Fault Node Identification Using Comparison Models

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Abstract- **To detect fault nodes, multiprocessor systems requires rapid and literal mechanisms. The main problem of system level fault diagnosis is difficult and not efficient and also no such generic deterministic solutions are known for motivating the purpose of heuristic algorithms. In this paper we are showing how artificial unaffected systems (AUS) can also be used for fault diagnosis in multiprocessor systems having large number of nodes. Here we deal with two models, (i) The generalized comparison model, (ii) The simple comparison model, and also we propose AUS based algorithms for identifying some faults in diagnosable systems and based variation among units. We conducted experimental analysis of these algorithms by reproduce them on randomly generated diagnosable systems of different sizes under different fault scenarios. These results indicate that the AUS based approach provides a better solution to the system level fault diagnosis problems.**

Keywords— **System level diagnosis, Fault tolerance, comparison models, artificial unaffected systems, multiprocessor systems.**
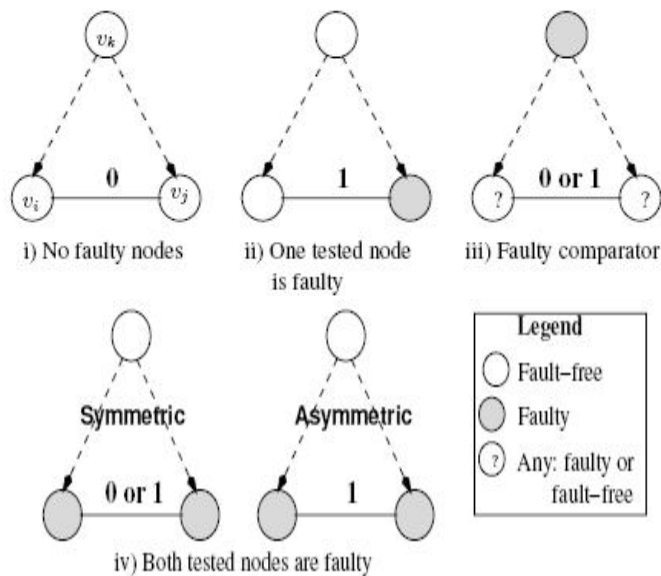
I. INTRODUCTION

Massive self-diagnosable distribute systems are helpful in providing dependable platforms for crucial applications, these also called loosely coupled multi-processer systems, these are sometimes composed of thousands of interconnected processing units and in order to identify faults at the processor level a group of diagnosis tests are performed by the units and results from those tests are the current processor also should need to be diagnosed as fault-free or faulty. These types of problems are known as system level fault diagnosis problems. In this paper first we define the comparison model for system level diagnosis, some related notations.

In multiprocessor systems, system level fault diagnosis can be described by two graphs, one is comparison graph and another one is communication graph. Here the communication graph shows the interconnection topology of the multiprocessor system. e = (p, q) undirected edge represents a communication link between two different processor p and q. The comparison graph shows the tests that executed in order to find out the group of faulty processors, once if a faulty situation is identified that is when the system differ from its expected behaviour because of some faults in the system processors. Here we can classify faults like either as transient faults or permanent faults; a transient fault may occur once and vanishes. A eternal fault is remains to exit until the fault unit is fixed. We measured only permanent faults in this paper, here if the fault node is problem to communicate with other of the system, then this fault is known as hard, if the fault unit continues to communicate with modified behaviours with the remaining nodes in the system, then these types of faults are known as soft. We considered two comparison models in this paper those are the generalized comparison models and simple comparison model, the distinction between these two models are in simple comparison model all comparison tests are executed by central observer that monitors the entire system, but in generalized comparison model the main central observer processor is one of the other processors beaning compared. In both models the diagnosis of faults based on the outcome comparisons, and it is performed by the central observer. If the system differ from its specified state behaviour and if the faulty situation is identified then the very first thing is to consists in diagnosing the current state of the system that is to identifying which nodes are faulty and which nodes are fault free. The fault identification process is depending on the comparison output by the system nodes. If there are no fault free units wrongly diagnosed as faults that diagnosis is said to be correct otherwise it is an incorrect diagnosis. If a diagnosis is said to be complete whenever if all faulty units are identified properly; otherwise that diagnosis is incomplete. (i) Simple comparison model- In this model there is a comparator which performs comparison between different processors by assigning tasks from the group of tasks A = {A1, A2, . . .} each processor p and q is assigned to a task A. Once the task A is completed by both processors their results are examined, here in this case the comparison graph is an undirected graph G = (N, C), where

