspects as a means of enabling the design and implementation of the next generation of heat pumping and distributed power generation technologies. In particular, positive displacement machines are critical components in today’s vapor compression refrigeration, air conditioning, and heat pumping applications, and are also widely employed as expanders in Organic Rankine Cycles (ORC) for waste heat recovery. The simulation of such components is essential for predicting and optimizing system performance behavior at full- and part-load conditions as well as for evaluating new concepts and working fluids in response to global warming. It will be shown how advanced manufacturing techniques (e.g., 3D printing) and Computational Fluid Dynamics (CFD) can be used to advance existing technologies. Furthermore, by employing data-driven modeling approaches, accurate performance predictions can be achieved with possible application to predictive diagnostics of connected smart systems with self-fault identification capabilities. Finally, an outlook on the impact of this research on advancements in heat pumping technologies and their integration into high performance buildings as well as new educational possibilities will be proposed.

Bio:
Dr. Davide Ziviani is a Post-Doc Research Associate of the Center for High Performance Buildings (CHPB) at the Ray W. Herrick Laboratories working with Prof. Eckhard A. Groll and Prof. James E. Braun. He has extensive expertise in the modeling and testing of thermal systems and their components, including positive displacement compressors and expanders, organic Rankine cycles for waste heat recovery, as well as advanced vapor compression cycles for residential and commercial applications. He is one of the organizers of Compressor Short Course during the 2018 Purdue Conferences, and also serves as the Compressor Engineering Conference Co-Chair. Dr. Ziviani received his Doctoral degree in Electromechanical Engineering from the University of Ghent in Belgium and Master’s and Bachelor’s degrees in Mechanical Engineering from the University of Ferrara in Italy. He started his research career at San Diego State University working on Organic Rankine Cycles (ORC) for waste heat recovery. He is member of the editorial committee of the Knowledge Center on Organic Rankine Cycle (KCORC) technology.