

【11】證書號數：I384416

【45】公告日：中華民國 102 (2013) 年 02 月 01 日

【51】Int. Cl. : G06T5/00 (2006.01)

發明

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【54】名稱：一種植基於三像素區塊差異之可回復式資料隱藏技術

A REVERSIBLE DATA HIDING SCHEME BASED ON THREE-PIXEL
BLOCK DIFFERENCES

【21】申請案號：096150375

【22】申請日：中華民國 96 (2007) 年 12 月 26 日

【11】公開編號：200929072

【43】公開日期：中華民國 98 (2009) 年 07 月 01 日

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【56】參考文獻：

TW I288892A

EP 1665123A2

EP 1692637A2

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[57]申請專利範圍

1. 一種植基於三像素區塊差異之可回復式資料隱藏方法，包括：將掩護影像分割為不重疊的三像素區塊；以一個三像素區塊中第一像素與第二像素(中央像素)或第二像素與第三像素之間的像素值差異的絕對值方式計算在每個三像素區塊中的二個差異值，再畫出這些差異值的分佈直方圖，找出直方圖上的最大值與最小值；掃描影像，對每一個三像素區塊執行嵌入程序，該嵌入程序又會依照三像素的差異執行只改變中央像素值 1 以同時嵌入 2 個位元“11”到一個三像素區塊的步驟、或只改變中央像素值 1 以同時增加三像素區塊中二個差異值的步驟、或只改變中央像素值 1 以同時嵌入 1 個位元“1”到一個三像素區塊並增加三像素區塊中另一個差異值的步驟；上述只改變中央像素值 1 以同時嵌入 2 個位元“11”到一個三像素區塊的步驟中，如中央像素為三像素中最小者，則中央像素值減 1，如中央像素為三像素中最大者，則中央像素值加 1；上述只改變中央像素值 1 以同時增加三像素區塊中二個差異值的步驟中，如中央像素為三像素中最小者，則中央像素值減 1，如中央像素為三像素中最大者，則中央像素值加 1；上述只改變中央像素值 1 以同時嵌入 1 個位元“1”到一個三像素區塊並增加三像素區塊中另一個差異值的步驟中，如中央像素為三像素中最小者，則中央像素值減 1，如中央像素為三像素中最大者，則中央像素值加 1。

