

# Hybrid Optimization Technique for Circuit Partitioning Using PSO and Genetic Algorithm

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**Abstract:** In the partitioning main objective is to minimize the number of cuts. For this PSO algorithm is proposed for the optimization of VLSI interconnection (net list) bipartition. Meanwhile, the corresponding evaluation function and the operators of crossover and mutation are designed. The algorithm is implemented to test various benchmark circuits. Compared with the traditional genetic algorithm (GA) with the same evaluation function and the same genetic operators concerned the hybrid PSO and GA algorithm will give better results.

**Keywords:** Partitioning, Particle Swarm optimization, Genetic Algorithm.

## I. INTRODUCTION

Circuit partitioning/clustering is an important aspect of VLSI design. It consists of dividing a circuit into parts, each of which can be implemented as a separate component (e.g., a chip) that satisfies certain design constraints [1]. The limited area of a component forces the designer to lay out a circuit on several components. Since crossing components incurs relatively large delay, such a partitioning could greatly degrade the performance of a design if not done properly. There has been a large amount of work done in the area of circuit partitioning and clustering [2] [3]. In circuit partitioning, the circuit is divided into two (bi-partitioning) or more (multi-way partitioning) parts. In circuit clustering, the circuit is built up cluster by cluster. To partition designs of large size bottom-up clustering is often combined with top down partitioning. The classical objective of partitioning is to minimize the cut-size, i.e. number of nets spanning two or more parts .

The different objectives that may be satisfied by partitioning are:

The minimization of the number of cuts: The number of interconnections among partitions has to be minimized. Reducing the interconnections not only reduces the delay but also reduces the interface between the partitions making it easier for independent design and fabrication. It is also called the min cut problem.

To improve the fitness function is the objective of circuit partitioning. Fitness function denotes the improvement in the parameters of the circuit. The more is the fitness function the better is the result of partitioning. Area of each partition is also used as a constraint to reduce the fabrication cost with minimum area or as a balance constraint so that partitions are of almost equal size.

Number of partitions appears as a constraint as more number of partitions may ease the design but increase the cost of fabrication and number of interconnections between partitions .

## II. CIRCUIT MINIMIZATION TECHNIQUES

### Particle swarm optimization (PSO):

The basic idea of PSO stems from the behavior of birds, in which each particle or bird keeps track of its coordinates in the solution space which are associated with the best solution that is achieved so far by that particle is called as personal best position (p best) and the another best value obtained so far by any particle is called as global best position (g best). Each particle tries to modify its position using the concept of velocity. The salient features of PSO are:

1. PSO method is based on researches on swarms such as fish schooling and bird flocking.
2. It is a history based algorithm such that in each step the particles use their own behavior associated with the previous iterations.
3. It is easy to implement. Therefore the computation time is less.

### GA (Genetic Algorithm):

All genetic algorithms work on a population or a collection of several alternative solutions to the given problem. Each individual in the population is called a string or chromosome, in analogy to chromosomes in natural systems. The population size determines the amount of information stored by the GA. The GA population is evolved over a number of generations. All information required for the creation of appearance and behavioral features of a living organism is contained in its chromosomes. GAs are two basic processes from evolution: inheritance, or the passing of features from one generation to the next, and competition, or survival of the fittest, which results in weeding out the bad features from individuals in the population. The objective of the GA is then to find an optimal solution to a problem .Since GA's are heuristic procedures, modeled as function optimizers, they are not guaranteed to find the optimum, but are able to find very good solutions for a wide range of problems [4].A GA based evolutionary approach for circuit partitioning giving a significant improvement in result quality. Comparative evaluation of genetic algorithm and simulated annealing was done with genetic algorithm giving better results [5] .A new hyper-graph partitioning algorithm was proposed.

