

A New Enhanced Constructive Decomposition and Mapping Algorithm

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ABSTRACT

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Categories and Subject Descriptors
 Logic Design

supergates,

General Terms

Keywords

1. INTRODUCTION

2. PRELIMINARIES

$f: X \rightarrow B$ $f: X \rightarrow B^n$

on-set f X *off-set* f X *support* f , $\text{supp } f$ f
cofactors q X q X q_μ X f
 μ *column multiplicity* f X X X
 f X h g X g X g_k X X
 X X *bound set* *free set*
 g_i X $\leq i \leq k$ *decomposition*
functions. h G X *composition function*

Lemma 1.
 $g X \quad g X \quad g X$
 μ
support-reducing
 $f X$

$f X$
 $f X$
 $f X$
 $X X$

Example 1.
 $f X$
 $X x x x$
 $k \lceil \log \rceil$
 $n |X$
 $c c c$
 $k \lceil \log \rceil$
 $n |X$

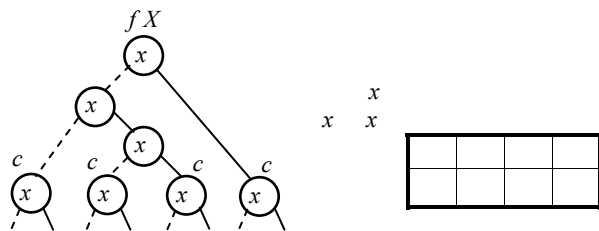


Figure 1. The function and the decomposition pattern.

3. DECOMPOSITION ALGORITHM

3.1 Algorithm Outline

f
 f_i
 f
 X
 $g_i \quad g_i \in \{f_i\}$
 g_i
 h
 f
network **ConstructiveDecomposition**(function f , functions $\{f_i\}$)
{
 N = empty network;
while ($f \notin \{f_i\}$) {
 X = **DetermineBoundSet**(f)
 $\{g_i\}$ = **DeriveDecompositionFunctions**(f , X , $\{f_i\}$);
 h = **DeriveCompositionFunction**(f , X , $\{g_i\}$);
AddToNetwork(N , $\{g_i\}$);
 $f = h$;
}
AddToNetwork(N , f);
return N ;
}

Figure 2. The pseudo-code of constructive decomposition.

3.2 Completely Specified Functions

$f X$
 X
decomposition pattern

Example 2.
 $X x x x$
 $c c c c$
 g, g, \dots, g_k
 μ
 $f X$
 g_i

Example 3.
 $f X$
 $m c \quad \bar{x} \bar{x} \quad m c \quad \bar{x} x \bar{x} \quad m c \quad \bar{x} x x \quad m c \quad x$
code c *code c* *code c* *code c*
 $g X \quad m c \vee m c \quad \bar{x} x \bar{x} \vee x$
 $g X \quad m c \vee m c \quad \bar{x} x x \vee x$
 $c \quad c \quad \text{code } c \quad \text{code } c$
code c *code c*
 $g X \quad m c \vee m c \quad \bar{x} x$
 $g X \quad m c \vee m c \quad x x \vee x$

3.3 Incompletely Specified Functions

Example 4.
 $x \quad x$
 $c c c c$
 $c \quad c$
 c
 $x x x$
 $x' x' x'$

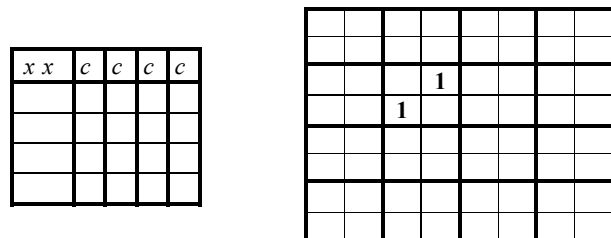


Figure 3. Cofactor truth tables and the compatibility relation.

R
 $f f f$
 $R X X' \quad \neg \exists X f X X f X' X \vee f X X f X' X$
 $\forall X \bar{f} X X \bar{f} X' X \vee \bar{f} X X \bar{f} X' X$
 $X \quad X'$
 A
 $f X \quad X \quad X'$
 $f X A f X' A \vee f X A f X' A$

Lemma 2.
 X

Example 5.

$$c \quad c$$

$$k \quad \lceil \log 3 \rceil \quad \mu \quad n$$

3.4 Selecting Decomposition Functions

Lemma 3. $R X X'$
 $g X g_2 X \quad g_p X \leq p \leq k,$

$$R_j X X' \leq j \leq p, \quad \mu$$

$$\lceil \log \mu \rceil \leq k-p.$$

Proof:

Q. E. D.

Example 6.

$$g \quad g \quad g \quad X \quad x \vee x \quad g \quad X \quad x$$

$$g \quad g \quad g \quad g \quad g$$

$$g \quad X \quad x \bar{x}$$

$$g \quad X \quad x \vee x \quad g \quad X \quad x$$

$$x \quad x \quad x$$

$$x' \quad x' \quad x'$$

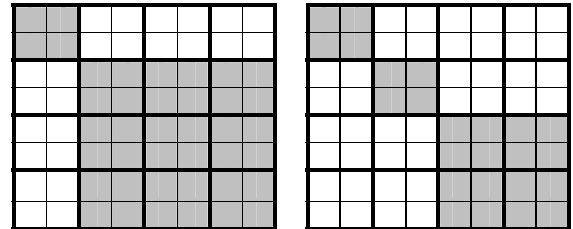


Figure 4. The cofactor relations.

