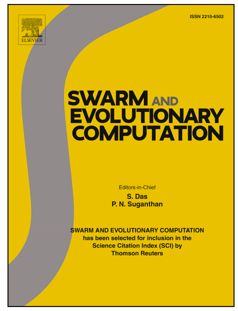

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Multi Objective Evolutionary Algorithm for Designing Energy Efficient Distribution Transformers

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Abstract--This paper has solved the transformer design optimization problem using Multi-Objective Evolutionary Algorithms based on Decomposition with Dynamical Resource Allocation (MOEA/D-DRA). For lesser computation burden, the existing design techniques merely employ few Standard Design Variables (SDV), satisfying only a few performance constraints, resulting in an approximated design, without any focus on an energy efficient transformer. The proposed methodology minimizes four sets of conflicting design bi-objectives, subjected to 27 constraints, incorporating three crucial design variables with SDV to ensure energy efficient transformer design with lesser losses, total life time cost (TLTC), green house gas emission, and failure rate. Different cases are analysed on a sample 1500kVA transformer, which is designed by existing technique and the proposed multi objective optimization problem formulation approach and the performances of the competing transformers are compared. To prove the effectiveness of Iterative Chaotic map with infinite collapses assisted MOEA/D-DRA (ICMDRA), NSGA-II has also been successfully applied to solve the problem. When tested in all three different rating transformers, the simulation results have proved that the proposed methodology saves energy, cost, and material, with ICMDRA rather than NSGA-II. This paper identifies ICMDRA as a superior algorithm for transformer design, in terms of diversity and convergence. Also, the core loss calculation of the transformer designed using the proposed methodology is validated by 3D-FEM assessment and experimental prototype setup for a 200kVA transformer.

Index Terms- Multi objective transformer design optimization, NSGA-II, MOEA/D-DRA, TLTC, crucial design variables, GHG emission.

Nomenclature

ABBREVATION:

CDV	Crucial Design Variables
FEM	Finite Element Method
GHG	Green House Gases
HV	High Voltage
ICMIC	Iterative Chaotic Map with Infinite Collapses
ICMDRA	Chaos with MOEA/D-DRA
KBS	Knowledge Based Systems
LV	Low Voltage
MOEA/D-DRA	MOEA based on Decomposition with Dynamical Resource Allocation
MOEA	Multi-Objective Evolutionary Algorithm
MOTDO	Multi Objective TDO
NSGA	Non-dominated Sorting Genetic Algorithm
SDV	Standard Design Variables
TDO	Transformer Design Optimization
TLTC	Total Life Time Cost