UCMERCED UNIVERSITY OF CALIFORNIA Graduate MECHANICAL ENGINEERING

Fall 2021 Graduate Seminar

Human-centered design of a clean, natural draft, cookstove for East Africa

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Zoom link: https://ucmerced.zoom.us/j/83398703496

Abstract

Nearly three billion people, primarily in low and middle income countries, rely on biomass (wood, charcoal, shrubs, etc.) as their primary source for heating and cooking. Cooking with traditional stoves emits large quantities of harmful air pollution, including fine particulate matter, that results in significant cardiovascular and respiratory disease which is estimated to cause five million deaths and 147 million years of life lost per year. Biomass combustion in stoves also negatively contributes to climate change as it generates an estimated 25% of the worldwide black carbon (BC) emissions and is a leading cause of deforestation. Cleaner burning cookstoves are needed to replace open fires and inefficient stoves to improve indoor air quality, personal health, livelihoods, and the environment. One of the most ubiquitous improved cooking solutions for biomass fuels is the natural-draft 'rocket' stove which consists of a simple side-feed combustion chamber and short vertical insulated riser upon which a cooking pot sits. Natural-draft rocket stoves are an attractive improved cooking solution due their robust design, relatively low cost, and minimal alterations to the cooking experience when replacing a traditional cooking. Currently available rocket stoves do not meet the goals for thermodynamic efficiency or particulate emissions that are required to substantially improve users' health or curb environmental impact. At this seminar, I will present our work on developing a commercially viable, natural draft cookstove that exceeds ISO performance goals while meeting the needs of rural and urban cooks in East Africa. The cookstove was developed to meet the manufacturing cost and usability expectations of the final users, including: durability, safety, comfort, aspirational value and compatibility with local fuels, foods, and customs. We employed an integrated and multidisciplinary design approach that included field-based user research and focus groups, empirically verified computational fluid dynamics and heat transfer modeling, lab and field-based emission and efficiency measurements, design for manufacturability, as well as in-home user product evaluations. Our improved cookstove, the Kuniokoa, is manufactured in Kenya by Burn Manufacturing Company. The Kuniokoa is the most efficient mass produced cookstove sold and has been placed in more than a quarter of a million homes.

Biography

Jonathan D. Posner is the Richard and Victoria Harrington Professor for Engineering Innovation in Health in Mechanical Engineering, Chemical Engineering, and Family Medicine (adjunct) at University of Washington. He is a founder and the Director of UW's Engineering Innovation in Health program that focuses on developing technical solutions to pressing challenges in health and healthcare. His research group works on a diverse set of need-driven research projects including medical devices, point-of-care in-vitro diagnostics, and improved cookstoves for the developing world. He has founded two companies: VICIS focused on a football helmet that reduces the risk of concussion, and Phoresa focused on point-of-care diagnostics. He was UW Medicine's Inventor of the Year in 2016 and was awarded a NSF career award in 2008.

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