

Multi Objective Optimization Of Two Stage Operational Amplifiers Using Antlion Optimization

Telugu Maddileti, S. Govindarajulu, S. Chandra Mohan Reddy

Abstract: Major Prominent strategy involved in the formulating of assorted category circuits will be the requirement of competent along with involuntary method of formulation. Upsurging difficulty involved in the formulation analog circuits requires appropriate handling utilizing the strategies for difficulty existed in formulation of integrated circuits design requires for dealing by means of suitable strategies for determining the best solutions along with precise explanation with respect to prototypes of formulation for the purpose of accomplishment of stipulated constrains in the formulation assuring nil faults. Characteristic issues existed in the formulation of integrated circuits that might be analog in nature will be involved in difficulty in processing along with the need of managing the many contradictory, along with purposes containing sturdy unproportionally inter relationship. The work establishes the strategy in identification of dimensions of equipment with respect to integrated circuits that might be analog in nature that adopts the strategy of determining the best solutions with multiple amount of motivations. For the purpose of assessing the suitability with respect to stipulations provided in the formulation of the circuit utilization of meta-heuristic strategy is established. Development of issue into complex one while motivations might be contradictory with respect to one another which is involved in providing the best solution will be dissimilar with respect to additional. For determining the solutions to mentioned may or may not contain the restrictions, the mentioned strategies involved in provision of compensatory solutions, famously called to be Pareto-optimal solutions. Here utilization of multi-objective ant lion optimization is suggested for designing two stage Operational amplifier which produces better results than single objective Chaotic Grey wolf Algorithm along with Salp Swarm Optimization Algorithm.

Keywords: Multi-Objective Optimization, Simulation based technique, Multi Objective Ant lions Optimization, Two Stage CMOS Op- amp, Power Dissipation, Device Dimensions

1. Introduction

WITH respect to the assorted circuits, the formulation of circuit that functions in analog manner could involve many probables such as takes a lot of time in formulation. Devoid of adequate tools that performs the process of formulation automatically involved in the design of analog circuits. Development of tools which performs the formulation of particular circuits was took place for the past two decades [1]. On the other hand, majority, the developed tools lack in accuracy along with approximate prototyping. Involuntary formulation with respect to integrated circuits that might function in the analog manner will be the toughest due to the requirement with respect to least power dissipation formulation along with minimization of duration involved in production [2]. Currently, majority of the analog circuit formulation will be carried out physically besides the utilization of certain modelling tools which performs with equations. Excellence of formulated circuit will be relied upon the skill set of the engineer. Duration of formulation must be completed within short duration by utilizing the sophisticated formulation tools. Transistors with diverse dimension will be contained in the integrated circuit in analog form [3]. Involuntary computations that falls back in accuracy besides prototypes dependent with prototypes, formulations performed with numerous steps involved in modelling utilizing spice along with compressive traditional production of outline.

Basic constraints that will dependent with excellence of developed circuit existed with knowledge belonging to the engineering along with duration and exertion incurred with formulation. The complete area belonging to formulation will be seldom investigated, transistors operating with prominently frail along with reasonable functioning areas, that might contain maximum suitability for power conscious designs [4]. For Involuntary combining belonging to formulation area pertaining to analog integrated circuits made up of CMOS transistors will extremely unproportioned. Lot of loosely bounded variables involved in the formulation of characteristic integrated circuits that might be function in analog mode like two phase operational amplifier circuits that might be varying with sizes, currents or inversion level. During certain instances the association among stipulation developed with formulation of circuit along with dimension will be contradictory. Hence, huge quantity of issues might be developed in determining the best solutions. Involuntary formulation of basic stages involved in the design of integrated circuits that functions with analog mode will be obligator for making the circuit into the successful one. Selection of appropriate dimension to device will be the toughest task along with more amount of time consumed developing latency in manufacturing in automated formulation technique because of huge along with extremely unproportioned area. Currently devoid of availability of strategies that utilizes the computer area of formulation was observed [5]. Reduction in the formulation duration might be resulted with the utilization of soft computing techniques. Functioning with global investigation which simulates certain naturally inspired performed was observed for determining the best values for characteristics for the projected challenge. For determining the solutions to issues related with formulation of ICs varying from sectioned proper dimension to fanout was performed with solitary motivational strategies with specified constraints. Degerming the best solutions with diverse motivational operations for concurrent accomplishment of best values for all the parameters specified is performed by means of multi-objective optimization approach. Mentioned approach might be established in diverse stages such while performing

