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Optimizing Multivariate Adaptive Regression Splines and Estimating Lower Bound Functions in Surrogate Optimization

Presented by: Jay Rosenberger

Professor at University of Texas at Arlington



DATE:

Friday, Oct. 9th

10:30am – 11:30am

Location: BYENG 361

Zoom:

<https://asu.zoom.us/j/88631401662?pwd=raGmcjbTCEd8K7C4x9WdRttktgVmwP.1>

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Bio:

Dr. Jay Rosenberger is Professor and the Associate Chair of Research Development in the Department of Industrial, Manufacturing, & Systems Engineering (IMSE) at The University of Texas at Arlington (UTA). He is the former Interim Department Chair of IMSE, the former Interim Director and Deputy Director of the Center for Transportation Equity, Decisions & Dollars, the Founder, the former Director of the Healthcare Enterprise Research Center, and the former Director of the Center on Stochastic Modeling, Optimization, & Statistics. Dr. Rosenberger has a B.S. in Mathematics from Harvey Mudd College, an M.S. in Industrial Engineering and Operations Research from the University of California at Berkeley, and a Ph.D. in Industrial Engineering from the Georgia Institute of Technology. His research interests include mathematical optimization in transportation, health care, and energy. Prior to joining the faculty at UTA, Dr. Rosenberger worked in the Operations Research and Decision Support Department at American Airlines. At UTA, Dr. Rosenberger teaches courses in engineering probability, operations research, linear programming, introduction to statistics, and combinatorial optimization. He is the former chair and cluster chair of the Institute for Operations Research and Management Science (INFORMS) Section on Health Applications. He is a senior member of INFORMS and has been a member of the Institute of Industrial and Systems Engineers since 2003. He is currently an area editor of Omega: The International Journal of Management Science.

ABSTRACT:

Surrogate optimization algorithms have been increasingly integrated into applications where expensive black-box simulations or expensive experiments are required. This research discusses two related surrogate optimization topics. First, we study a Mixed Integer Quadratically Constrained Program (MIQCP) based approach that optimizes a Quintic Multivariate Adaptive Regression Splines (QMARS) metamodel. The QMARS-MIQCP based approach is integrated into a surrogate optimization framework called QMARS-MIQCP-SUROPT. The QMARS-MIQCP-SUROPT algorithm is evaluated on test functions that have been used as benchmarks in both surrogate optimization and global optimization applications as well as a simulation of a 2D – Liquid Chromatography (LC) system and a series of real-world analytical chemistry laboratory experiments to optimize the parameter settings of the Shimadzu Liquid Chromatography Mass Spectrometry (LCMS) 2020 instrument for efficient flow injection analysis. We then discuss a new approach to estimate lower bound functions within the context of surrogate optimization. We incorporate the proposed lower bounds as acquisition functions within surrogate optimization. Experiments on benchmark test problems and a planar robot pushing task show that the proposed framework improves lower-bound quality, supports more effective candidate selection, and compares favorably with standard Lipschitz-based, statistical, and six surrogate-optimization baselines.