אוניברסיטת בן-גוריון בנגב

Ben-Gurion University of the Negev

הפקולטה למדעי ההנדסה

המחלקה להנדסת חשמל ומחשבים

Faculty of Engineering Science

Dept. of Electrical and Computer Engineering

Algorithmic Approach to Reliable HW Design

Research proposal

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Associative proof of the Diamond Operator & Associative characteristics of MS Boolean functions

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Primary Research Goal: Introduce an analytic based solution that shows the associative of the MS-closer diamond operator.

$$\binom{x_1}{x_2} \diamond_m \binom{y_1}{y_2} \diamond_m \binom{z_1}{z_2} = \binom{x_1}{x_2} \diamond_m \left(\binom{y_1}{y_2} \diamond_m \binom{z_1}{z_2}\right)$$

Secondary Research Goal: Deduce a more general approach of proving (analytically) the associative characteristics of MS-closer operators & provide an automation method to determine the associative characteristics of an operator.

Summary: As taught in lectures 5 + 6, when implementing a Boolean combinational circuit (can be an FSM or any kind of function that satisfy the requirements of a Boolean combinational circuit) with an input data stream, it is highly efficient (as proved) to use PPC. In order to use the PPC characteristics, we must stand the PPC requirement that the function is an Associative Operator. While it is rather simple to deduce Associative characteristics in normal Boolean Operators, in MS circuits it adds a level of complexity, since we need to hold the MS – closer definition.

$$f_m(\hat{x}) :=\star f(res(\hat{x}))$$

The Problem: So far it has been proven only by manually testing all input combinations, and it has been shown that for every three inputs our Diamond Operator is indeed Associative, but a more general analytic proof has yet to be introduced. Hence, in my research I will try to prove the Associative of the diamond operator using analytical approach and try to deduce general characteristics when confronting such problems.

$\diamond_M$	00	0M	01	M1	11	1M	10	M0	MM
00	00	0M	01	M1	11	1M	10	M0	MM
0M	0M	0M	01	M1	M1	MM	MM	MM	MM
01	01	01	01	01	01	01	01	01	01
M1	M1	MM	MM	MM	0M	0M	01	M1	MM
11	11	1M	10	M0	00	0M	01	M1	MM
1M	1M	1M	10	M0	M0	MM	MM	MM	MM
10	10	10	10	10	10	10	10	10	10
M0	M0	MM	MM	MM	1M	1M	10	M0	MM
MM	MM	MM	MM	MM	MM	MM	MM	MM	MM

Figure 1 - MS closer of Diamond Operator