- Telugu Maddileti, Research scholar, JNTUA, Ananthapuramu, Andhra Pradesh, INDIA, Email: madhu14283@gmail.com
- S. Govindarajulu, Professor in ECE Department, Dr. KVSRIIT, Kurmool. E-Mail: rajulusg09@gmail.com
- S Chandra Mohan Reddy, Associate Professor, ECE Department, JNTUA, Ananthapuramu. E-Mail: cmr.ece@jntua.ac.in

the preliminary formulation, combination of Logic/RTL along with deployment and path finding strategies with the motivation of determining best values for speed of clock, wastage of power along with space occupied during the same instance[27]. Determining the best values with respect to latency along with wastage of power will produce contradictory outcomes. While performing the above-mentioned task, selection of proper dimension for device will be complex. The mentioned issues might also develop the circuit functioning with diverse voltage supplies or frequencies or diverse conditions. Multi-motivational strategies involved in determining the best solutions might provide automatic compensation for power along with latency [6]. Engineer performing the formulation of integrated circuit that functions in analog mode selects the proper structure along with the assessment of voltages and currents involved. Subsequently, selection of appropriate dimension for the device will be carried with the help of expressions which incorporates the aspect ratio alongside stipulations provided for formulations. Then the supporting tool will be utilized for examining along with adjusting the formulated circuit. Nevertheless, modifying aspect ratios dimensioning will be the toughest while employing the physical execution. Involuntary selection of circuit dimensions will be the most sought research in recent days [7] by which utilization of many motivational strategies will be quite apparent. [8].

2. Literature Survey

Work by Garbaya et al., [9] established the unique strategy to produce least delicate solutions with Pareto fronts for proper functioning of the circuit that functions in analog mode. With the inspiration of community communication among elements that existed inside the many motivational Particle Swarm Optimization strategy with the help of directing the universal leading procedure in the direction of least delicate solutions. Considerable accomplishment of suggested strategies besides the production of delicate conscious pareto optimal solutions with respect to processing duration besides the quality of solution developing the compromise was established by the authors. With respect to work performed by Lyu et al., [10], unique many motivational strategy dependents with Bayesian approach was established for dimensioning the circuits that functions in analog mode. Outline of Bayesian optimization was adopted for stabilizing the utilization along with investigation. Utilization of procedures involved with Gaussian functions in many motivational operations was observed. Least assurance limit was considered in the choice of information with respect to superiority established with Pareto along with variety. Altered Non-dominated arrangement dependent with nature inspired many-motivational strategy was suggested for determining Pareto Front (PF) along with many Least assurance limit operations, along with subsequent modelling PF with respect to many Least assurance limit operations. Suggested strategy involved in improved estimation of Pareto -front while prominently minimization of modellings. This paper by Sasikumar and Muthiah [11] established modeling dependent formulation of integrated circuit that functions with analog mode utilizing nature inspired techniques. To device the strategy for fundamental two-phase operational amplifier utilizing many motivational strategies like employed of swarm-based strategy that implemented particle swarm strategy and non-dominated arrangement genetic algorithm. Mentioned strategies will adopt the fresh category belonging to many motivation approaches utilized in selection of dimensions Integrated circuits that

functions in analog mode. Mentioned strategy involved in minimization of duration for formulation along with enhancement of preciseness with respect to stipulated factor. Involuntary combination of dimensions of devices besides the conditions utilizing Particle Swarm Optimization along with Genetic Algorithm. The paper by Kammara et al., [12] established unique strategy that performs formulation circumstances specified as ABSYNTH, utilizing framework that trains by itself to competent ordered strategy in determining the best solution with series that incorporates the operational estimators along with prototypes learned with the help of assured nature inspired strategies along with innovative strategy that might be enforced to particular region to dedicated imagining belonging to area of determining the best solutions along with the path of formulation procedure. Improvement in formulation of integrated circuit might be involved in improving the applications pertaining to signal processing. Work by Tlelo-Cuautle et al., (2010) [13] established dedicated with respect to enforcing nature inspire strategies to incorporation along with selection of dimensioning for integrated circuits that functions with analog mode. Review of several works were summarized. The work by Golmakani et al., (2009) [14] established fresh strategy to formulate along with the strategies involved in optimization for integrated circuits that functions with analog by means of generating solutions dependent with Pareto strategy with Many motivational Genetic Algorithm. Competence with mentioned strategy was assessed with utilizing standard challenges. Mentioned strategy was enforced in the formulation of telescopic cascode Op-Amp. Dimensions of device will be identified with the help of Genetic Algorithm. Furthermore, development of circuit with the help of elements along with the modelling the developed circuits in HSPICE was established. Factors like gain, phase margin along with utilization of power will be utilized with the respect to produced document along with space occupied by the integrated circuit will be computed. Work by Soorapanth, [15] established the formulation strategy involved in formulation that will be dependent with many motivational Geometric Program. Concurrent processing with respect to entire motivations produces considerable solutions by satisfying motivations. With the help of modifying discrete motivation's biasing parameter will be developed with establishment of tradeoff. Work by Biondi et al., [16] established the utilization of nature inspired strategies along with the exploration of arrangement with respect to formulation of circuit Operational Transconductance Amplifier utilizing the many motivational strategy for determining the best solutions. Specifically, determination of Pareto fronts was established with he improved distribution of solutions besides the greater quantity of non-dominated solutions while related with traditional many motivational strategies. Work by Oltean et al., [17] demonstrated the fresh strategy for determining the best solution with respect to formulation of circuits that functions with analog mode. Mentioned strategy utilizes the many motivational approach of determining the best solutions along with alteration of fact with the help of considering proportion of fulfillment level with respect to stipulated demands. To determine the best solutions for devising strategy utilization of fuzzy group which explains the motivation by means of fuzzy technique for determining the fresh values for mentioned factors. Obtained solution contains the pareto optimal group along with determination of group of solutions from the mentioned solutions. Authentication of mentioned strategy was provided with the help of utilizing the mentioned strategy with the

