Applying Parallel Processing Technique in Parallel Circuit Testing Application for improve Circuit Test Ability in Circuit manufacturing

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Abstract: Circuit testing process is very important in IC Manufacturing there are two ways in research for circuit testing improvement. These are ATPG Tool Design and Test simulation application. We are interested in how to use parallel technique such as one-side communication, parallel IO and dynamic Process with data partition for circuit testing improvement and we use one-side communication technique in this paper. The parallel ATPG Tool can reduce the test pattern sets of the circuit that is designed in laboratory for make sure that the fault is not occur. After that, we use result for parallel circuit test simulation to find fault between designed circuit and tested circuit. From the experiment, We use less execution time than non-parallel Process. And we can set more parameter for less test size. Previous experiment we can't do it because some parameter will affect much waste time. But in the research, if we use the best ATPG Tool can optimize to least test sets and parallel circuit testing application will not work. Because there are too little test set for circuit testing application. In this paper we use a standard sequential circuit of ISCAS89.

Keywords: IC Manufacturing, Circuit testing improvement, ATPG Tools, MPI-2, one-side communication

1. INTRODUCTION

Modern VLSI technology today is extremely developed and increase complexity [1]. The products with VLSI technology that means product in IC Manufacturing are contain faults and we want to detect faults as early as possible. In a lot of researches, they present how to produce the ATPG (Automatic Test Pattern Generation) to create the test vector to test the circuit.

Many Parallel ATPG tools are implemented to increase performance improvement such as CRIS [2], GATEST [3],[4], DIGATE[5] and HPGAST[8]. Previous parallel tools use technique of two-side communication. So it takes a more latency and synchronization overhead and more overlap of communication and computation[9]. We present one-side communication model that solve above problem to reduce time in execution. The time reduction support more than opportunity in increase GA Population generation to get more optimum solution that means a less test size and number of fault detect.

In this paper, Next section we present concept of ATPG, Fault Simulation, Basic GA Technique in ATPG and Parallel Technique for Parallel ATPG Tools and fault simulation. Section 3 present how using parallel technique to solve limitation of GA ATPG. Section 4 Present Experiment result and Last Section is conclusion.

2. Related Work

2.1 ATPG (Automatic Test pattern Generation)

The Objective of ATPG is to find and create test set. And use the test vector to test the real circuit from the first vector to last vector. ATPG Tool is a necessary tool to generate the test vector. If we don't use ATPG Tool, We have to test all of inputs with in test circuit. A size of problem is $2^N$when N is inputs or flip-flops in the circuit [6], [7]. It takes several times to find the faults.

2.2 Fault Simulation

We use Fault Simulation to find fault in circuit. After we use ATPG to create test, we can use test set to generate outputs and find difference between correct circuit and any test circuit. The difference can detect that the failure of circuit occurs. And when we check location of different value with fault simulation we can find where circuit failure is.

2.3 GA Technique for Parallel ATPG Tools

There are many approach to develop ATPG Tools. One of the famous techniques that this paper use is simulation approach with GA(Genetic Algorithm). Test sets are assign to population of string or individuals and use fitness function to assign value for population and use evolutionary process of selection, crossover and mutation for generate new population

From the existing population. The important thing of GA Technique is GA parameter configuration, that consists of population sizes and number of generations, the number of selections, percentage of crossover and mutations that achieving good results.

2.4 Parallel ATPG Tools and Fault Simulation

There are many parallel ATPG Tools and fault simulation. Almost parallel Tools use two-sided communication model, communication involves both sender and receiver sides and the synchronization is implicitly through communication operations. When MPI-2 standard introduces one-sided communication model that means all communication parameter and synchronization is done explicitly to ensure the completion of communication.

3. PARALLEL TECHNIQUE

3.1 Solving Limitation of ATPG Tools with GA

From Section 2.3 when we consider about GA parameter. We find that when we use more population and higher mutation, we will have more optimal solutions but we will have a more long waiting time too. That is problem to find how to get optimal solution with not too long time. We suggest to use some parallel technique that reduce communication and

computation time

3.2 Parallel Technique

When we look previous parallel ATPG Application in section 2.4, we find that one-sided communication model can improve throughput and reduce latency and synchronization overhead that improve communication time and also achieve better overlap of communication and computation. With this parallel technique, we will use less time to create ATPG Tools. And when we config for more GA Parameter, We will Get a better test set result that means less the number of test sets.

4. EXPERIMENTAL RESULT

4.1 Experiment Testbed

Our this Experiment we use HPGAST GA ATPG Tools, HOPE sequential circuit fault simulation MPI and MPI2 for the ISCAS89 sequential benchmark on 72-PC Cluster. First we use previous GA Parameter that is population generation equal 600,tournament selection without replacement and uniform crossover and use mutation at 20 percent or 0.2-mutation probability.

4.2 Parallel Implementation

We focus on active one-sided communication in experiment with MPI2 and MPICH. We use MPI_Win_Start, MPI_Win_Complete, MPI_Win_Post and MPI_Win_Wait function for synchronization and use MPI_put, MPI_Get and MPI_Accumulate for data transfer and communication.

4.3 Experiment Evaluate

Two results that we are interested are less time using and better test set solution. Parallel Technique can less execution time and we apply to config more population. First we look at time using with MPI (column A) and MPI-2 (column B) in table 1

Circuit	Execute time (minute) (MPI VS MPI2) and # of CPU							
	2 CPU		4 CPU		8 CPU		16 CPU	
	A	B	A	B	A	B	A	B
S298	4.70	3.95	4.70	3.87	2.02	1.72	1.43	1.20
S386	1.88	1.64	1.80	1.51	0.95	0.85	0.72	0.63
S526	18.53	15.94	9.30	7.72	3.68	3.13	2.65	2.27
S641	31.55	26.82	7.42	6.46	3.12	2.62	2.17	1.91

From Table1 we find that when we use MPI2 in one-side communication model. We can reduce execute time 10-14 percent from previous Tool with two-side communication Model that we can config GA Parameter from 600 to 630 and 600 we get less test set size but almost same value in Fault Detect when we look at 16 CPU in Table 2

Circuit	Faults	#Fault Detect VS Test Set length VS Number of population at 16 CPU					
		#Fault Detect			Test Set length		
		600	630	660	600	630	660
S298	308	264	265	264	478	459	427
S386	384	300	305	303	213	203	187
S526	555	427	430	432	456	434	407
S641	467	404	403	404	124	116	110

From Table2 when we increase number of population from 600,630 and 660 we can get less test set size and get less time when we use two-side communication Model . In Fact we can increase more than 660 but there effect to Fault Detect that we must optimize GA tool too. That is difficult. In this research we want to present when we increase number of population and we get test set length only

We try to use this technique with fault simulation but it's not work because when we get less test set length the sequential process will get less execution time than parallel process.

5. CONCLUSION

We use one of new parallel Technique that is one-side communication to apply in ATPG Tool and fault simulation. In ATPG Tool we find that reduce execute time up to 14 percent and when we increase population size we can get less Test Set size too. But Two factor that we consider in this paper is number of fault detect and time that would less than we use two-side communication.

Future work, We will try another MPI2 Feature (dynamic process and Parallel IO) to less execute time and try to optimize ATPG Tools to support the more population too.

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