

A Novel Cross-Diamond Search Algorithm for Fast Block Motion Estimation

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Reference :

Chun-Ho Cheung and Lai-Man Po, " A novel cross-diamond search algorithm for fast block motion estimation," *IEEE Trans. Image Processing*, vol. 12, pp. 1168-1177, Dec. 2002.

Outline

- Introduction
- Cross-Diamond Search Algorithm (CDS)
- Example for CDS
- Experimental Results

Introduction

- This paper proposed a novel cross-diamond search
 - Improves the searching speed by up to 40%, as compared to the diamond search (DS) algorithm
- It is suitable for a wide range of video applications such as low-bit-rate videoconferencing

Cross and Diamond Searching Patterns

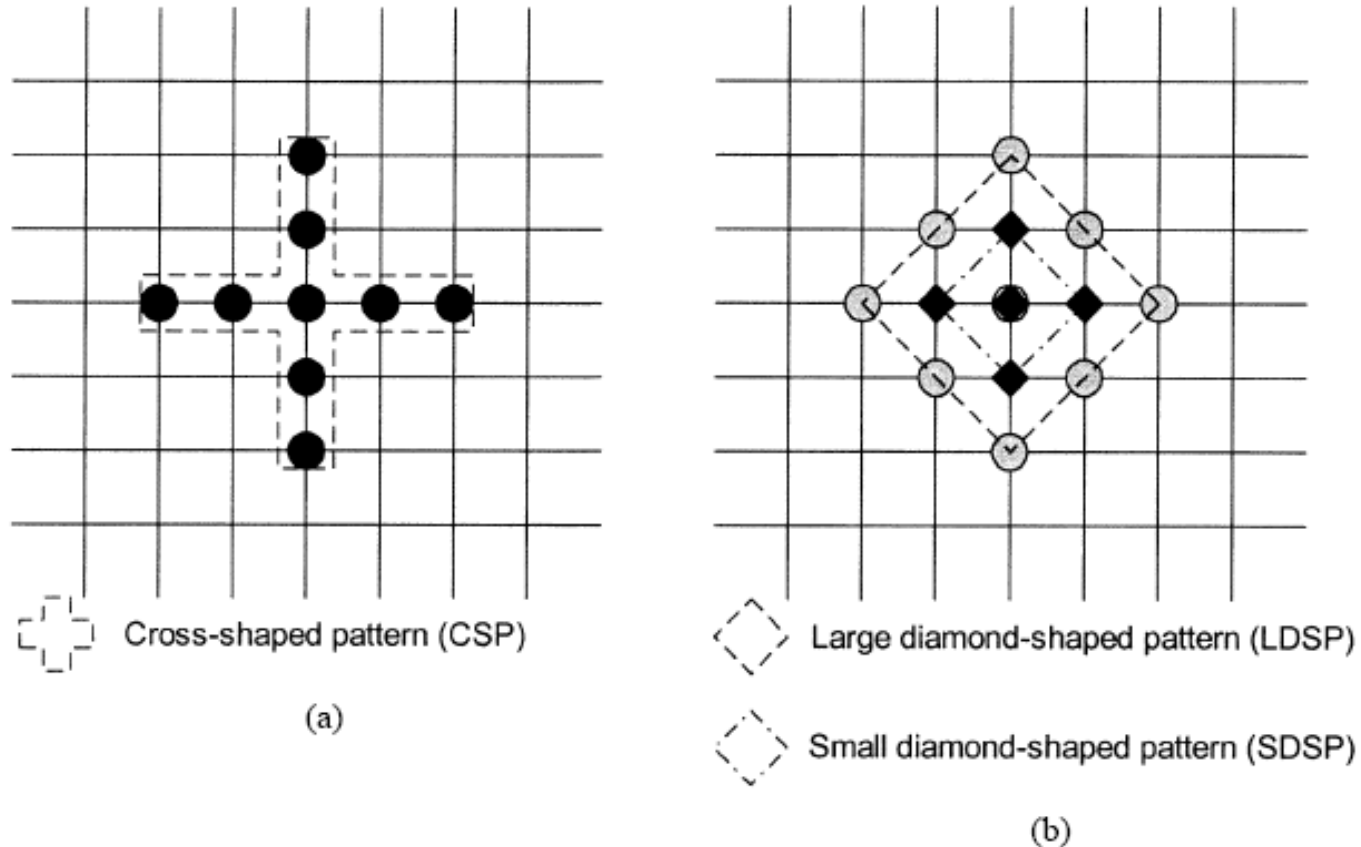


Fig. 1. Cross and Diamond Searching Patterns

The CDS Algorithm

- CDS differs from DS by
 - Performing a CSP in the first step
 - Employing halfway-stop technique for quasi-stationary or stationary candidate blocks
- Below summarizes the CDS algorithm