formulation of two-phase operational amplifiers that utilizes the MOS device.

3. PROBLEM STATEMENT

Huge quantity of concentration was spent in establishment of solutions by means of System Assisted formulation was performed [18]. Establishment of determining the best solutions using involuntary manner inside the formulation procedure took place with reduced difficulty. Engineers must be involved in developing the factors for the issues related with optimization. On the other hand, no assurance of formulated solution as the best solution. Engineers must be involved in framing the objective function for characterizing the motivation that has to be accomplished. Subsequently handling of provision of compensation while trying to optimize the simultaneous motivation of many parameters. Mentioned likings along with motivational operation will be basic in assuring the competent solution in the strategies involved in determining best solutions. With respect to suggested work following paper, for determining the competent solution development of multi-objective optimization devoid of need of further expertise from the experts.

4. PROPOSED METHODOLOGY

Prominent stages involved in the formulation of circuit that operates with analog mode comprised of stages involved in finalizing the structural needs will be selected initial along with subsequent with the equipment utilizing proportional first order expressions must be selection of proper dimensions. The proper selection of dimension generally requires numerous stages along with faults with system-based modeling. Mentioned strategy eats up lot of duration due to experimental basic procedure will be resulted in un-proportionality, estimates utilized with physical expressions along with greater arrangement impacts with respect to sophisticated prototypes. Prominent challenge lies in the fact of least utilization of power along with the development of difficulty. The formulation might take huge quantity of duration. Figure 1 presents the two-stage operational amplifier circuit. Mentioned two stage operational amplifier contains the characteristic like larger gain along with huge fluctuation in output and appropriately enforced to applications that functions least level of voltage by which little quantity of device might be delivery of adequate gain.

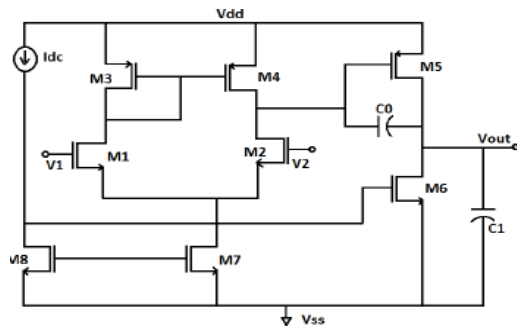


Figure 1 Two Stage Operational Amplifier

Expressions comprised with estimating factors linked with the functionality

a) Open loop gain

$$A_v = \frac{g_{m1}}{g_{ds2} + g_{ds4}} * \frac{g_{m6}}{g_{ds7} + g_{ds6}} \quad (1)$$

b) Unity - Gain bandwidth

Unity gain bandwidth was provided with the help of equation

$$GBW = \frac{g_{m1}}{C_c} \quad (2)$$

While C_c will be capacitor that performs the process of compensation

c) Phase margin

Phase margin was provided with the help of expression

$$PM = \pm 180 - \tan^{-1} \frac{GBW}{P_1} - \tan^{-1} \frac{GBW}{P_2} - \tan^{-1} \frac{GBW}{z} \quad (3)$$

d) Slew rate

Slew rate was provided with the help of

$$SR = \frac{I_s}{C_c} \quad (4)$$

e) Power Consumption

Utilization of power was provided with the help of

$$P = (V_{DD} - V_{SS})(I_5 + 2I_7) \quad (5)$$

f) Area

$$Area = \sum_{i=1}^{11} W_i L_i \quad (6)$$

Determination of best values for the parameters for the mentioned circuit will be explained with subsequent section. Selected Parameters for the application of Multi-Objective Optimization will be listed as open loop gain, unity-gain bandwidth, slew-rate, phase margin and power consumption along with explanation of appropriateness operation. While performing the process of optimization, by providing the maximization of appropriateness function, for satisfying the entire group of stipulations provided.

