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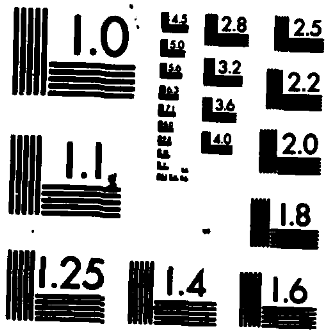

THE PMC SYSTEM LEVEL FAULT MODEL:
MAXIMALITY PROPERTIES OF
THE IMPLIED FAULTY SETS

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ABSTRACT

In this paper, we examine the implied faulty sets in the case of the PMC system level fault model. We show that those sets possess a maximality property whenever: the system is one-step τ-diagnosable, no two modules test each other and the number of faulty modules is no larger than τ. In addition, we propose a syndrome-decoding algorithm based on that maximality property.

INTRODUCTION

Since its introduction in 1967, the *PMC* system level fault model proposed by Preparata, Metze and Chien [9] has been the subject of much attention. Conditions that insure one-step τ-diagnosability have been proposed in [1], [3] and [9], and decoding algorithms have been proposed in [2] and in [4]-[8].

One of the major stumbling blocks for the synthesis of decoding algorithms for the *PMC* model is the absence of known useful properties that result from the assumptions of the model. Thus, the existing algorithms depend either on strong assumptions on the structure of the testing interconnection [5], [7], on unproven conjectures [2], or on searches with the associated drawback -- namely, backtracking [4] -- or they are insured to work only when few faults are present [6] [8].

It seems reasonable to assume that if a *PMC* model is one-step τ-diagnosable, then well-chosen quantities exist that exhibit useful properties. In previous work [5]-[8], we used the concept of the *implied faulty set* to analyze the *PMC* model. The implied faulty set of a module is simply the set of all the modules in the system that may be deduced to be faulty under the assumption that the module is non faulty. The usefulness of this concept has been demonstrated in [5] and [7] for the case of $D_{\delta,\tau}$ interconnection structures, and in [6] and [8] for the case in which no two modules test each other, and the number of faulty modules is small.

In this paper, we show that the implied faulty sets of one-step τ-diagnosable *PMC* models in which no two modules test each other satisfy a *principle of optimality:* the module that corresponds to a maximal implied faulty set is always faulty.

THE *PMC* SYSTEM LEVEL FAULT MODEL

Consider a system S of n modules $U_0, U_1, \ldots, U_{n-1}$ and a testing interconnection design $TID = \{(i,j) \mid U_i \text{ tests } U_j\}$. It is assumed that when (i,j) is in TID, the test outcome $a_{i,j}$ of U_i testing U_j is $a_{i,j} = 0$ if U_i believes U_j to be nonfaulty, and $a_{i,j} = 1$ if U_i believes U_j to be faulty. A complete set of test outcomes, i.e., an outcome $a_{i,j}$ for each (i,j) in TID is called a *syndrome*. The diagnosis problem consists in partitioning S into the set G_S of non faulty modules and the set F_S of faulty modules from the knowledge of one of the possible corresponding syndromes. In this paper, we assume that the only faults that may occur are solid, and that the test-fault relationship satisfies at least the Preparata-Metze-Chien assumption given below.

Hypothesis 1:

(i) If (i,j) is in TID and U_i is nonfaulty, then $a_{i,j} = 0$ implies that U_j is nonfaulty, and $a_{i,j} = 1$ implies that U_j is faulty;

(ii) If (i,j) is in TID and U_i is faulty, then U_j may be nonfaulty or faulty regardless of the value of $a_{i,j}$.

Given (G_S, F_S), Hypothesis 1 implies that only a subset of all possible syndromes may occur. Determining all possible syndromes that correspond to a given partition (G_S, F_S) of S is not difficult. On the other hand, the problem we address in this paper -- that is, given a syndrome produced by a partition (G_S, F_S) of S, find (G_S, F_S) -- is much more difficult to solve.