N denotes the group of processors and C = {(p, q): (p, q)} is a pair of processors performing the same task A. (ii) Generalized comparison model generalizes both invalidation models and comparison models. In validation model units tests each other directly that is, the comparator node is also a one of the nodes under comparison. According to the generalized comparison model if the main comparator node is fault free node then 0 is the outcome of comparison if none of the compared nodes are faulty and it is 1 if any one of them is faulty and one of the main thing is if the comparator itself is faulty then the outcome of comparison is unreliable, and the value is may be 0 or 1.

i) No faulty nodes ii) One tested node is faulty iii) Faulty comparator Symmetric Asymmetric iv) Both tested nodes are faulty

Legend

○ Fault–free
◑ Faulty
? Any: faulty or fault–free

II.   RELATED WORK

We worked on artificial unaffected system, which design is pretty similar to the design of other common computational intellectual methods, such as genetic algorithm. First we need to select one representation scheme for the search space after that we need to define one or more calculation tasks to access the behavior of the possible solutions. At last we have to propose an unaffected algorithm which will be leading the dynamics of the search. Our artificial unaffected system based diagnosis uses a binary scheme to represent likely solutions. A binary string length |L| is used to model a possible solution *ab*, is defined like for each $i \leq |L|$, $ab[i] = 1$ if the processor P_i is considered as like faulty, $ab[i] = 0$ if P_i is expected to be like fault free node. Meanwhile we are dealing with N diagnosable systems; the number of bits at 1

in a possible solution should not surpass the range of N, and should not be less than once in a faulty condition and at least one processor is faulty. We need some methods or ways that can provide a degree of the compatibility between a given comparison condition ant that condition is generated by our algorithm from a possible solution.

Algorithm analysis – A diagnosis algorithm is said to be correct if and only if all fault free processors are exactly acknowledged, the accuracy of our algorithm follows irrelevant from the definition of the affinity quantity given in equation. We provide the correctness for general comparison model.

The fault identification problem has been widely studied resulting in the expansion of various diagnosis algorithms; among earlier solutions to this fault diagnosis problem there have been only a few results that deal with the system level diagnosis problem under general comparison model. Sengupta diagnosis algorithm offers a exact solution under general comparison model, inappropriately this algorithm has time complexity of $O\ (N^5)$ which makes it unreasonable, especially when seeing large systems those are having thousands of nodes, Blough studied about the complexity of fault diagnosis systems beneath comparison models and the deliver well organized algorithms for diagnosing systems for those comparison task is a mutual graph. One of the diagnosis algorithm also been proposed by Blough for their comparison model, it requires $O\ (|C|\ +\ t^2|V|)$ steps under some asymmetric expectations. Chessa offered a new comparison based diagnostic model based on one to many communication data transfer which takes advantage of the ad-hoc networks. They designed a diagnosis protocol and also gave implementations for their model. The need for effective solutions for diagnosis of huge systems are inspired the use of heuristic algorithms and evolutionary ways. To solve the self-diagnosis problems we are using some genetic algorithms in both simple comparison model and generalized evaluation model, the approach used by the Abrougui is quite efficient in to identifying the faulty processors, the main disadvantage of these approaches are the running time of these algorithms are very huge. In detail the genetic algorithm suffers from loss in inhabitant's diversity due to the use of transformation operation other than a random operation, this experimental result has in high worst case behaviour especially for huge systems composed of thousands of processors. In this paper we proposed artificial unaffected based method; it avoids such worst case behaviours because artificial unaffected systems based algorithms do not suffer from a loss of inhabitant's diversity.