Appropriateness Assessment

To assess the appropriates with respect to issues related with many motivations numerous approaches were adopted. Appropriateness operation (ff) will be described subsequent expression

$$ff = \frac{1}{n} (\sum_{i=1}^n opt(w_i, f_i)) \quad (7)$$

While

$$opt(x) = 1 - e^{-x} \quad (8)$$

$f_i = (\text{desired value} - \text{determined value})$ for object i

$w_i = \text{Weight Coefficient of Object } i$

$n = \text{Number of Objects}$

Collection of various motivation operations (f_i) generates improved outcomes related with the additional approaches. Initially the appropriateness operation might contain value smaller when compared with 1. On attaining the preferred value by the object, the impact of appropriateness operation might be minimized along with the approach for determining the best solutions stimulates the additional objects for delivering the preferred values. Significant contribution of the mentioned approach will be it follows the simulation dependent strategy instead of dependent with expression.

4.1 Need for Optimization

In the circuit mixed mode circuit analog portions comprises of only 10%, but the amount of duration involved with respect to formulation of the circuit consumes 90% of exertion. Therefore,

determination of solutions involuntary manner might conserve lot of duration involved in formulation. Nowadays, lot of exertion in the development of tool for determining the solution in an involuntary manner [19]. Three formulation methods are explained in the subsequent section that depends with the determination of best solutions. Utilization of optimization engineer was proposed rather than devising the formulation for carrying out formulation. Mentioned optimization procedure will be repetitive process. Improvement in formulated values might be carried out while performing every step still the accomplishment of stipulated condition. Mentioned strategy explores into the available pool of solutions for every elements of the circuit. Functionally investigation will be carried out for assuring the satisfaction of stipulated conditions.

Expression dependent strategy involved in utilization of investigational formulation expressions for assessing the functionality of the circuit [20]. Mentioned expressions will be devised physically or involuntarily with the utilization of tools that performs the symbolic investigation. Development of issue with respect to strategy involved in the determination of best solutions that might be usually determined utilizing the statistics. Investigational prototypes might have shortcoming in formulation of expressions with respect to each fresh structure. Nevertheless, progression in the investigation of circuit utilizing symbolic manner, utilization of comprehensive factors that were stipulated during the formulation will not be feasible. Investigational expressions developed with the help of above-mentioned strategy will fall back in exactness particularly while formulating the difficult circuits.

Modelling dependent [21] strategy involved in the utilization of models for assessing the functionality. Mentioned strategy involved in mining of factors with respect to outcomes of simulations that were performed. Mentioned strategy involved in accomplishment of improved preciseness when compared with additional strategies. Determining the best solutions might be achieved so many numbers while similar circuit will be utilized with diverse stipulations by adapting the appropriateness operations. Evidently entire categories of circuits might be formulated with best value along with minimum quantity of duration. Amount spent for the processing is quiet high for assessing the functionality of the circuit with the help of modelling using electrical characteristics.

Training dependent approach [22] –performance pertaining to the circuits that has to be identified in development of best solutions will be prototyped with the help of training approach dependent with spread belonging to dissimilarity. Mentioned

strategy permit the rapid assessing of functionality to particular group belonging to formulation stipulations. Approach might be in need of group of learning illustrations which might be assessed during the commencement of procedure. Quantity pertaining to learning information might impact preciseness with respect to functionality assessment developed with the help of training model. Existence of compromise among preciseness along with competence with the training dependent like expression dependent approach.

Expression dependent approaches will provide the solutions devoid of preciseness while performing the formulation with involuntary manner. Training dependent approaches might be involved in generation of influential circuits. On the other hand, it might consume larger amount of duration for framing the problem devoid of utilization of any aid due to generation of learning illustration. Modelling dependent aids might be involved generation more precis circuit along with very least amount of processing duration. Therefore, here utilization of Multi-objective optimization in nature inspired algorithms was established in this paper.