### Hybrid PSO and GA introduction:

Hybridization of evolutionary algorithms with local search has been investigated in many studies [6]. Such a hybrid model is often referred to as a mimetic algorithm. Two global optimization algorithms GA and PSO are combined. Since

PSO and GA both work with a population of solutions combining the searching abilities of both methods seems to be a good approach. Originally PSO works based on social adaptation of knowledge and all individuals are considered to be of the same generation. On the contrary, GA works based on evolution from generation to generation so the changes of individuals in a single generation are not considered [7]. Through GA & PSO have their specific advantage have their specific advantage when solving different algorithm, it is necessary to obtain both their individual feature by combining the two algorithms. The performance of algorithm is described as follow:

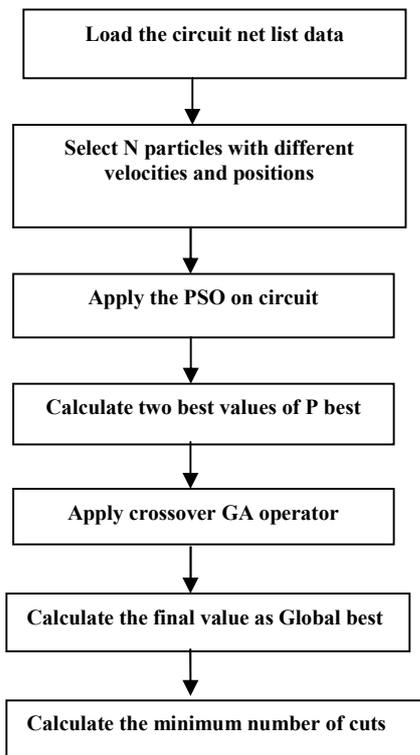


Figure: 1 Flowchart of Hybrid PSO\_GA Algorithm

Table 1 Results of partitioning on different Netlists with Hybrid PSO and Genetic Algorithms with different iterations:			
Circuit Series of different net list	Number of Nodes	Number of netlists	Minimum cut
SPP N-65 Series	65	7	10.71
SPP N-70 Series	70	10	16.90
SPP N-75 Series	75	10	13.33
SPP N-80 Series	80	12	15.41
SPP N-85 Series	85	11	20.36
SPP N-90 Series	90	4	15.75
SPP N-95 Series	95	9	14.88

Table: 1 Results of partitioning with Hybrid PSO and Genetic Algorithms with different iterations

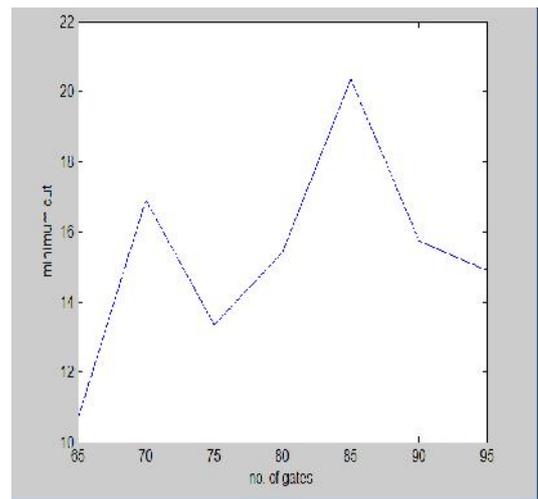


Figure: 2 . No. of Gates Vs. Minimum Cut.

III. RESULTS AND DISCUSSIONS

The Proposed Algorithm is tested on 07 netlists to demonstrate the effect of iteration by using hybrid PSO and GA algorithm on partitioning. The result of partitioning with PSO and GA is given in Table 1, here the number of particles are taken as 5. Fig 2 shows the plot between the no of gates and minimum cuts for the best of first 50 iteration. .

IV. CONCLUSION

In this Paper, Hybrid PSO and GA algorithm is applied to VLSI circuit partitioning problem. It is observed that by increasing in the number of iteration we can decrease the min. cut of the system. By applying the Hybrid PSO and GA algorithms to different netlist, we are getting better results in hybridization. So, by this paper, we have concluded that the

Hybrid PSO and GA method is better than any other optimization technique for minimizing the number of cuts in the different circuit series.

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