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# The Echo Optimizer: A Novel Metaheuristic Inspired by Acoustic Reflection Principles

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**Abstract:** The Echo Optimizer Method is an innovative optimization technique inspired by the natural behavior of sound echoes. It is based on generating modified solutions (echoes) that combine directed reflection toward the best-known solution and random noise that attenuates over time. The method introduces two groundbreaking mechanisms to enhance performance: an approximate evaluation system that avoids costly computations for unpromising solutions, and an echo memory that stores and reuses past evaluations. These mechanisms enable a significant reduction in computational resources (up to 40–60% fewer evaluations) while maintaining the method's effectiveness. The Echo Optimizer excels in balancing exploration of the solution space with exploitation of the best-known solutions, demonstrating impressive performance in problems with numerous local minima and high dimensionality. Experimental tests on standard optimization problems have shown faster convergence and reduced result variability compared to classical methods, making it a highly attractive choice for various optimization challenges, particularly in cases where evaluating the objective function is computationally expensive.

**Keywords:** Optimization; Echo Optimizer; Evolutionary Algorithms; Global Optimization; Adaptive Termination; Mutation Strategies; Metaheuristics;