Not all the partitions of S into nonfaulty and faulty modules may explain a given syndrome. A partition (G, F) of S is *consistent* with a given syndrome if and only if the assumption that all the modules in G are nonfaulty and all the modules in F are faulty is consistent with the syndrome. The partition (G_S, F_S)

is obviously consistent, but unfortunately, many partitions usually exist that are consistent with any given syndrome. Thus, given a syndrome, one cannot identify the faulty modules without additional assumptions.

If we assume that the *a priori* probability that a set of modules F is faulty is inversely proportional to the cardinality $\| F \|$ of F, then it is reasonable to look for the consistent partitions of S that are most likely to occur: namely, the consistent partitions of S in which $\| F \|$ is minimal. Such partitions, called *minimal consistent partitions* are the solutions to the following discrete minimization problem.

Problem 1: Given a syndrome, find a consistent partition $(G_{\#}, F_{\#})$ of S such that $\| F_{\#} \| \leq \| F \|$ for all the partitions (G, F) of S that are consistent with the syndrome.

If the number of faulty modules does not exceed τ, at least one consistent partition, namely (G_S, F_S), exists such that $\| F_S \| \leq \tau$. If only one such partition exists, then finding the partition (G_S, F_S) reduces to solving Problem 1 whenever $\| F_S \| \leq \tau$. Thus, in the context of our paper, one-step τ-diagnosability [9] reduces to:

Definition 1: A system S is one-step τ-diagnosable if and only if whenever a consistent partition (G, F) exists such that $\| F \| \leq \tau$, that partition is the unique solution to Problem 1.

IMPLIED NON-FAULTY AND FAULTY SETS

We have reduced the problem of identifying the partition (G_S, F_S) to that of solving a discrete minimization problem, Problem 1. Our approach to this problem depends on the concepts of implied non faulty and faulty sets.

Definition 2: The implied non faulty set $M(U_i)$ of a module U_i (with respect to a given syndrome) is the set of all the modules in S that may be deduced to be non faulty under the assumption that U_i is non faulty.

Definition 3: The implied faulty set $L(U_i)$ of a module U_i (with respect to a given syndrome) is the set of all the modules in S that may be deduced to be faulty under the assumption that U_i is non faulty.

If the module U_i is in G_S, then $M(U_i)$ is a subset of G_S, $L(U_i)$ is a subset of F_S, and therefore, $M(U_i)$ and $L(U_i)$ are disjoint. Thus, if $M(U_i)$ and $L(U_i)$ are not disjoint, we may conclude that U_i is in F_S. Let F_0 and G_0 be the sets defined by

$$F_0 = \{ U_i \in S \mid M(U_i) \cap L(U_i) \neq \phi \},$$

and

$$G_0 = S - F_0.$$

The set F_0 is a subset of F_S, provided that the basic assumption on the fault-test relationship, namely Hypothesis 1, holds. The fact that F_0 is a subset of F_S does not depend on any assumption concerning the maximum number of faulty modules, nor on assumptions concerning the structure of the testing interconnection network. The set F_0 is not difficult to obtain. Given a system S and a syndrome, we may compute F_0 and consider the reduced system S_0 obtained by deleting F_0 from S and the corresponding reduced syndrome obtained by deleting all the tests links between G_0 and F_0 from the original syndrome. Note that if S is one-step τ-diagnosable, then S_0 is one-step $(\tau - |F_0|)$-diagnosable.

Clearly, if Hypothesis 1 is satisfied and if $L(U_i) \cap G_0 = \phi$ for every module U_i in G_0, then the partition (G_0, F_0) is a solution to Problem 1. Thus, Definition 1 implies that, in some cases, the set F_S of faulty modules is the set F_0.

Lemma 1: If Hypothesis 1 is satisfied, if S is one-step τ-diagnosable, if $L(U_i) \cap G_0 = \phi$ for every module U_i in G_0, and if $|F_0| \leq \tau$, then $F_S = F_0$.