圖式簡單說明

圖一 嵌入程序演算法

圖一之一 為圖一的流程說明圖。

圖二 嵌入二個位元演算法

圖三 嵌入一個位元與增加差異演算法

圖四 嵌入一個位元與保持不變演算法

圖五 增加差異與嵌入一個位元演算法

圖六 增加二個差異演算法

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圖七 增加差異與保持不變演算法

圖八 保持不變與嵌入一個位元演算法

圖九 保持不變與增加差異演算法

圖十 萃取資料的條件及其動作

圖十一 Lena 影像

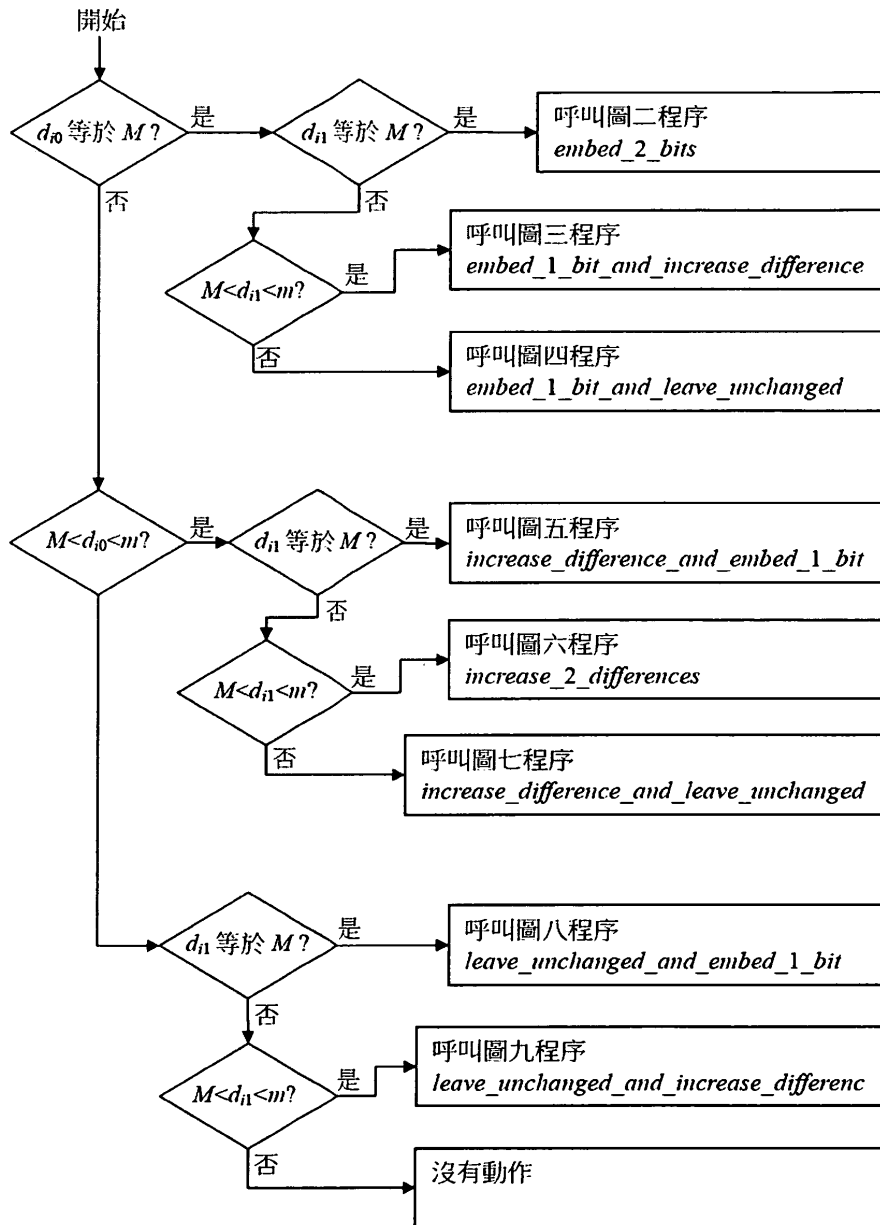
圖十二 文獻[3]直方圖範例

圖十三 本發明直方圖範例

```
Procedure embedding_procedure:
if  $d_{i0} == M$  {
  if  $d_{i1} == M$ 
    call embed_2_bits;
  else {
    if  $M < d_{i1} < m$ 
      call embed_1_bit_and_increase_difference;
    else
      call embed_1_bit_and_leave_unchanged;
  }
}
else if  $M < d_{i0} < m$  {
  if  $d_{i1} == M$ 
    call increase_difference_and_embed_1_bit;
  else {
    if  $M < d_{i1} < m$ 
      call increase_2_differences;
    else
      call increase_difference_and_leave_unchanged;
  }
}
else {
  if  $d_{i1} == M$ 
    call leave_unchanged_and_embed_1_bit;
  else {
    if  $M < d_{i1} < m$ 
      call leave_unchanged_and_increase_difference;
    else
      do nothing;
  }
}
```

圖一

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圖一之一

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Procedure *embed_2_bits*:

條件	動作
$b_{i0} > b_{i1} > b_{i2}$	$b_{i0} = b_{i0} + eb_1, b_{i2} = b_{i2} - eb_2$
$b_{i0} < b_{i1} < b_{i2}$	$b_{i0} = b_{i0} - eb_1, b_{i2} = b_{i2} + eb_2$
$b_{i0} = b_{i1} = b_{i2}$	if $eb_1 == 1$ and $eb_2 == 1$ $b_{i1} = b_{i1} + 1$ else $b_{i0} = b_{i0} - eb_1, b_{i2} = b_{i2} + eb_2$
$b_{i0} < b_{i1} > b_{i2}$	if $eb_1 == 1$ and $eb_2 == 1$ $b_{i1} = b_{i1} + 1$ else $b_{i0} = b_{i0} - eb_1, b_{i2} = b_{i2} - eb_2$
$b_{i0} > b_{i1} < b_{i2}$	if $eb_1 == 1$ and $eb_2 == 1$ $b_{i1} = b_{i1} - 1$ else $b_{i0} = b_{i0} + eb_1, b_{i2} = b_{i2} + eb_2$

圖二

Procedure *embed_1_bit_and_increase_difference*:

