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DUALITY FORMULATIONS IN NON-DIFFERENTIABLE MULTI-OBJECTIVE AND VARIATIONAL OPTIMIZATION VIA GENERALIZED INVEXITY

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ABSTRACT

This research investigates the theoretical foundations and practical applications of duality formulations in non-differentiable multi-objective and variational optimization problems through the lens of generalized invexity. Traditional convexity assumptions often fail in real-world optimization scenarios, necessitating the development of more flexible mathematical frameworks. This study introduces novel duality theorems for multi-objective optimization problems involving non-differentiable objective functions under generalized invexity conditions. We establish weak, strong, and strict converse duality results for both Wolfe-type and Mond-Weir-type dual formulations. The research extends classical results to variational optimization problems, providing new insights into the relationship between primal and dual solutions. Our theoretical findings are validated through computational experiments demonstrating the effectiveness of the proposed framework. The results show significant improvements in solution quality and convergence rates compared to traditional approaches, with applications in engineering design optimization, portfolio management, and resource allocation problems.

KEYWORDS: *Duality Theory, Multi-Objective Optimization, Variational Optimization, Generalized Invexity, Non-Differentiable Optimization, Subgradient Methods.*

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