$$X \quad R X X'$$

$$relations \quad g X \quad g_2 X \quad g_p X \quad cofactor$$

$$S_j X \quad g X \quad g_2 X \quad g_p X \quad j \leq j \leq p$$

$$R_j X X' \quad R X X' \wedge S_j X \wedge S_j X'$$

$$R_j X X'$$

$$g_p X \quad g_2 X \quad g_p X$$

$$R X X'$$

4. BOUND SET COMPUTATION

$$n$$

$$\mu \quad \lceil \log \mu \rceil \quad n$$

Step 1. $Y \quad Z \quad m \quad \text{supp } f \quad X$

Step 2. $x \quad y \quad z \quad x \quad y \quad z \quad x_m \quad y_m \quad z_m$
 $f \quad X$
 $fX \quad x \quad XYZ$
 $x \quad y \quad z \quad \leq i \leq m \quad fXYZ$
 $fX \quad f$

restrict

5. GATE LIBRARY REPRESENTATION

supergate

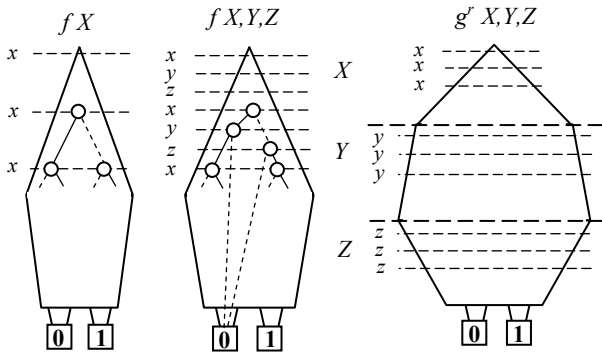


Figure 5. Transformation for the BDD for $f(X)$ during computation of all support-reducing bound sets

Step 3. $g \quad XYZ \quad f \quad XYZ \quad \wedge \quad \text{Tuples}_{n,m} \quad X$
 $\text{Tuples}_{n,m} \quad X \quad n \quad X$

Step 4. $Y \quad g \quad XYZ \quad Y \quad Z$
 $X \quad \text{dominated}$

$x \quad x \quad x_m \quad y \quad y \quad y_m \quad z \quad z \quad z_m$
 $g^r \quad XYZ \quad X$
 $n \quad x \quad x \quad x \quad X$
 $r \quad x \quad x \quad x \quad Y \quad Z$
 Y

Step 5. $Y \quad Z$

$r \quad x \quad x \quad x \quad Y \quad Z$
 μ
 $\lceil \log \mu \rceil \quad n$

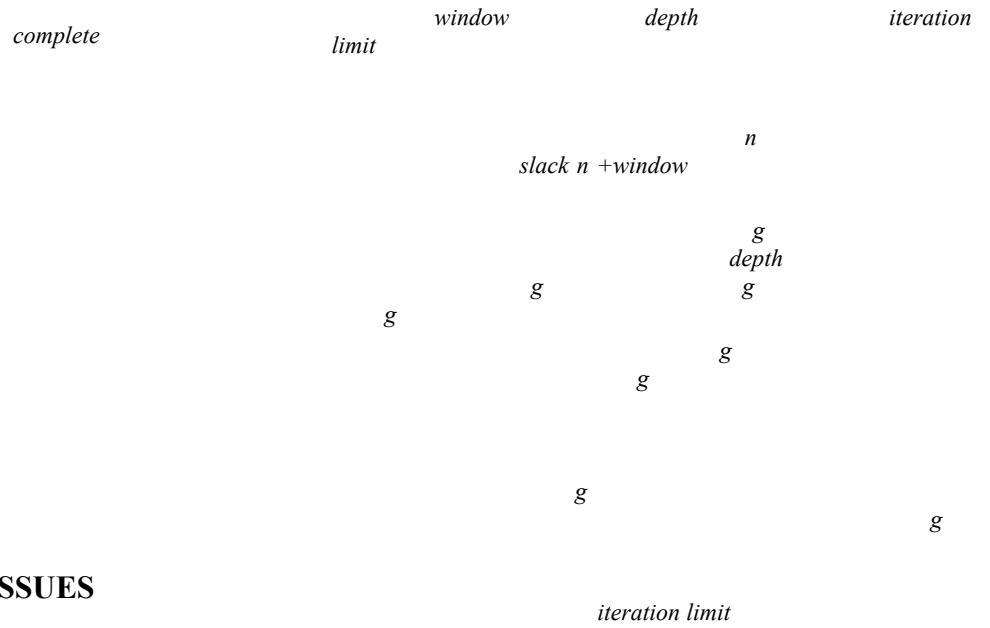
$g^r \quad XYZ$

$g \quad XYZ$

$g^r \quad XYZ$

6. DON'T-CARE COMPUTATION

7.2 Re-Synthesis Framework



7. IMPLEMENTATION ISSUES

decomposition engine

re-synthesis framework

g

7.1 Decomposition Engine

$R X \quad X'$
 $\quad \quad X$

$k \quad x \quad X \quad X$

$X \quad X$

8. EXPERIMENTAL RESULTS

menc.genlib

script.rugged *speed_up*