條件	動作
$b_{i0} > b_{i1} > b_{i2}$	$b_{i0} = b_{i0} + eb_1, b_{i2} = b_{i2} - 1$
$b_{i0} < b_{i1} < b_{i2}$	$b_{i0} = b_{i0} - eb_1, b_{i2} = b_{i2} + 1$
$b_{i0} \leq b_{i1} > b_{i2}$	if $eb_1 == 1$ $b_{i1} = b_{i1} + 1$ else $b_{i2} = b_{i2} - 1$
$b_{i0} \geq b_{i1} < b_{i2}$	if $eb_1 == 1$ $b_{i1} = b_{i1} - 1$ else $b_{i2} = b_{i2} + 1$

圖三

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Procedure *embed_1_bit_and_leave_unchanged*:

條件	動作
$b_{i0} > b_{i1}$	$b_{i0} = b_{i0} + eb_1$
$b_{i0} \leq b_{i1}$	$b_{i0} = b_{i0} - eb_1$

圖四

Procedure *increase_difference_and_embed_1_bit*:

條件	動作
$b_{i0} > b_{i1} > b_{i2}$	$b_{i0} = b_{i0} + 1, b_{i2} = b_{i2} - eb_1$
$b_{i0} < b_{i1} < b_{i2}$	$b_{i0} = b_{i0} - 1, b_{i2} = b_{i2} + eb_1$
$b_{i0} < b_{i1} \geq b_{i2}$	if $eb_1 == 1$ $b_{i1} = b_{i1} + 1$ else $b_{i0} = b_{i0} - 1$
$b_{i0} > b_{i1} \leq b_{i2}$	if $eb_1 == 1$ $b_{i1} = b_{i1} - 1$ else $b_{i0} = b_{i0} + 1$

圖五

Procedure *increase_2_differences*:

條件	動作
$b_{i0} > b_{i1} > b_{i2}$	$b_{i0} = b_{i0} + 1, b_{i2} = b_{i2} - 1$
$b_{i0} < b_{i1} < b_{i2}$	$b_{i0} = b_{i0} - 1, b_{i2} = b_{i2} + 1$
$b_{i0} < b_{i1} > b_{i2}$	$b_{i1} = b_{i1} + 1$
$b_{i0} > b_{i1} < b_{i2}$	$b_{i1} = b_{i1} - 1$

圖六

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Procedure *increase_difference_and_leave_unchanged*:

條件	動作
$b_{i0} > b_{i1}$	$b_{i0} = b_{i0} + 1$
$b_{i0} < b_{i1}$	$b_{i0} = b_{i0} - 1$

圖七

Procedure *leave_unchanged_and_embed_1_bit*:

條件	動作
$b_{i1} > b_{i2}$	$b_{i2} = b_{i2} - eb_1$
$b_{i1} \leq b_{i2}$	$b_{i2} = b_{i2} + eb_1$

圖八

Procedure *leave_unchanged_and_increase_difference*:

條件	動作
$b_{i1} > b_{i2}$	$b_{i2} = b_{i2} - 1$
$b_{i1} < b_{i2}$	$b_{i2} = b_{i2} + 1$