Step 1

- Starting

- A minimum block distortion measure (BDM) is found from the nine search points of the CSP
- If the minimum BDM point occurs at the center of the CSP, the search stops
- Otherwise, go to Step 2

Example for Step 1

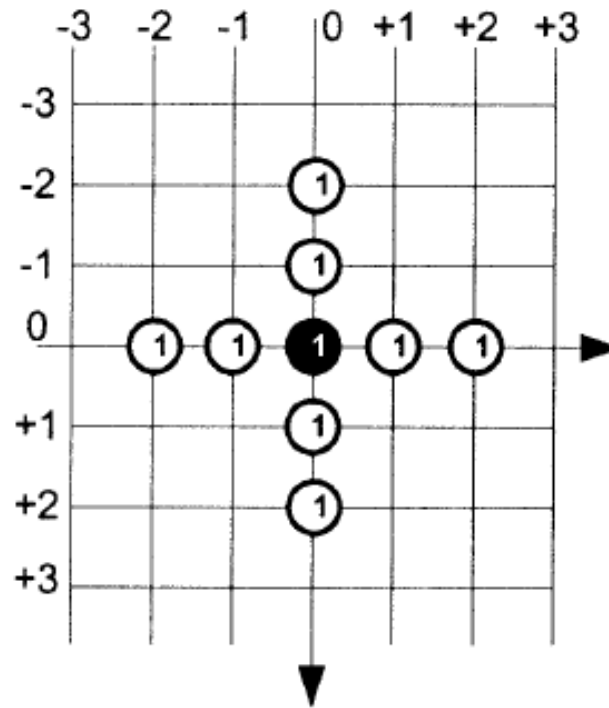


Fig. 2. First-step-stop with MV (0,0)

Step 2

- Half-diamond Searching
 - Two additional search points of the central LDSP closest to the current minimum of the central CSP are checked
 - If the point of the minimum BDM found in step1 coincides with the point found in this step, the search stops
 - Otherwise, go to step 3

Example for Step 2

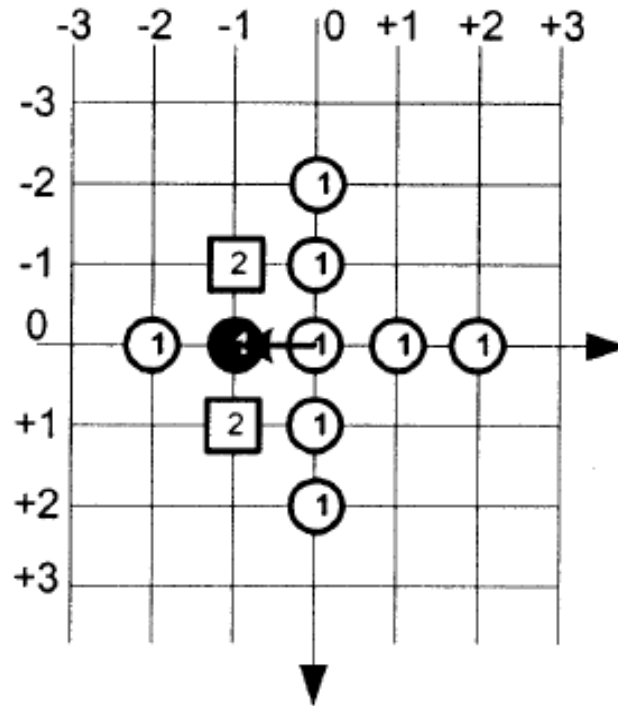


Fig. 3. Second-step-stop with MV (-1,0)

Step 3

■ 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 4
- Otherwise, this step is repeated recursively

