

# OPTIMIZING THE CAPACITATED ELECTRIC VEHICLE ROUTING PROBLEM USING CHAOTIC DISCRETE CHIMP OPTIMIZATION ALGORITHM

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## Abstract

Electric vehicles (EVs) are rapidly becoming a core component of modern transportation and logistics, with adoption extending from consumer markets to freight and delivery operations where industrial-grade optimization is essential, particularly under payload, range, and charging constraints. In this context, we address a capacitated electric vehicle routing problem (EVRP) that integrates classical vehicle capacity limitations with battery and charging considerations to optimize route planning for EV fleets. We propose the Chaotic Discrete Chimp Optimization Algorithm (CDChOA) for this EVRP, which combines the coordinated hunting behavior of chimpanzees with the Tinkerbell chaos map to achieve an effective exploration–exploitation balance over a large combinatorial search space. In CDChOA, complete EV routes (including optional visits to charging stations) are encoded as discrete candidate solutions, while problem-specific operators enforce vehicle capacity, battery consumption, and charging feasibility.

The proposed CDChOA is evaluated on standard EVRP benchmark instances and is compared against an adaptive Nawaz–Enscore–Ham heuristic with nearest-neighbor subtours (NEH-NN), a random search baseline, and a Genetic Algorithm (GA). Experimental results show that CDChOA consistently achieves competitive or superior solution quality in terms of total routing cost, particularly on large-scale instances with many customers and complex charging requirements, while maintaining acceptable computational effort. Statistical analysis indicates that CDChOA significantly outperforms random search and GA on most large instances and provides improved or comparable performance relative to NEH-NN. These findings highlight CDChOA as a promising metaheuristic for EV routing optimization and as a strong candidate component within hybrid frameworks for sustainable freight and delivery planning.