Two-Steps Cross-Diamond Fast Search Algorithm on Motion Estimation in H.264

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Reference：

Liu Qin, Hiratsuka Seiichiro, Goto Satoshi, and Ikenaga Takeshi, "Two-Steps Cross-Diamond Fast Search Algorithm on Motion Estimation in H.264," *ICCCAS 2007. International Conference*, pp. 782-786, July, 2007.

Outline

- Introduction
- Review
- Proposed Algorithm
- Example
- Experimental Results

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Introduction

- This paper proposed a fast search algorithm for motion estimation in H.264 called Two-Steps Cross-Diamond Fast Search (TSCDS)
  - It can save almost 60% search points and 20% searching time
- It is a very efficient algorithm for real-time video coding applications

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Diamond Search (DS)

- DS is an effective search algorithm
- However, it still has two problems
  - It searches too many points
  - The speed of convergence is not good enough

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Four Kinds of Search Pattern (1/2)

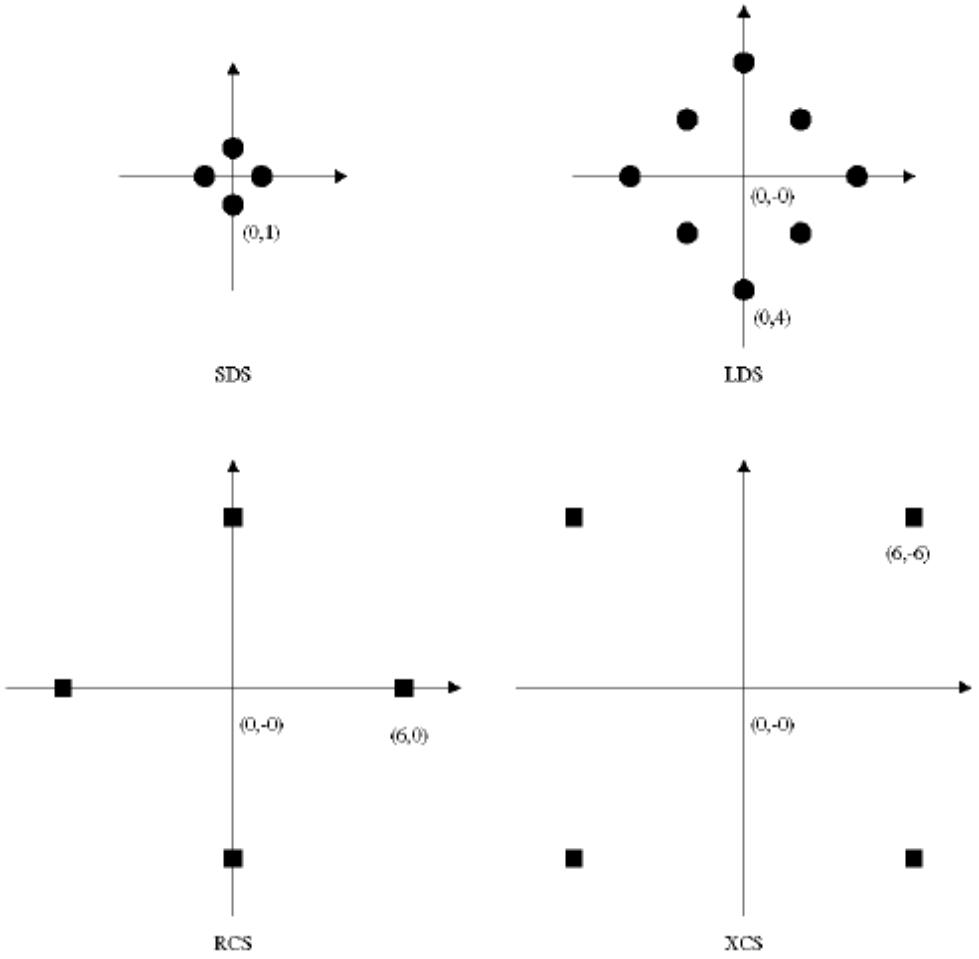

Fig. 1. Four kinds of search pattern

Four Kinds of Search Pattern (2/2)

- SDS
  - Slow motion, used to do the fine search
- LDS
  - Medium motion, between slow and fast motion
- RCS and XCS
  - Fast motion, used to find the coarse diamond center

Step 1

- Search around the center point for slow motion by Step 1.1 and medium motion by Step 1.2 respectively
  - If the result cannot meet the early termination, go to the fast motion search
  - Otherwise, go to Step 3

Step 2

- Use XCSP on Step 2.1 to find the best coarse search point
- Use RCSP on Step 2.2 to refine it
  - Then, go to the Step 3

Step 3

- Use LDSP to find the best fine search point repetitively
  - If the fine search point is occurred on the center of LDSP, go to the Step 4

Step 4

- Use SDSP to find the best fine search point
  - This point is the final result we are looking for