4.2 Multi-Objective Optimization

Concentration for mentioned work was accomplished with the help of taking into account of majority of issues related with formulation which might constitute, many, contradictor along with non- conforming motivations. This developed the utilization of appropriate strategies for determining the best solutions with many contradictory motivations with respect to meeting many stipulated conditions [23]. Whereas the entire group of variables involved in the mentioned issue will be distinct inherently. Therefore, allocation of floating-point values might be carried out to distinct variables. Explanation of variables might be done with the respect to assorted integer / distinct/unceasing areas. Formulation of integrated circuit might be explained many motivational strategies with stipulated conditions involved in the identification of best solutions with respect to assorted integer / distinct/ unceasing areas [24].

4.3 Multi – Objective Ant Lion Optimization

For the motivation of projecting many motivations variety pertaining to Ant Lion Optimization strategy [25], basics belonging to Ant lion algorithm might be explained in the subsequent section. Strategy might involve the similar exploration conduct taken into account as prolonged version of similar approach. Mentioned approach exploits the search along with attacking conduct of antlion along with communication with the preferred targets ants. Figure establishes the algorithmic flow of antlion technique in pictorial format

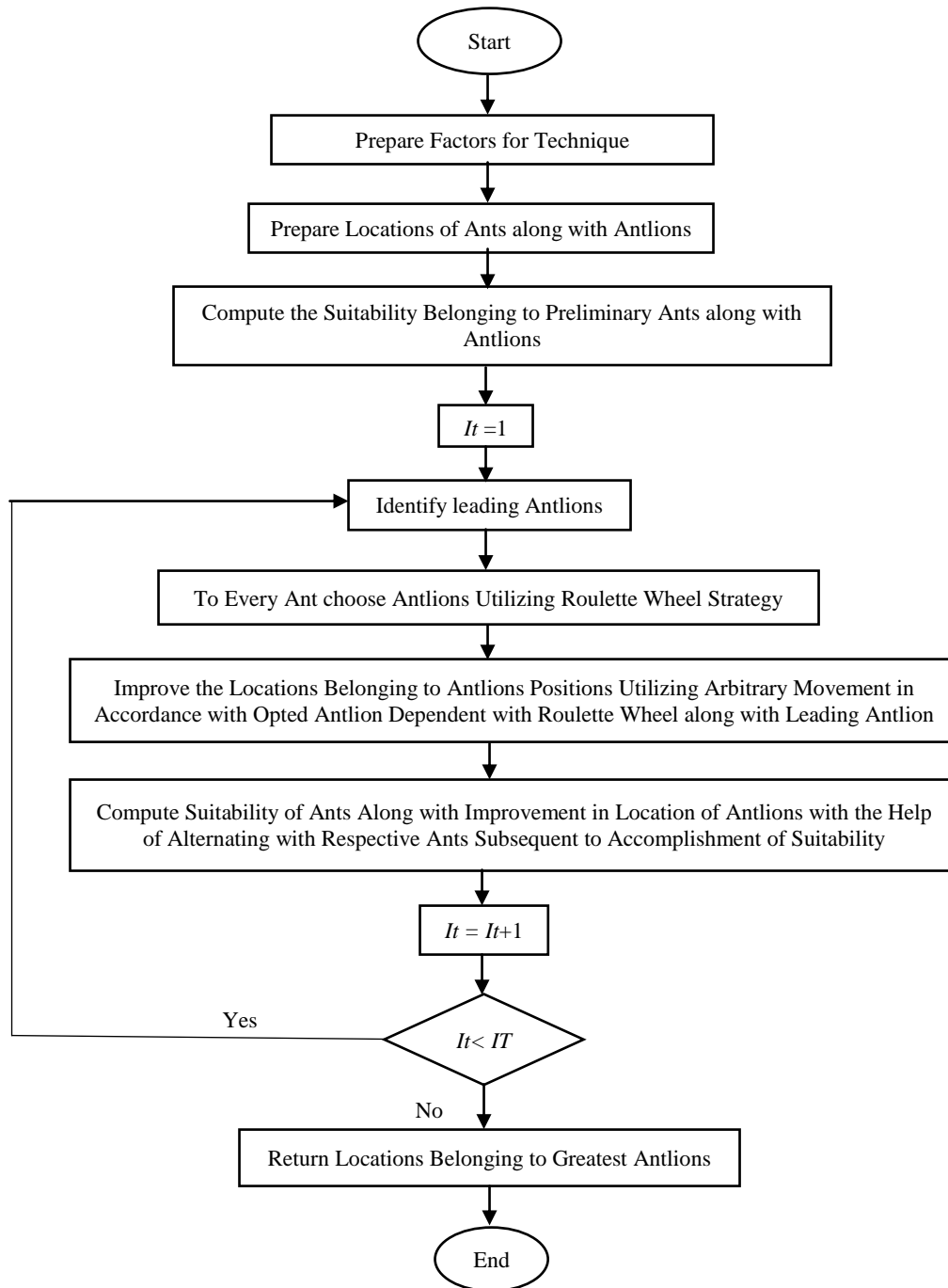


Figure 2 Flow Chart of Ant lion Optimization

Correspondingly, with respect to additional group dependence strategies, Ant Lion Optimization estimates the best solution for issues related with optimization besides implementing the group of arbitrary solutions. Mentioned group relied with basics attained by observing the communication among antlions along with ants. Two groups were mentioned with respect to Antlion Optimization strategies group belonging to ants along with group belonging to antlions. Usual stages involved in the explanation of Antlion Optimization for modifying the groups along with ultimately assessment of universally best solution for the provided challenges will be provided in the subsequent sections.

a) Preparation of ant group utilizing the arbitrary number

along with the prominent exploration candidates with respect to Ant Lion Optimization.

- b) Assessment of suitability with respect to every ant utilizing motivational operation during every step.
- c) Navigation of ants might take with respect to area of exploration utilizing arbitrary movement about the antlions.
- d) Assessment of group of antlions might not be performed. Existence of antlion within the position of ant while performing the initial step subsequently repositioning of fresh location belonging to ants while performing additional steps whether ants develops improvement.

- e) Allocation of solitary antlion with respect to every ant along with improvement in location while the ant develops suitability.
- f) Leading antlion that affects navigation pertaining to notwithstanding to distance.
- g) Development of antlion into suitability when compared with the leader, it might be substituted with the leader.
- h) Phases b to g will be recurrently implemented till the fulfillment pertaining to terminating condition.