MAXIMALITY OF THE IMPLIED FAULTY SETS

The set F_0 may be computed as soon as the implied non faulty and faulty sets have been obtained, and we know that every module in F_0 is faulty. We have no reason to believe that F_0 contains all the faulty modules. We could use the fact [8] that $F = L(G)$, where

$$L(G) = \{ U_j \mid U_j \in L(U_i), U_i \in G \}$$

whenever (G, F) is a minimal consistent partition, to search for the minimal consistent partitions, but this search may be tedious. We will now present a property of the implied faulty sets that holds when the Hakimi-Amin [3] sufficient conditions for one-step τ-diagnosability are satisfied.

Hypothesis 2 (Hakimi-Amin):

(i) every module is tested by at least τ other modules;

(ii) no two modules test each other.

We know from [3] that Problem 1 possesses a unique solution whenever Hypotheses 1 and 2 are satisfied and the number of faulty modules is not greater than τ. In such a case, the implied faulty sets possess a property that greatly simplifies the task of decoding syndromes.

Theorem 1: If Hypotheses 1 and 2 are satisfied, and if $1 \leq |F_S| \leq \tau$, then at least one module U_i in S exists such that either $M(U_i) \cap L(U_i) \neq \phi$, or $\| L(U_i) \| \geq \tau+1$, or both.

Proof: See Appendix.

We may use Theorem 1 to exhibit a maximality property of the implied faulty sets. If F_S is non-empty and if F_0 is empty, then at least one module U_i exists so that $\| L(U_i) \| \geq \tau + 1$; thus, the modules U_j in S that maximize $\| L(U_j) \|$ are faulty.

Corollary 1: If Hypotheses 1 and 2 are satisfied, if $1 \leq \| F_S \| \leq \tau$ and if $M(U_i) \cap L(U_i) = \phi$ for every module in S, then the modules U_j that maximize $\| L(U_j) \|$ are in F_S.

Corollary 1 may be used recursively to generate the set F_S of faulty modules in S, and thus, when Hypotheses 1 and 2 are satisfied, an iterative "greedy-type" algorithm will produce the set of faulty modules, provided that the set F_0 is first identified.

Algorithm 1:

Step 0: Let $F_0 = \{ U_i \in S \mid M(U_i) \cap L(U_i) \neq \phi \}$, and let $k = 0$.

Step 1: Let $h_k = \max \{ \| L(U_i) \cap (S - F_k) \| \mid U_i \in S - F_k \}$.

Step 2: If $h_k = 0$, let $F_A = F_k$ and stop; otherwise, go to Step 3.

Step 3: Let $H_k = \{ U_i \in S - F_k \mid \| L(U_i) \cap (S - F_k) \| = h_k \}$.

Step 4: Let $F_{k+1} = F_k \cup H_k$.

Step 5: Let $k = k+1$, and go to Step 1.

The fact that S contains a finite number of modules implies that Algorithm 1 terminates after a finite number of iterations. Using Lemma 1, Theorem 1 and Corollary 1, we may then obtain the following result.

Theorem 2: If Hypotheses 1 and 2 are satisfied, and if $|F_S| \leq \tau$, the set F_A generated by Algorithm 1 is equal to the set of faulty modules F_S.

APPENDIX: Proof of Theorem 1

Our proof of Theorem 1 is similar to the one used by Hakimi and Amin in [3]. First, we assume that the result of the theorem does not hold; we then partition the system S and using that partition, we exhibit two inequalities which taken together, lead to a contradiction. Thus, in this appendix we shall assume that we have a *PMC* system level model in which:

(A1) every module is tested by at least τ other modules,

(A2) no two modules test each other,

(A3) the number of faulty modules $|F_S|$ satisfies $1 \leq |F_S| \leq \tau$,

(A4) $M(U_i) \cap L(U_i) = \phi$ for every module U_i in S, and

(A5) $|L(U_i)| \leq \tau$ for every module U_i in S.

Let U_* be a faulty module in S such that for every faulty module U_i in S,

$$|M(U_*) \cap F_S| \geq |M(U_i) \cap F_S|. \quad (1)$$

We now partition our system S into five subsets: V_1, V_2, V_3, V_4 and V_5.

