Design and Performance of Derivative-Free Optimization Algorithms Used with Hybrid Electric Vehicle Simulations

by

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Abstract

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Gradient-based optimization algorithms are inherently ill-suited for use with hybrid electric vehicle simulations because the responses from the simulations are noisy, discontinuous, and multimodal. Therefore, to perform design optimization when using these simulations requires the use of derivative-free algorithms. However, derivative-free algorithms are notorious for being inefficient and slow to converge, thus posing a significant problem because of the computational expense of the simulations. Therefore, it becomes necessary to test the performance of different derivative-free algorithms on optimizing hybrid electric vehicle design problems. The first part of this thesis tests the performance of the Simulated Annealing algorithm, an Evolutionary Algorithm, and the DIRECT algorithm on a three-variable hybrid electric vehicle design problem. The second part of the thesis proposes two methods to improve the local convergence of the DIRECT algorithm and tests them on two analytical test problems and a ten-variable hybrid electric vehicle test problem.