- i) Location along with suitability belonging to leader antlion must be displayed to be with better approximation with respect to estimation of universally best.

Investigation of best area of exploration will be prominent duty. Navigation about the area of exploration by means of arbitrary movement will be required. Retaining the greatest location achieved with the help of ants along with assisting the exploration of ants in the direction of fascinating areas with respect to area of exploration. For determining the best solutions, Ant lion algorithm involved in exploiting arbitrary movement belonging to ant, getting caught antlion's hole, developing the hole, movement of ants in the direction of antlion, getting hold of target along with redevelopment of hole in addition with leadership strategy. Development of scientific prototype will be performed to every stage with respect to subsequent sections. Actual arbitrary movement employed with Ant lion optimization for modeling the arbitrary navigation of ants will be provided in expression

$$x(t) = [0, \text{cumsum}(2r(t1) - 1), \text{cumsum}(2r(t2) - 1), \dots, \text{cumsum}(2r(tn) - 1)] \quad (9)$$

while cumsum evaluates the increasing addition n will be greatest quantity of steps demonstrates the stage belonging to arbitrary movement

$$r(t) = \begin{cases} 1 & \text{if } rand > 0.5 \\ 0 & \text{if } rand \leq 0.5 \end{cases} \quad (10)$$

will be statistical operation while t demonstrates stage belonging to arbitrary movement along with $rand$ will be arbitrary value produced besides regular spread within the range of [0,1]. For retaining arbitrary movement with the limits pertaining to area of exploration along with prohibiting ants from shooting, arbitrary movements must be standardized utilizing the subsequent expression

$$X_i^t = \frac{(x_i^t - a_i) * (d_i^t - c_i^t)}{(b_i - a_i)} + c_i^t \quad (11)$$

while c_i^t will be least i^{th} variable during t^{th} iteration, d_i^t characterizes highest belonging to i^{th} variable during t^{th} step, a_i will be least arbitrary movement belonging to i^{th} variable, along with b_i will be greatest belonging to arbitrary movement with respect to i^{th} variable. Ant Lion Optimizer algorithm models catching the ants within holes created with the help of antlions by means of altering arbitrary movements about antlions. Succeeding expression was suggested to explain the above-mentioned strategy.

$$c_i^t = Antlion_j^t + c^t \quad (12)$$

$$d_i^t = Antlion_j^t + d^t \quad (13)$$

while c^t will be least entire group of variables during t^{th} step, d^t designates vector comprising greatest among entire variables during t^{th} step, c_i^t will be least among entire variables to i^{th} ant, d_i^t will be greatest among entire variables to i^{th} ant, along with $Antlion_j^t$ demonstrates location belonging to opted j^{th} antlion during t^{th} step. Development of Greater antlions holes with respect to enhancing likelihood existence. For the purpose of modeling Ant Lion optimization employs the roulette wheel strategy which chooses antlions depending with the suitability. Guiding the suitable antlions for instigating a greater number of ants towards hole, utilizing the roulette wheel strategy. To attract ants for navigating in the direction of antlions' limits belonging to arbitrary movement must be diminished flexible with respect to subsequent expression.