Let $V_1 = M(U_*) \cap F_S$. Thus, V_1 consists of all the modules in F_S that must be nonfaulty if U_* is assumed to be nonfaulty and U_* is in V_1.

Let V_2 be the subset of S that consists of all the modules in $L(U_*)$ that are actually faulty, i.e.,

$$V_2 = L(U_*) \cap F_S.$$

Let V_3 be the set of all faulty modules that are not in V_1 or V_2, i.e.,

$$V_3 = F_S - (V_1 \cup V_2).$$

Let V_4 be the subset of S that consists of all the modules in the implied faulty set of U_* that are actually nonfaulty, i.e.,

$$V_4 = L(U_*) \cap G_S.$$

Let V_5 be the set of all nonfaulty modules that are not in $L(U_*)$, i.e.,

$$V_5 = G_S - V_4.$$

Clearly, the sets V_1, V_2 and V_3 form a partition for F_S, and the sets V_4 and V_5 form a partition for G_S.

For $i = 1, 2, 3, 4, 5$ and $j = 1, 2, 3, 4, 5$, let $E_{i,j}$ be the set of testing links from V_i into V_j, let v_i denote the cardinality of the partition block V_i, let $e_{i,j}^0$ denote the cardinality of the set of 0-links from V_i to V_j, let $e_{i,j}^1$ denote the cardinality of the sets of 1-links from V_i to V_j, and let $e_{i,j} = e_{i,j}^0 + e_{i,j}^1$, i.e., $e_{i,j}$ is the cardinality of the set of testing links $E_{i,j}$.

The definition of the partition blocks V_i implies that the number and type of testing links between blocks may not be arbitrary.

Lemma 2: The testing links sets $E_{i,j}$ satisfy:

(i) $e_{1,3} = e_{5,1} = e_{5,4} = 0$;

(ii) $E_{1,1}$, $E_{1,5}$, $E_{3,1}$, $E_{4,4}$, $E_{4,5}$ and $E_{5,5}$ consists only of 0-links;

(iii) $E_{1,2}$, $E_{1,4}$, $E_{3,2}$, $E_{3,4}$, $E_{4,1}$, $E_{4,2}$, $E_{4,3}$, $E_{5,2}$ and $E_{5,3}$ consist only of 1-links;

(iv) $E_{2,1}$, $E_{2,2}$, $E_{2,3}$, $E_{2,4}$, $E_{2,5}$, $E_{3,3}$ and $E_{3,5}$ consist of both 0-links and 1-links.

Proof: Let U_i be in V_1, and let U_j be in S. If a 0-link from U_i to U_j exists, then U_j must be in $V_1 \cup V_5$, and if there is a 1-link from U_i to U_j, then U_j must be in $L(U_*)$ and hence, in $V_2 \cup V_4$. We may then conclude that $E_{1,1}$ and $E_{1,5}$ consist of only 0-links, that $E_{1,2}$ and $E_{1,4}$ consist of only 1-links, and that $e_{1,3} = 0$.

Let U_i be in V_3, and let U_j be in S. If a 0-link from U_i to U_j exists, then U_j must be in $V_1 \cup V_3 \cup V_5$; if there is a 1-link from U_i to U_j, then U_j must be in $V_2 \cup V_3 \cup V_4 \cup V_5$. We may then conclude that $E_{3,1}$ consists of only 0-links, and that $E_{3,2}$ and $E_{3,4}$ consist of only 1-links.

Let U_i be in V_4, and let U_j be in S. By construction, U_i is non faulty and U_j is faulty whenever U_j is in $V_1 \cup V_2 \cup V_3$; U_j is non faulty whenever U_j is in $V_4 \cup V_5$. We may then conclude that $E_{4,1}$, $E_{4,2}$ and $E_{4,3}$ consist of only 1-links, and that $E_{4,4}$ and $E_{4,5}$ consist of only 0-links.

