

RECENT PROGRESSES IN DIRECT MULTISEARCH (DMS)

Ana Luísa Custódio

NOVA University of Lisbon

Keywords: Derivative-free Optimization, Black-box optimization, Multiobjective Optimization, Direct Multisearch, Polynomial Interpolation, Constrained Optimization, Parallel Implementations, Many-objective Optimization

Abstract

Direct Multisearch (DMS) is a directional direct search class of methods for multiobjective derivative-free optimization that relies solely on function evaluations while providing rigorous convergence guarantees to Pareto-stationary points under standard assumptions. Its solid theoretical foundation and robust numerical behavior have led to successful applications in both benchmark and engineering optimization problems. Nonetheless, evaluation complexity and scalability remain key challenges, particularly in constrained and large-scale scenarios.

This talk reviews the core components of DMS, including the poll step based on positive spanning sets and the dominance-based acceptance mechanism that drives convergence in the multiobjective setting. We then present recent algorithmic developments designed to enhance numerical efficiency while preserving the theoretical properties of the original scheme.

A first contribution consists of a model-based search step built from quadratic interpolation or regression models constructed using previously evaluated points. By systematically reusing past function evaluations, this mechanism generates informed trial points that improve practical performance without introducing derivative information or compromising convergence guarantees.

We further discuss parallelization strategies for both search and poll steps, enabling concurrent evaluation of trial points and improved wall-clock performance on modern computing architectures. For constrained multiobjective problems, we describe feasibility-handling mechanisms that balance objective improvement and constraint violation reduction within the DMS framework, using a filter approach combined with an inexact feasibility restoration step.

Finally, we outline recent extensions targeting large-scale settings, addressing both high-dimensional decision spaces and problems with many objective components. Numerical experiments demonstrate consistent reductions in evaluation cost and improved scalability.