$$c^t = \frac{c^t}{I} \quad (14)$$

$$d^t = \frac{d^t}{I} \quad (15)$$

While I will be ratio, that contains least of entire variables during t^{th} step, d^t designates vector comprising greatest of entire variables during t^{th} step. $I = 1 + 10^{w \frac{t}{T}}$ while t will be present step, T will be greatest quantity of steps, along with w will be explained dependent with the present step. $w = 2$ when $t > 0.1T$, $w = 3$ when $t > 0.5T$, $w = 4$ when $t > 0.75T$, $w = 5$ when $t > 0.9T$, and $w = 6$ when $t > 0.95T$. For fine tuning preciseness of implementation, the factor w might be utilized. Penultimate stage with respect to Ant Lion Optimization lies with the getting hold of ants along with the redevelopment of holes. With respect to Antlion Optimization next procedure is followed by getting hold of ant and reconstructing hole for entrapment. Subsequent expression provides the above-mentioned strategy.

$$Antlion_j^t = Ant_i^t \text{ if } f(Ant_i^t) < f(Antlion_j^t) \quad (16)$$

while t displays present step, $Antlion_j^t$ displays location belonging to nominated j^{th} antlion during t^{th} iteration, along with Ant_i^t designates location belonging to i^{th} ant during t^{th} step. Final function with respect to Ant Lion Optimization algorithm by development of appropriate antlion while performing the process of anion will be retained. Mentioned solitary containing the capability producing the impact with ants. Arbitrary movements with respect to antlions attracts the in the direction of chosen antlion. Subsequent equation describes the strategy

$$Ant_i^t = \frac{R_A^t + R_E^t}{2} \quad (17)$$

R_A^t will be arbitrary movement about chosen antlion with the help of roulette wheel during the t^{th} step along with R_E^t will be arbitrary movement about elite during t^{th} step. Obviously, the convergence of the MOALO algorithm inherits from the ALO algorithm. For mitigating the challenge of generating the Pareto Optimal Solutions with variation overcome this challenge, influence attained with respect to Multi-Objective Particle Optimization along with option of front runner in addition with retaining the archive. A boundary be stipulated to archive from where solutions might be selected. Locality belonging to every solution might be analyzed with respect to specified radius. Quantity of solutions within the locality will be measured. For enhancing the spread belonging to solution within the mentioned archive taking into account of two strategy. Primarily,

choosing antlions with respect to solution besides the small gathered vicinity. Subsequent expression explains the likelihood of selectin the archive

$$P_i = \frac{c}{N_i} \tag{18}$$

while c assumes fixed value and have to larger when compared with 1 along with N_i will be quantity of solutions with in the locality belonging to i^{th} solution. Subsequently, while archive contains the fullest capacity, solutions containing heavily crowded locality will be eradicated with respect to archive for placing fresh solutions. Subsequent expression explains the likelihood of eradicating the solution from group.

$$P_i = \frac{N_i}{c} \tag{19}$$

while c assumes the fixed value along with larger when compared with 1 along with N_i will be quantity of solutions with in the locality belonging i^{th} solution. For the purpose of determining the solutions Ant Lion by utilizing many motivation strategy expression (16) have to be altered because of behaviors of many motivational challenges.

$$Antlion_j^t = Ant_i^t \text{ if } f(Ant_i^t) < f(Antlion_j^t) \tag{20}$$

while t demonstrates present step $Antlion_j^t$ displays the location belonging to chosen j^{th} antlion during t^{th} step, along with Ant_i^t designates location belonging to i^{th} ant during t^{th} step. Additional alteration with respect to options of arbitrary of random antlions along with elite with respect to expression (18). Employment of roulette mechanism as provided in expression (16) for opting the non-dominated solution with respect to the archive. Balance functions pertaining to Multi-objective Antlion Optimization will be identical. The pseudocodes of the MOALO algorithm will be presented in figure 3. Processing difficult involved in projected Multi objective Ant lion optimization might contains $O(mn^2)$ while m will be quantity belonging to motivations along with objectives along with n will be quantity of discrete candidates [26]. With respect to storage necessitated with respect to Multi-Objective Ant lion requires the similar quantity belonging to memory related with MOPSO.