We cannot have any testing links from V_5 to V_1 or V_4, because whenever a non faulty module tests a module in either V_1 or V_4, it must be in $L(U_*)$, thus $e_{5,1} = e_{5,4} = 0$. By construction, a module U_i in V_5 is non faulty and thus, $E_{5,2}$ and $E_{5,3}$ consist of only 1-links, and $E_{5,5}$ consists of only 0-links. □

Every module is tested by at least τ other modules, and therefore,

$$e_{1,1} + e_{2,1} + e_{3,1} + e_{4,1} \geq \tau v_1, \tag{2}$$

and

$$e_{1,4} + e_{2,4} + e_{3,4} + e_{4,4} \geq \tau v_4. \tag{3}$$

No two modules test each other, and thus

$$e_{1,1} \leq v_1(v_1-1)/2, \tag{4}$$

$$e_{4,4} \leq v_4(v_4-1)/2, \tag{5}$$

$$e_{1,4} + e_{4,1} \leq v_1 v_4, \tag{6}$$

and

$$e_{2,4} \leq v_2 v_4. \tag{7}$$

The fact that $\|L(U_i)\| \leqslant \tau$ for every module U_i in S implies that the number of 1-links from a partition block V_i to S cannot be larger than the number of 0-links from S to V_i, and therefore,

$$e^1_{2,1} + e^1_{2,2} + e^1_{2,3} + e^1_{2,4} \leqslant e^0_{2,2}, \tag{8}$$

and

$$e_{3,4} \leqslant e^0_{2,3} + e^0_{3,3}. \tag{9}$$

The maximality of the module U_* on which the basic partition is based implies that no faulty module may find more than $\nu_1 - 1$ faulty modules non faulty, and thus,

$$e^0_{2,1} + e^0_{2,2} + e^0_{2,3} \leqslant \nu_2(\nu_1 - 1), \tag{10}$$

and

$$e_{3,1} + e^0_{3,3} \leqslant \nu_3(\nu_1 - 1). \tag{11}$$

Equations (2) and (4) imply

$$e_{4,1} \geqslant \tau\nu_1 - \nu_1(\nu_1 - 1)/2 - e_{2,1} - e_{3,1}. \tag{12}$$

Equations (3), (5) and (7) imply

$$e_{1,4} \geqslant \tau\nu_4 - \nu_2\nu_4 - e_{3,4} - \nu_4(\nu_4 - 1)/2. \tag{13}$$

Thus, using (6), we obtain

$$X + Y \geqslant 0 \tag{14}$$

where

$$X = \nu_1\nu_4 - \tau\nu_1 + \nu_1(\nu_1 - 1)/2 - \tau\nu_4 + \nu_4(\nu_4 - 1)/2 + \nu_2\nu_4, \tag{15}$$

and

$$Y = e_{2,1} + e_{3,1} + e_{3,4}. \tag{16}$$

Using (9), we obtain

$$Y \leqslant e_{2,1} + e_{3,1} + e^0_{2,3} + e^0_{3,3}. \tag{17}$$

and using (11), we find that

$$Y \leqslant e_{2,1} + e^0_{2,3} + \nu_3(\nu_1-1). \tag{18}$$

Inequalities (8) and (10) yield

$$e^1_{2,1} + e^1_{2,2} + e^1_{2,3} + e^1_{2,4} + e^0_{2,1} + e^0_{2,2} + e^0_{2,3} \leqslant e^0_{2,2} + \nu_2(\nu_1-1), \tag{19}$$

thus

$$e^0_{2,1} + e^1_{2,1} + e^0_{2,3} \leqslant \nu_2(\nu_1-1), \tag{20}$$

and we may conclude that

$$e_{2,1} + e^0_{2,3} \leqslant \nu_2(\nu_1-1). \tag{21}$$

Using (18) and (21), we obtain

$$Y \leqslant \nu_3(\nu_1-1) + \nu_2(\nu_1-1). \tag{22}$$

The number of faulty modules is at most τ, i.e.,

$$\nu_1 + \nu_2 + \nu_3 \leqslant \tau, \tag{23}$$

and thus

$$\nu_1(\nu_1-1)/2 + \nu_2(\nu_1-1) + \nu_3(\nu_1-1) \leqslant \tau(\nu_1-1) - \nu_1(\nu_1-1)/2. \tag{24}$$