Step 4

■ 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 CDS Algorithm

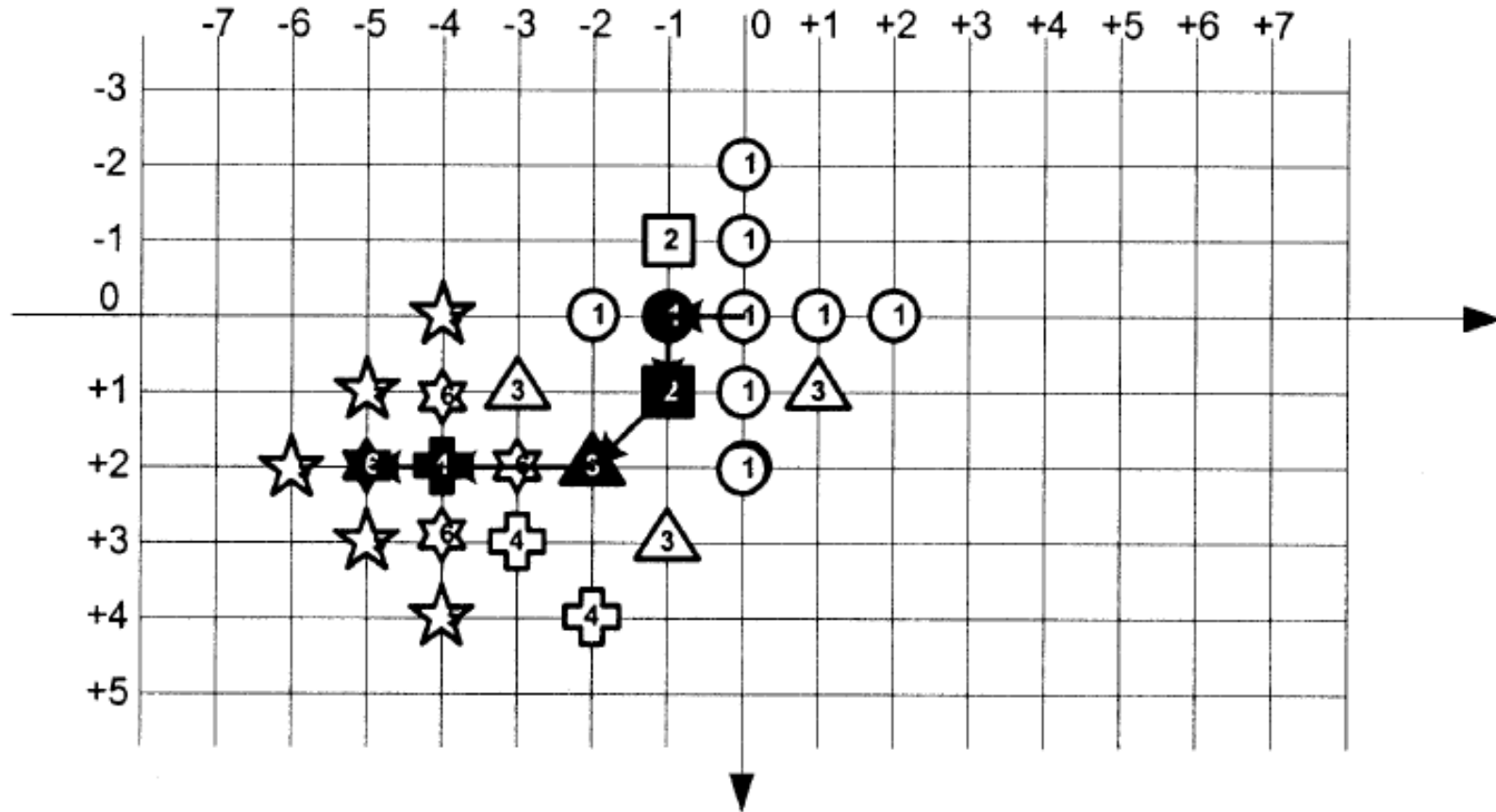


Fig. 4. CDS algorithm example

Experimental Results

Table 1 Performance comparison of CDS

Using CIF sequence "Miss America"

BMA	Points	Speedup ratio	MAD	Distance	Probability
FS	204.283	1.000	1.929	0.000	100.000
3SS	23.451	8.711	2.032	2.527	54.510
4SS	18.334	11.142	2.030	2.506	53.500
N3SS	19.950	10.240	1.952	1.679	68.810
DS	16.408	12.450	2.020	2.429	55.650
CDS	11.681	17.488	1.961	1.832	64.920

Using CCIR601 sequence "Tennis"

BMA	Points	Speedup ratio	MAD	Distance	Probability
FS	916.067	1.000	5.941	0.000	100.000
3SS	32.003	28.624	6.790	3.467	63.880
4SS	27.150	33.741	6.473	2.326	71.280
N3SS	22.997	39.834	6.598	2.737	64.730
DS	17.201	53.257	6.365	1.933	75.570
CDS	15.470	59.216	6.398	1.960	74.920