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ABSTRACT:

Introduction: Optimal charging of RC circuits is a well-studied problem in the integer-order domain due to its importance from economic and system temperature hazards perspectives. However, the fractionalorder counterpart of this problem requires investigation. Objectives: This study aims to find approximate solutions of the most energy-efficient input charging function in fractional-order RC circuits. Methods: This paper uses a meta-heuristic optimization technique called Cuckoo search optimizer to attain the maximum charging efficiency of three common fractional-order RC circuits. An analytical expression of the fractional capacitor voltage is suggested such that it satisfies the boundary conditions of the optimal charging problem. The problem is formulated as a fractional-order calculus of variations problem with compositional functional. The numerical solutions are obtained with the meta-heuristic optimization algorithm's help to avoid the complexities of the analytical approach. Results: he efficiency surfaces and input voltage charging curves are discussed for fractional-order in the range $0.5 < a < 1$. Conclusion: The optimized charging function can approximate the optimal charging curve using at most 4 terms. The charging time and the resistive parameters have the most dominant effect on charging efficiency at constant fractional-order.

CONTRIBUTION OF THE APPLICANT:
- Literature review.
- Ideas involved.
- The mathematical model and its solution.
- Analysis of the results.
- Writing up the manuscript.

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