Minimizing Fuel Use at Forward Operating Bases

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With Guest Lecturer Dr. Alexandra Newman

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Abstract:

Renewable energy technologies, specifically, solar photovoltaic cells, combined with battery storage and diesel generators, form a hybrid energy system capable of independently powering remote locations, i.e., those isolated from the grid, across the world. Forward Operating Bases, which are critical to the Department of Defense's ability to project combat forces throughout the world, serve as examples of such locations. Currently, diesel generators, whose maximum power rating often far exceeds the demand causing excess fuel use, power most bases. We present an optimization model for establishing a power design and dispatch strategy for a base that minimizes costs (fuel use) in a military theater of operation. Modeling the acquisition, deployment, and operation of different energy technologies requires integer restrictions. Additionally, modeling the fuel consumption of diesel generators, battery power, and battery lifetime introduces nonlinear equality constraints. Thus, our optimization model is a non-convex, mixed-integer nonlinear programming (MINLP) problem. Given the difficulties associated with solving large, non-convex MINLPs to global optimality, we present convex underestimation and linearization techniques to bound and solve a mixed integer program (MIP).

Biography:

Alexandra Newman is a Professor in the Mechanical Engineering Department at the Colorado School of Mines. She holds a B.S. in Applied Mathematics from the University of Chicago, an M.S. in Operations Research from the University of California, Berkeley, and a Ph.D. in Industrial Engineering and Operations Research from the University of California, Berkeley. Prior to joining the Colorado School of Mines, she held the appointment of Research Assistant Professor in the Operations Research Department at the Naval Postgraduate School. Her primary research interests lie in optimization modeling, particularly as it is applied to logistics, the energy and mining industries, and military operations. She is serving as Associate Editor of the Operations Research and Interfaces Journal and is an active member of INFORMS.

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