The fact that $\| L(U_i) \| \leqslant \tau$ for every module U_i in S implies that $\nu_2 + \nu_4 \leqslant \tau$, and thus

$$\nu_2 \leqslant \tau - \nu_4. \tag{25}$$

Using (14), (15), (16), (22), (24) and (25), we obtain

$$\nu_1\nu_4 - \tau\nu_1 + \tau(\nu_1-1) - \nu_1(\nu_1-1)/2 - \tau\nu_4 + \nu_4(\nu_4-1)/2 + (\tau-\nu_4)\nu_4 \geqslant 0. \tag{26}$$

Equation (26) may be rewritten as

$$(v_1 - v_4)/2 - (v_1 - v_4)^2/2 - \tau \geq 0. \tag{27}$$

It is easy to verify that

$$(v_1 - v_4)/2 - (v_1 - v_4)^2/2 \leq 0.125 \tag{28}$$

for all values of v_1 and v_4, and thus

$$0.125 - \tau \geq 0. \tag{29}$$

Equation (29) implies that τ must be equal to 0, and this contradicts (A3).

We have shown that the five basic assumptions given at the beginning of the appendix lead to a contradiction and thus may not hold. We can therefore conclude that if a *PMC* model satisfies (A1), (A2) and (A3), then (A4) and (A5) may not hold simultaneously; that is, if (A1), (A2) and (A3) hold, then at least one module U_i in S exists so that either (i) $M(U_i) \cap L(U_i) \neq \phi$, or (ii) $\| L(U_i) \| \geq \tau + 1$, or both.

REFERENCES

[1] Allan, F. J., Kameda, T., and Toida, S., An Approach to the Diagnosability Analysis of a System, *IEEE Trans. Computers*, Vol. C-24, October 1975, pp. 1040-1042.

[2] Corluhan, A. M., and Hakimi, S. L., On an Algorithm for Identifying Faults in a t-Diagnosable System, Proceedings of the 1976 Conference on Information Science and Systems, The Johns Hopkins University, Baltimore, 1976, pp. 370-375.

[3] Hakimi, S. L., and Amin, A. T., Characterization of Connection Assignment of Diagnosable Systems, *IEEE Trans. Computers*, Vol. C-23 , January 1974, pp. 86-88.

[4] Kameda, T., Toida, S., and Allan, F. J., A Diagnosing Algorithm for Networks, *Information and Control*, Vol. 29 (1975), pp. 141-148.

[5] Meyer, G. G. L., and Masson G. M., An Efficient Fault Diagnosis Algorithm for Multiple Processor Architectures, Proceedings of the 1976 Conference on Information Sciences and Systems, The Johns Hopkins University, Baltimore, Maryland, pp. 249-251.

[6] Meyer, G. G. L., Fault Diagnosis of Modular Networks with a Small Number of Faults, Proceedings of the Fifteenth Annual Allerton Conference on Communication, Control, and Computing, Allerton House, Monticello, Illinois, September 1977, pp. 727-731.

[7] Meyer, G. G. L., and Masson, G. M., An Efficient Fault Diagnosis Algorithm for Symmetric Multiple Processor Architectures, *IEEE Trans. Computers*, Vol. C-27, No. 11, November 1978, pp. 1059-1063.

[8] Meyer, G. G. L., A Fault Diagnosis Algorithm for Asymmetric Modular Architectures, *IEEE Trans. Computers*, Vol. C-30, No. 1, January 1981, pp. 81-83.

[9] Preparata, F. P., Metze, G., and Chien, R. T., On the Connection Assignment Problem of Diagnosable Systems, *IEEE Trans. Electronic Computers*, Vol. EC-16 , December 1967, pp. 848-854.

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