March LA: A Test for Linked Memory Faults

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This paper introduces a test which can detect all simple faults as well as all linked faults, involving an arbitrary number of simple faults.

Theorem 1: Assume the multiple linked fault, let **S** = $\{f_1, f_2, \ldots\}$ be the set of involved simple coupling faults. If a particular march test **M** guarantees the detection of each of the faults $<y;x>j_ai$ and $<y;x>ik_1$ (j_a and k_1 are the coupling cells with the closest address to the coupled cell) of **S** within a single march element, then that march test can detect linked faults consisting of any number of faults of **S**. Exceptions consist of some faults which are not detectable by linear tests [1]

Proof: If a march element of **M** can *sensitize and detect* the simple fault in position j_ai (this element has to have an $\Uparrow$ address order) all faults with lower addresses are irrelevant because the fault in j_ai will always be detected by this march element. If a march element of **M** can *sensitize and detect* the fault in position ik_1 (this element has to have a $\Downarrow$ address order) all faults with higher addresses are irrelevant because the fault in ik_1 will always be detected by this march element.

Suppose **S** = $\{ <r0;\uparrow>, <r0;\downarrow>, <r1;\uparrow>, <r1;\downarrow>, <w0;\uparrow>, <w0;\downarrow>, <w1;\uparrow>$ and $<w1;\downarrow> \}$, which is the set of all CFdst subtypes [2].

By inspecting MOVI ($\{\Downarrow\ (w0); \Uparrow\ (r0,w1,r1); \Uparrow\ (r1,w0,r0); \Downarrow\ (r0,w1,r1); \Downarrow\ (r1,w0,r0)\}$) it is not difficult to see that some operations required to sensitize all CFdst subtypes (see [1]) are missing. If M1, i.e. $\Uparrow (r0,w1,r1)$, in addition, contains the $w0$ operation, then all CFdsts of subtype $<p;\uparrow>j_ai$, $p \,\epsilon\, \{r0,r1,w0,w1\}$, will be sensitized and detected by M1. The same applies to M2: if M2 in addition contains the $w1$ operation, all faults of type $<p;\downarrow>j_ai$ will be sensitized and detected. M3 and M4 are required to allow sensitization and detection of the faults $<p;\uparrow>ik_1$ and $<p;\downarrow>ik_1$, respectively. From the above it should be obvious that M1 of the test March LA below can detect all CFdsts of subtype $<p;\uparrow>j_ai$, M2 can detect all CFdsts of subtype $<p;\downarrow>j_ai$, M3 can detect all CFdsts of subtype $<p;\uparrow>ik_1$, and M4 can detect all CFdsts of subtype $<p;\downarrow>ik_1$, $p \,\epsilon\, \{r0,r1,w0,w1\}$. Because March LA satisfies Theorem 1, all linked CFdsts (involving an arbitrary number of CFdsts) will be detected.

$$\{ \underbrace{\Updownarrow (w0)}_{M0} ; \underbrace{\Uparrow (r0,w1,w0,w1,r1)}_{M1} ; \underbrace{\Uparrow (r1,w0,w1,w0,r0)}_{M2} ; \underbrace{\Downarrow (r0,w1,w0,w1,r1)}_{M3} ; \underbrace{\Downarrow (r1,w0,w1,w0,r0)}_{M4} ; \underbrace{\Downarrow (r0)}_{M5} \}$$

March LA also detects all AFs linked with AFs or MCAFs because March LA detects SOFs and satisfies Condition 1LA [1] given below.

Condition 1LA: Any march test will detect 'AF # CFs'; i.e., an AF linked with *any* number of CFs, if the test satisfies the following two subconditions:

1. the march test detects all simple CFs in such a way that faults of each subtype are sensitized and detected by a *single* march element
2. the march test detects all simple AFs (i.e. AFsrs)

Condition 1LA(1) is satisfied by March LA via march elements M1 through M4. Condition 1LA(2) is satisfied via march elements M1 and M4 or via M2 and M3.

The derivation of March LA-, March LAD and March LADD- can be found in [1]. They all are extensions of March LA for detecting DRFs.

References

[1] Gaydadjiev, G.N. and van de Goor, A.J. (1995). An analysis of Linked faults. *Technical Report No 1-68340-44(1995)08*, Delft University of Technology.

[2] van de Goor, A.J., Gaydadjiev, G.N., Yarmolik, V.N., and Mikitjuk V.G. (1996a) March LR: A Test for Realistic Linked Faults. In *Proc. 14-th IEEE VLSI Test Symposium*, pp. 272-280.

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