Figure 3 Pseudo code for Multi-objective Ant Lion Optimization

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when not satisfying termination condition
for each mentioned insect
    Choose arbitrary antlion belonging to collection
    Choose leading antlion utilizing the strategy Roulette wheel belonging to assembly
    Improve the variables  $c$  and  $d$  utilizing expressions (14) and (15)
    Generate arbitrary movement along with perform standardization utilizing Expressions (9) along with (10)
    Improve location belonging to ant utilizing (17)
end for
Compute motivational standards belonging to entire ants
Improve assembly
On filling the collection
    Remove certain answers utilizing the strategy Roulette wheel along with Expression (19) belonging to collection for entertaining fresh group of answers.
end
display collection
    
```

5. EXPERIMENTAL RESULTS

Stipulated values for identified factors to formulation along with chosen technique 180 nm established with Table 3. With the help of system having configurations with CPU Intel core i7 which comprises 4 GB RAM and MATLAB Software Package version 7.5. Performance Evaluations were carried out. For the proposed Multi-objective Antlion Optimization algorithm, Total quantity of candidates for exploration chosen will be 10 i.e. the formulation variables opted to the selected circuit will be 7. Quantity of repetitive steps chosen to perform the proposed approach will be 100. For the purpose of performing the optimized formulation mentioned two stage Operational amplifier provided specifications will be registered below in table 1.

TABLE 1
TECHNOLOGY PARAMETERS, INPUTS AND LENGTH OF MOS

S. No	Specification	Values used
1	$V_{DD}(V)$	2.5
2	$V_{SS}(V)$	-2.5
3	$V_{IP}(V)$	-0.39
4	$V_{tn}(V)$	0.35
5	$K'_N (\mu A/V^2)$	177.2
6	$K'_P (\mu A/V^2)$	35.6
7	Length (μm)	0.18

TABLE 2
ASPECT RATIOS SELECTED

Design Parameters	Aspect Ratios and Bias Current
$I_{BIAS} (\mu A)$	21.8
C_c	2.018
W_1/L_1	8=1.44/0.18
W_2/L_2	8=1.44/0.18
W_3/L_3	4=0.72/.18
W_4/L_4	4=0.72/0.18
W_5/L_5	1=0.4/0.4
W_6/L_6	40=7.20/0.18
W_7/L_7	8=1.44/0.18

TABLE 3
OBTAINED RESULTS COMPARISON USING MULTI OBJECTIVE ANT LION OPTIMIZATION WITH OTHER TECHNIQUES FOR TWO STAGE OPERATIONAL AMPLIFIER

Design Criteria	Specifications	MALO	SSA	CGWO	GA
Gain	40 dB	44.10	39.89	39.64	36.48
Unity Gain Frequency	5MHz	20.21	19.32	18.43	16.54
Slew rate	$\geq 10 V / \mu s$	24.8	24	20	15
Phase Margin	≥ 60 Degree	63.2	59.24	58.6	48.4
Power Consumption	$\leq 200 \mu$ watt	25.45	67	72	117
Total Area	$\leq 180 \mu m^2$	56.42	65.7	71.26	94.7
CMRR	≥ 60 dB	164.71	142.35	134.6	133.7

The optimization procedures involved with formulation belonging to integrated circuit that functions in analog mode consider the single objective optimization of area or power or delay along with satisfying the other constraints. But here simultaneous consideration of so many important objectives such as Area, Power, Open loop Gain, Unity Gain Bandwidth

ratio and so on. Based on the above objectives'fitness function is evaluated. For maximizing the fitness function is fundamental motive of the paper. By the tabulated results it was observed that the multi objective antlion optimization performs better and produces improved results compared with single objective Chaotic Grey Wolf Optimization, Salp Swarm Optimization Algorithm, along with Genetic Algorithm.

6. CONCLUSION

Research work concentrated in the establishment of determining the best design parameters for CMOS Operational Amplifier with the help of Multi-Motivational Optimization strategy. The mentioned strategy involved in obtaining the best sizes of transistor to accomplish the best functionality of the circuit using Operational Amplifier. Fundamental motivation lies in the fact of identifying the dimension of transistor for satisfying the provided constraints such as duration of formulation, Area, the amount of power dissipated and etc., With respect to the proposed work, a unique multi-motivational strategy for determining the best solution utilizing Multi-Objective Ant Lion Optimization was performed. Suggested approach permits the concurrent determination of best values for various parameters stipulated due to the alterations with the characteristics was considered for the purpose of satisfying the stipulated values. Subsequent to the identification of best values for the formulation of two-stage operational amplifier that utilizes the transistor of CMOS device and by observing the tabulated results, it was noticed that the suggested strategy produced excellent outcomes. Because of utilization of group of solutions, group of pareto best solutions was determined, along with the least was selected as concluding best solution.

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