ANALOG CIRCUIT OPTIMIZATION WITH GENETIC ALGORITHM

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I. INTRODUCTION

Genetic algorithms are computerized search and optimization algorithm based on the mechanics of natural genetics and natural selection [7]. This method is very different and very efficient comparing with traditional method. Genetic algorithm uses a population of point at one time in contrast to the single point approach by traditional optimization method [7]. Genetic algorithm is based on the darvins theorem "survival of the fittest". Generating new design solutions from a population of existing solutions, and discarding those design solutions which have an inferior performance or fitness [5]. Here design and optimizing the analog circuit with the help of genetic algorithm. So for this genes are represented by each part of the circuit.

II. ANALOG CIRCUIT DESIGN WITH GENETIC ALGORITHM

Now days many of the circuits are designed with digital system. Invention of integrated circuit will reduce the size and increase the compatibility of the circuit. But so many issues are there for digital circuits. Main issues are some components like transformer. Inductors can't be integrated by an IC; they are normally connected externally to the circuit. And also issue on designing of the digital circuits. Second option is designing an analog circuit. Designing an analog circuit with manual control of the parameter are time consuming. So a new technology ois invented. Optimizing the circuit with the help of genetic algorithm.

Genetic algorithm consist of two steps

- Selection of the circuit design
- Optimization of the circuit parameter

In the first step a circuit topology is generated including expected characteristics expected output and the components values. Components values are a arbitrarily selected values they have a huge different from the original value. They are generally used to make a population for the reproduction. Reproduction which is usually the first operator applied on a population selects good chromosomes in a population to form the mating pool [7]. In the second step circuit components will converges to its original value. So this process includes following steps

- Selection
- Cross over
- Mutation

In the selection process choosing the right parents from the mating pool for the reproduction then only a better offspring generates. Second operator is different from the first one in this operation the parents will exchange their one part of the chromosomes. Mutation operator when compared to crossover is used sparingly. The operator changes a 1 to a 0 or vice versa to keep the diversity of the population. The whole process will continue until obtain desired offspring or

output. Here the circuit output and the component values are offspring. Genetic algorithm (GA) is based on the Darwin's theorem "survival of the fittest". GAs mimics the Darwinian theory of survival of the fittest and principle of nature to make a search process. GA starts with pool of randomly generated candidate solutions, which are then tested and scored with respect their utility [4]. These solutions are produce offspring's which are closer to the desired solution than precious generation. Each component in the circuit is encoded in to gene, mainly it has 4 fields they are TYPE, START POINT, END POINT, and COMPONENT VALUE. This is a net list method [8]. Another type is programming type [9]. Each component will be represented by a group of instruction. In each generation or evolution the instruction will be modified. E.g. X-move-to-new in this example outgoing node is new node, active node is new node. We can represent any two pin component with this instruction, X in the instruction indicate which type of component is used. Most important decision in applying Gas to an optimization problem is how to represent the design solution in the chromosome [5]. When considering the chromosome all are equal length but in the case of circuit size may vary from branch to branch so an extra component known as „empty" component along with normal circuit component. Circuit complexity is determine by maximum number of gene, a population of circuit details are formed they will generate new chromosomes by crossover between two parents or mutation of one single chromosome, this will repeated until obtain a desired fitness value. Fitness values are calculated after generating the topology and optimizing the component value. In general, fitness function is first derived from the objective function and used in successive genetic operations. There are different methods are adopted for component value optimization. One method adopted is using a quasi-newton-fletcher-powell method (DFP method). Another method used for optimization by using MATLAB software and HSPICE. Evolutionary algorithm can be implemented using the MATAB; HSPICE can be used to examine fitness function. After simulation these parameter are send back to MATLAB again so that they are examined by the evolutionary algorithm and they optimized [3]. These are like a a loop operation, so above explained process will continue to attain the stop point.

III. CONCLUSION

Designing of analog circuit using genetic algorithm is one of the best and efficient method and also this method will help to reduce the time consumption for analog circuit design. We can generate circuit that are efficient and fully meet the design goal by using personal computer. For this process no need for high level knowledge only basic knowledge is needed.

REFERENCES

[1] Mansour Barari,1 Hamid Reza Karimi,2 and Farhad Razaghian1 "Analog Circuit Design Optimization Based on Evolutionary Algorithms"

[2] Navid Azizi "Automated Analog Circuit Design Using Genetic Algorithms"

[3] Varun Aggarwal "Analog Circuit Optimization using Evolutionary Algorithms and Convex Optimization"

[4] Jason D.Lohn_, Silvano P. Colombano_, Gary L. Haithy, Dimitris Stassinopoulos_ _Computational Sciences Division j yRecom Technologies, Inc. "A PARALLEL GENETIC ALGORITHM FOR AUTOMATED ELECTRONIC CIRCUIT DESIGN" NASA Ames Research Center

[5] James B. Grimbleby "Automatic analogue circuit synthesis using genetic algorithm"

[6] www.circuitstoday.com/integrated-circuits

[7] S. Rajasekaran, G.A. vijayalakshmi pai "neural networks, fuzzy logic, and genetic algorithms synthesis and applivation"

[8] C. Goh and Y. Li, " GA Automated Design and Synthesis of Analog Circuits with Practical Constraints," Proceedings of the 2001 Congress on Evolutionary Computation, vol. 1, no. 1, pp. 170-7, 2001.

[9] J.D. Lohn, G.L. Haith, S.P. Colombana and D. Stassinopoulos, " Towards Evolving Electronic Circuits for Autonomous Space Applications," Proceedings of the 2000 IEEE Aerospace Conference, vol. 5, no. 1, pp. 476-86, 2000.

[10] Mansour Barari,1 Hamid Reza Karimi,2 and Farhad Razaghian1 "Optimizing an LNA Circuit by Combining Multi-Objective Genetic Algorithm and HSPICE"

[11] Angan Das and Ranga Vemuri "GAPSYS: A GA-based Tool for Automated Passive Analog Circuit Synthesis"