III. RESULTS

The artificial unaffected system -based fault identification algorithm has been implemented in language c++ and executed using a PC equipped with a Intel CPU 2.4GHz and 256MB of RAM. We designed two versions of the algorithm first one is the simple comparison model and the second one is the generalized comparison model. The performance calculation of the algorithms is based on randomly generated comparison graphs and using all possible fault sets that may occur in a N-diagnosable situation.

Performance beneath the Simple Comparison Model

For the comparison model we used basically N-diagnosable systems from the special design Data transfer (N) with t ≤ N, here x denotes the largest integer and not larger than the x. A comparison graph G (P,Q) is a Dα(N) design if for all pi ∈ P, |Гi| ≥ α, i.e., each processor is at least compared with other α processors. The parameters for the algorithm is set to the following values pop size, the population size is fixed to 10 if N ≤ 25. This method was proposed by de Castro for optimization tasks. That means that we are not applying the affinity balanced cloning
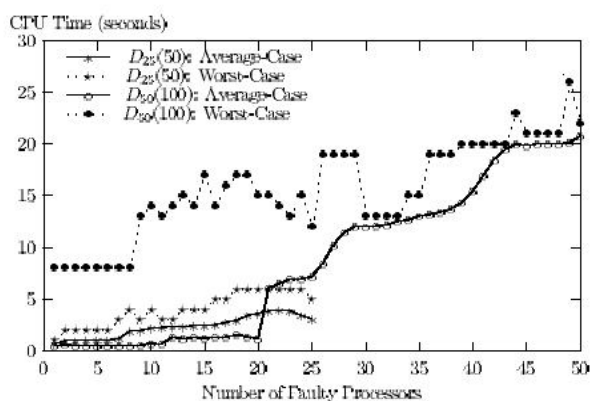
Performance beneath the generalized comparison model

The classification of generalized comparison model based N-diagnosable systems the one provided by Sengupta and those implemented by Bough and are somewhat theoretical and difficult to implement especially for huge systems, we used a distinct class of diagnosable systems. The immune diagnosis approach does not depend on the comparison

multigraph, then it follows that the following results remain valid for general graph structures. Below figure shows the average and the worst case cpu times for the unaffected diagnosis algorithm.
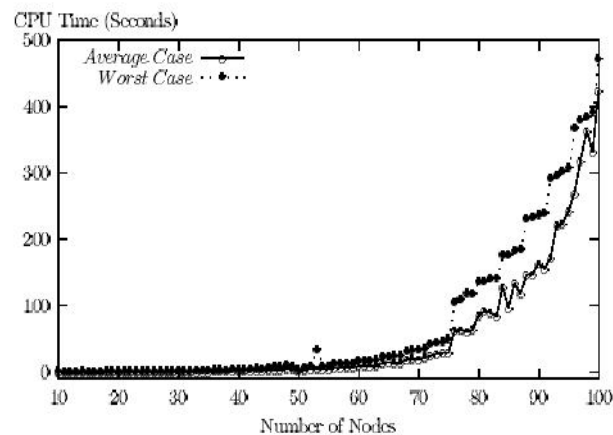

Fig. CPU time vs Number of processors

IV. CONCLUSION

The difficulty of fault identification in diagnosable systems are based on an input condition tolerates certain comparisons to the process by which the unaffected system produces antibodies against specific antigens. That means artificial unaffected systems can also be used to design solutions to the fault system diagnosis problems like we are shown in this paper. Artificial unaffected systems-based algorithms were developed for fault identification in the circumstances of various evaluation based models. The investigational results from wide replications showed that the artificial unaffected systems-based diagnosis method can properly recognize the faulty processors. Furthermore, the model results specify that the artificial unaffected systems-based diagnosis algorithm is effective in both the average and worst cases scenarios, when seeing large systems.

Our experimental results presented that the AUS-based methods are an attractive and feasible alternative to extant fault diagnosis methods. Additional experimental analysis and evaluations with the current solutions. We trust that given the structures of the immune diagnosis approach a usual allowance would be to apply this new method to the probabilistic models for fault system diagnosis. It would also be stimulating to testing and analyse the use of different mechanisms.

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