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Example for TSCDS Algorithm

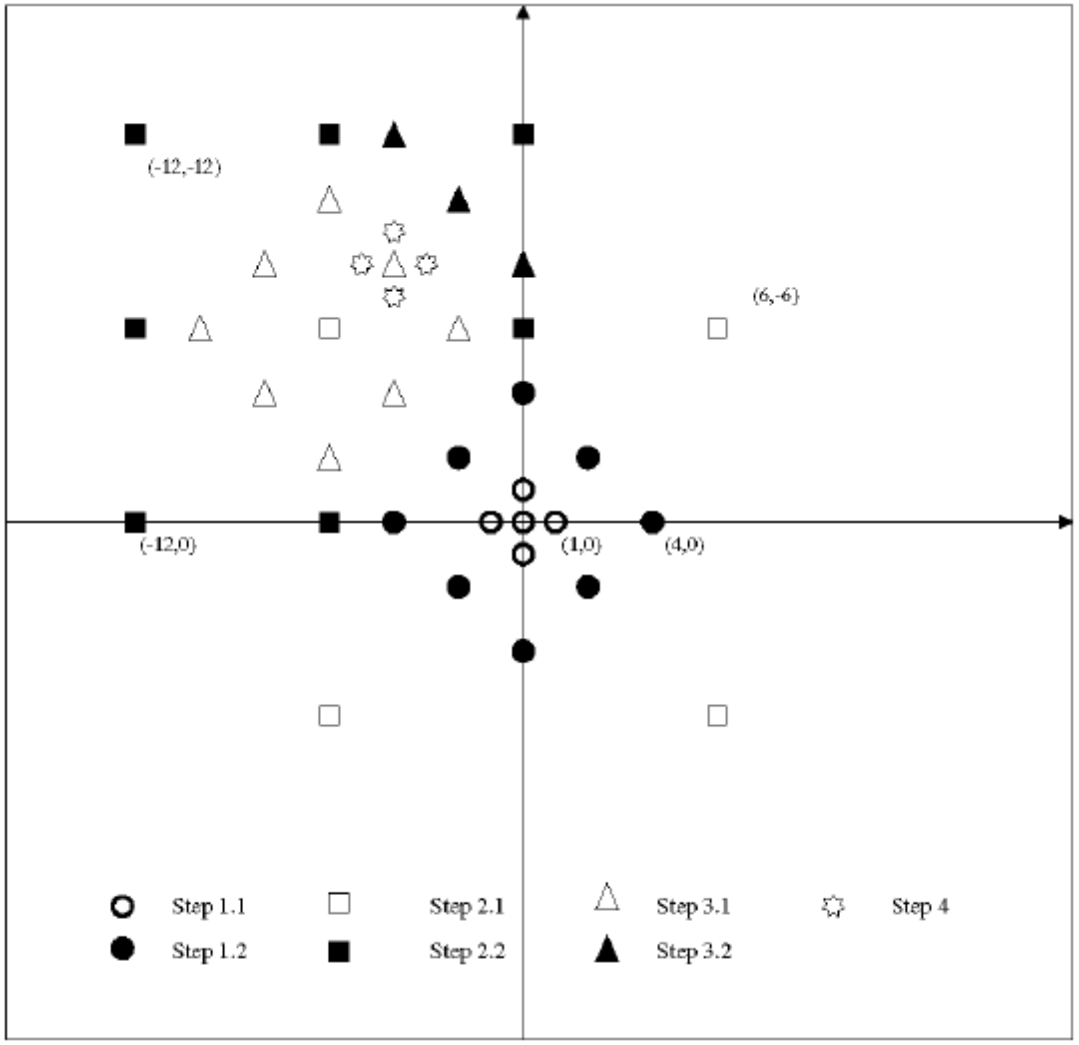

Fig. 2. Example for TSCDS Algorithm

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Experimental Results (1/2)

Table 1 Motion estimation time compared with fast full search on QCIF

Motion Estimation Time Compared with Fast Full Search	coastgaurd	football	foremen	mobile	tempete	table	Average
DS[5]	47.40%	47.66%	46.36%	47.72%	48.09%	41.82%	46.51%
HEXBS[6]	46.59%	46.97%	45.19%	46.57%	46.81%	41.12%	45.375%
UMHexgonsS[10]	45.38%	50.98%	42.21%	46.94%	48.14%	40.16%	45.701%
TSCDS	37.68%	39.71%	35.87%	38.35%	39.04%	35.47%	37.68%

Experimental Results (2/2)

Table 2 Number of search points per macroblock

Num of Search Point per Macroblock		coastgaurd	football	foremen	mobile	tempete	table	carphone	Average
UMHexgonsS [10]	QP=28	299.62	382.45	206.15	338.78	359.74	161.76	166.94	273.63
	QP=32	256.46	380.12	203.37	318.82	332.76	165.35	168.59	260.78
	QP=36	223.68	369.95	199.75	292.81	299.41	169.11	166.79	245.93
	QP=40	197.10	336.92	196.09	262.29	261.59	170.18	161.14	226.47
TSCDS	QP=28	112.77	147.48	91.97	112.73	122.31	75.73	78.00	105.86
	QP=32	100.74	143.03	89.33	108.42	117.10	75.99	78.36	101.85
	QP=36	93.02	135.42	89.53	106.18	112.39	78.11	78.48	99.02
	QP=40	86.86	126.08	88.71	104.24	105.91	78.71	76.83	95.33