A Novel Small-cross-diamond Search Algorithm for Fast Video Coding and Videoconferencing Applications

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Reference：
Outline

- Introduction
- Small-cross-diamond Search Algorithm (SCDS)
- Example for SCDS
- Experimental Results
Introduction

- This paper proposed a novel small-cross-diamond search
  - Improves the searching speed by up to 146%, as compared to the diamond search (DS) algorithm
- It is suitable for a wide range of video applications, like videoconferencing
Cross and Diamond Searching Patterns

Fig. 1. Cross and Diamond Searching Patterns
The SCDS Algorithm

- SCDS differs from DS by
  - Performing a cross-center-biased SCSP in the first step
  - Employing halfway-stop technique for quasi-stationary or stationary candidate blocks

- Below summarizes the SCDS algorithm
Step 1

- Starting
  - A minimum block distortion measure (BDM) is found from the five search points of the SCSP
  - If the minimum BDM point occurs at the center of the SCSP, the search stops
  - Otherwise, go to Step 2
Example for Step 1

Fig. 2. First-step-stop with MV (0,0)
Step 2

- Large Cross Searching
  - The four outermost search points of the central LCSP are checked
  - This step guides the possible correct direction for the subsequent step
  - Go to step 3
Step 3

- **Half-diamond Searching**

  - Two additional search points of the central LDSP closest to the current minimum of the central LCSP are checked.
  
  - If the point of the minimum BDM found in step 1 coincides with the point found in this step, the search stops.

  - Otherwise, go to step 4.
Example for Step 3

Fig. 3. Third-step-stop with MV (-1,0)
Step 4

- Searching

- A new LDSP is formed by repositioning the minimum BDM found in previous step as the center of the LDSP

- If the new minimum BDM point is still at the center of the newly formed LDSP, then go to step 5

- Otherwise, this step is repeated recursively
Step 5

- Ending

- With the minimum BDM point in the previous step as the center, a new SDSP is formed

- Identify the new minimum BDM point from the new four candidate points, which is the final solution
Example for SCDS Algorithm

Fig. 4. SCDS algorithm example
### Experimental Results

Table 1  Performance comparison of SCDS

<table>
<thead>
<tr>
<th>BMA</th>
<th>$N_s$</th>
<th>$Sp_{Up}$</th>
<th>MAD</th>
<th>Distance</th>
<th>Prob.</th>
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</thead>
<tbody>
<tr>
<td>FS</td>
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<td>1.000</td>
<td>1.031</td>
<td>0.000</td>
<td>100.00</td>
</tr>
<tr>
<td>3SS</td>
<td>21.519</td>
<td>8.577</td>
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<td>0.202</td>
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Using QCIF sequence “grandma”

<table>
<thead>
<tr>
<th>BMA</th>
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<th>$Sp_{Up}$</th>
<th>MAD</th>
<th>Distance</th>
<th>Prob.</th>
</tr>
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<td>FS</td>
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Using MPEG-4 class A QCIF sequence “mother daughter”