"Beyond Ethanol: A Process and Systems Engineering Framework for the Design of Advanced Biofuels"

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3:30 pm
Wu & Chen Auditorium

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Abstract

In my talk, I will present my work on the application of process and systems engineering techniques to the design of integrated biorefineries that produce middle distillates (jet fuel and diesel). Unlike gasoline, demand for middle distillates is expected to increase over the next 30 years, and electrification and decarbonization of sectors where middle distillates are used (such as aviation and freight) is challenging. Biofuels offer a potentially sustainable alternative, with the upgrading of ethanol to diesel and jet fuel being especially attractive. The ethanol upgrading platform has several advantages: (1) it can make use of available infrastructure; (2) it can be used to produce fuels over the whole distillation spectrum; and (3) it offers multiple chemical alternatives, enabling the possibility of tailoring the properties of the fuels produced.

Despite its advantages, designing an optimal ethanol upgrading strategy is challenging, as it requires the integration of three different areas: catalysis, process synthesis, and fuel property modeling. The challenges associated with the formulation of a framework integrating these areas, coupled with the large design space characteristic of the problem, have led scientists to rely on ad hoc approaches. In contrast, in this talk, the systematic design of ethanol upgrading biorefineries based on superstructure optimization will be discussed. Four fundamental questions will be addressed: (1) What are the energy requirements associated with the production of middle distillates? (2) What is the interplay among fuel properties, economics, and processes? (3) What is the relationship among biorefinery complexity, processes, and the fuels obtained? and (4) What is the ability of the advanced fuels identified in this work to satisfy fuel demand and mitigate CO_2 emissions?

Bio

Juan Manuel Restrepo-Flórez is a postdoctoral associate at the University of Wisconsin–Madison. Before accepting his position in Madison, he was a Ph.D. candidate at the Georgia Institute of Technology. During his Ph.D. program, he pioneered the use of metamaterials theory in mass diffusion and membrane applications. He holds a bachelor's degree in biological engineering from the National University of Colombia and a master's degree in chemical and biochemical engineering from the University of Western Ontario.

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