圖九

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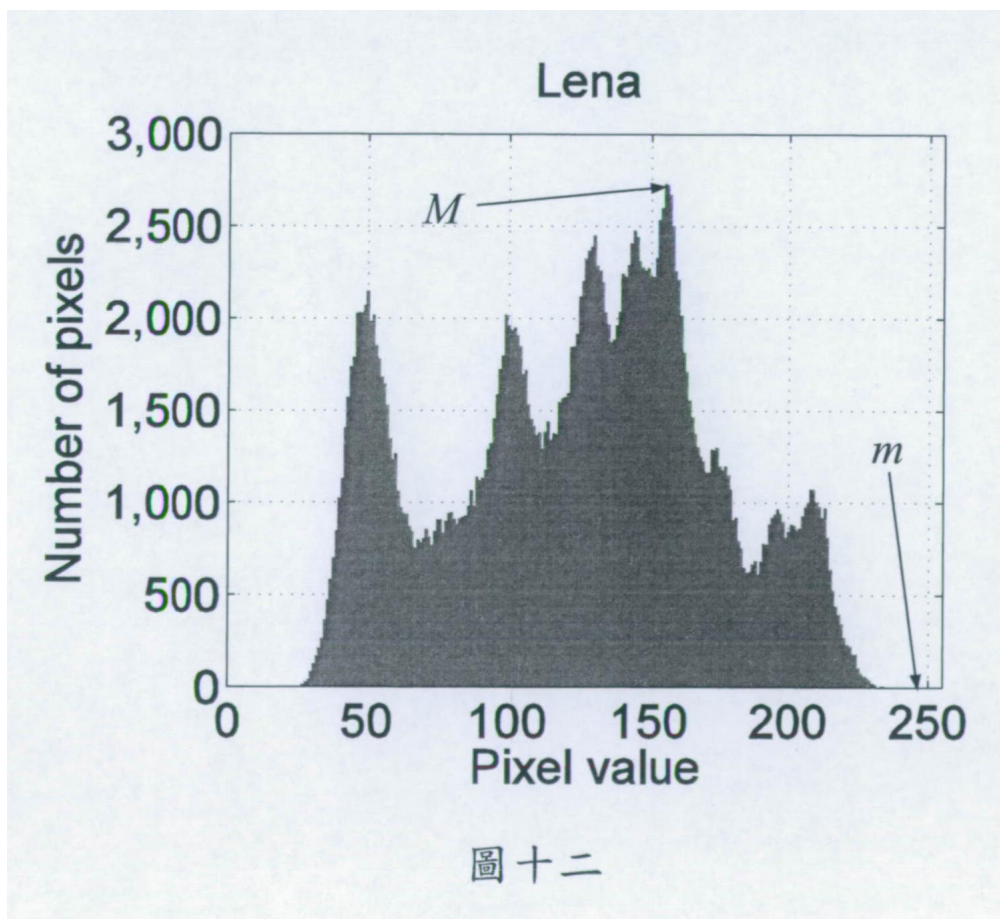
條件	動作
$d_{i0} = M$ and $d_{i1} = M$	Extract "00"
$d_{i0} = M$ and $d_{i1} = M + 1$ and $b_{i1} > b_{i2}$	Extract "01", $b_{i2} = b_{i2} + 1$
$d_{i0} = M$ and $d_{i1} = M + 1$ and $b_{i1} < b_{i2}$	Extract "01", $b_{i2} = b_{i2} - 1$
$d_{i0} = M$ and $M + 1 < d_{i1} \leq m$ and $b_{i1} > b_{i2}$	Extract "0", $b_{i2} = b_{i2} + 1$
$d_{i0} = M$ and $M + 1 < d_{i1} \leq m$ and $b_{i1} < b_{i2}$	Extract "0", $b_{i2} = b_{i2} - 1$
$d_{i0} = M$ and ($d_{i1} < M$ or $d_{i1} > m$)	Extract "0"
$d_{i0} = M + 1$ and $d_{i1} = M$ and $b_{i0} < b_{i1}$	Extract "10", $b_{i0} = b_{i0} + 1$
$d_{i0} = M + 1$ and $d_{i1} = M$ and $b_{i0} > b_{i1}$	Extract "10", $b_{i0} = b_{i0} - 1$
$d_{i0} = M + 1$ and $d_{i1} = M + 1$ and $b_{i0} < b_{i1} < b_{i2}$	Extract "11", $b_{i0} = b_{i0} + 1$, $b_{i2} = b_{i2} - 1$
$d_{i0} = M + 1$ and $d_{i1} = M + 1$ and $b_{i0} > b_{i1} > b_{i2}$	Extract "11", $b_{i0} = b_{i0} - 1$, $b_{i2} = b_{i2} + 1$
$d_{i0} = M + 1$ and $d_{i1} = M + 1$ and $b_{i0} < b_{i1} > b_{i2}$	Extract "11", $b_{i1} = b_{i1} - 1$
$d_{i0} = M + 1$ and $d_{i1} = M + 1$ and $b_{i0} > b_{i1} < b_{i2}$	Extract "11", $b_{i1} = b_{i1} + 1$
$d_{i0} = M + 1$ and $M + 1 < d_{i1} \leq m$ and $b_{i0} > b_{i1} > b_{i2}$	Extract "1", $b_{i0} = b_{i0} - 1$, $b_{i2} = b_{i2} + 1$
$d_{i0} = M + 1$ and $M + 1 < d_{i1} \leq m$ and $b_{i0} < b_{i1} < b_{i2}$	Extract "1", $b_{i0} = b_{i0} + 1$, $b_{i2} = b_{i2} - 1$
$d_{i0} = M + 1$ and $M + 1 < d_{i1} \leq m$ and $b_{i0} < b_{i1} > b_{i2}$	Extract "1", $b_{i1} = b_{i1} - 1$
$d_{i0} = M + 1$ and $M + 1 < d_{i1} \leq m$ and $b_{i0} > b_{i1} < b_{i2}$	Extract "1", $b_{i1} = b_{i1} + 1$
$d_{i0} = M + 1$ and ($d_{i1} < M$ or $d_{i1} > m$) and $b_{i0} < b_{i1}$	Extract "1", $b_{i0} = b_{i0} + 1$
$d_{i0} = M + 1$ and ($d_{i1} < M$ or $d_{i1} > m$) and $b_{i0} > b_{i1}$	Extract "1", $b_{i0} = b_{i0} - 1$
