

FORMULATION OF DUALITY STRUCTURES FOR NON-DIFFERENTIABLE MULTI-OBJECTIVE OPTIMIZATION AND VARIATIONAL PROBLEMS UNDER GENERALIZED INVEXITY CONDITIONS

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ABSTRACT

This paper presents a novel methodology for constructing duality frameworks in non-differentiable multi-objective optimization problems under generalized invexity conditions. The research addresses the fundamental challenge of establishing strong duality relationships when objective functions lack differentiability properties, particularly in variational contexts. We introduce a comprehensive framework that extends classical duality theory through the incorporation of generalized invexity concepts, subdifferential calculus, and convex analysis techniques. The proposed methodology establishes necessary and sufficient conditions for strong duality, develops computational algorithms for solving dual problems, and provides theoretical guarantees for solution quality. Experimental results demonstrate the effectiveness of the approach across various problem classes, showing improved convergence rates and solution accuracy compared to existing methods. The framework offers significant contributions to multi-objective optimization theory and provides practical tools for solving complex engineering and economic optimization problems where traditional gradient-based approaches fail.

KEYWORDS: Multi-Objective Optimization, Non-Differentiable Optimization, Duality Theory, Generalized Invexity, Variational Problems, Subdifferential Calculus.

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