Environmental Engineering & Sciences

Department of Civil and Environmental Engineering

CEE 595EWS Seminar

Monday, April 22, 2024 | 12:00 – 12:50 p.m. CST | 1310 Yeh Center

Charting Development Pathways for Precision Fermentation Through Agile System Analyses

To address climate change by mitigating greenhouse gas emissions, there is a pressing need to develop technologies that can facilitate replacing crude oil with alternative, renewable feedstocks to manufacture fuels and chemicals. Precision fermentation has emerged as promising for the sustainable manufacturing of biofuels and bioproducts. Developments in metabolic engineering of microbial candidates have enabled the biological production of commercially significant chemicals including succinic acid (e.g., by Issatchenkia orientalis), 3-hydroxypropionic acid (3-HP; e.g., by Corynebacterium glutamicum), and triacetic acid lactone (TAL; e.g., by Yarrowia lipolytica), among others. We leveraged BioSTEAM—an open-source platform—to design, simulate, and evaluate under uncertainty (via techno-economic analysis, TEA, and life cycle assessment, LCA) biorefineries producing these chemicals by fermentation of substrates obtained from renewable feedstocks including sugarcane and corn stover. Further, we simulated and evaluated entire theoretical fermentation performance landscapes (e.g., formed by all potential combinations of fermentation yield, titer, and productivity) in each of these biorefineries, revealing fermentation development pathways to achieve system-wide sustainability targets. This presentation will showcase how agile and robust system analyses can elucidate key drivers of system cost and environmental impacts across technological landscapes, chart roadmaps to navigate the opportunity space for precision fermentation, and prioritize research, development, and deployment needs for financial viability and environmental benefits.

Sarang Bhagwat, PhD Candidate

PhD Candidate (Advisor Jeremy Guest)

Biography

Sarang is a 5th-year PhD candidate in Prof. Jeremy Guest's research group. Sarang's research focuses on expediting the research, development, and deployment (RD&D) of emerging technologies to advance circular bioeconomies. In particular, he aims to develop and leverage open-source computational tools (such as AutoSynthesis and BioSTEAM, in Python) to design, simulate, and evaluate engineered processes that convert renewable feedstocks to optimized portfolios of bioproducts and bioenergy tailored to local contexts. He develops and leverages agile analytical frameworks to elucidate key drivers of system cost and environmental impacts across technological landscapes, chart roadmaps to navigate the opportunity space for emerging technologies and prioritize RD&D needs. The tools Sarang develops are also used by industry; for example, by Bluestem Biosciences, a synthetic biology company in Nebraska for which he serves as a consultant. Sarang aspires to a career in academia and is currently open to postdoctoral and faculty opportunities.