$M + 1 < d_{i0} \leq m$ and $d_{i1} = M$ and $b_{i0} > b_{i1}$	Extract "0", $b_{i0} = b_{i0} - 1$
$M + 1 < d_{i0} \leq m$ and $d_{i1} = M$ and $b_{i0} < b_{i1}$	Extract "0", $b_{i0} = b_{i0} + 1$
$M + 1 < d_{i0} \leq m$ and $d_{i1} = M + 1$ and $b_{i0} > b_{i1} > b_{i2}$	Extract "1", $b_{i0} = b_{i0} - 1$, $b_{i2} = b_{i2} + 1$
$M + 1 < d_{i0} \leq m$ and $d_{i1} = M + 1$ and $b_{i0} < b_{i1} < b_{i2}$	Extract "1", $b_{i0} = b_{i0} + 1$, $b_{i2} = b_{i2} - 1$
$M + 1 < d_{i0} \leq m$ and $d_{i1} = M + 1$ and $b_{i0} < b_{i1} > b_{i2}$	Extract "1", $b_{i1} = b_{i1} - 1$
$M + 1 < d_{i0} \leq m$ and $d_{i1} = M + 1$ and $b_{i0} > b_{i1} < b_{i2}$	Extract "1", $b_{i1} = b_{i1} + 1$
$M + 1 < d_{i0} \leq m$ and $M + 1 < d_{i1} \leq m$ and $b_{i0} > b_{i1} > b_{i2}$	$b_{i0} = b_{i0} - 1$, $b_{i2} = b_{i2} + 1$
$M + 1 < d_{i0} \leq m$ and $M + 1 < d_{i1} \leq m$ and $b_{i0} < b_{i1} < b_{i2}$	$b_{i0} = b_{i0} + 1$, $b_{i2} = b_{i2} - 1$
$M + 1 < d_{i0} \leq m$ and $M + 1 < d_{i1} \leq m$ and $b_{i0} < b_{i1} > b_{i2}$	$b_{i1} = b_{i1} - 1$
$M + 1 < d_{i0} \leq m$ and $M + 1 < d_{i1} \leq m$ and $b_{i0} > b_{i1} < b_{i2}$	$b_{i1} = b_{i1} + 1$
$M + 1 < d_{i0} \leq m$ and ($d_{i1} < M$ or $d_{i1} > m$) and $b_{i0} < b_{i1}$	$b_{i0} = b_{i0} + 1$
$M + 1 < d_{i0} \leq m$ and ($d_{i1} < M$ or $d_{i1} > m$) and $b_{i0} > b_{i1}$	$b_{i0} = b_{i0} - 1$
($d_{i0} < M$ or $d_{i0} > m$) and $d_{i1} = M$	Extract "0"
($d_{i0} < M$ or $d_{i0} > m$) and $d_{i1} = M + 1$ and $b_{i1} < b_{i2}$	Extract "1", $b_{i2} = b_{i2} - 1$
($d_{i0} < M$ or $d_{i0} > m$) and $d_{i1} = M + 1$ and $b_{i1} > b_{i2}$	Extract "1", $b_{i2} = b_{i2} + 1$
($d_{i0} < M$ or $d_{i0} > m$) and $M + 1 < d_{i1} \leq m$ and $b_{i1} < b_{i2}$	$b_{i2} = b_{i2} - 1$
($d_{i0} < M$ or $d_{i0} > m$) and $M + 1 < d_{i1} \leq m$ and $b_{i1} > b_{i2}$	$b_{i2} = b_{i2} + 1$
($d_{i0} < M$ or $d_{i0} > m$) and ($d_{i1} < M$ or $d_{i1} > m$)	Do nothing

圖十

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圖十一



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