Hexagon-Based Search Pattern for Fast Block Motion Estimation

Presenter：M9535204
蔡鐘葳

Reference：

Ce Zhu, Xiao Lin, and Lap-Pui Chau, "Hexagon-based search pattern for fast block motion estimation," *IEEE Trans. Circuits Syst. Video Technol.*, vol.12, pp. 349-355, May, 2002.

Outline

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

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Introduction

- This paper proposed a novel fast algorithm using a hexagon-based search pattern (HEXBS)
  - It has a faster search performance than diamond search (DS)
  - Uses much fewer search points than the DS algorithm
- Theoretical analysis shows that a speed improvement of up to 83% over the DS algorithm

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Diamond Search

- 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

Diamond-shaped Pattern

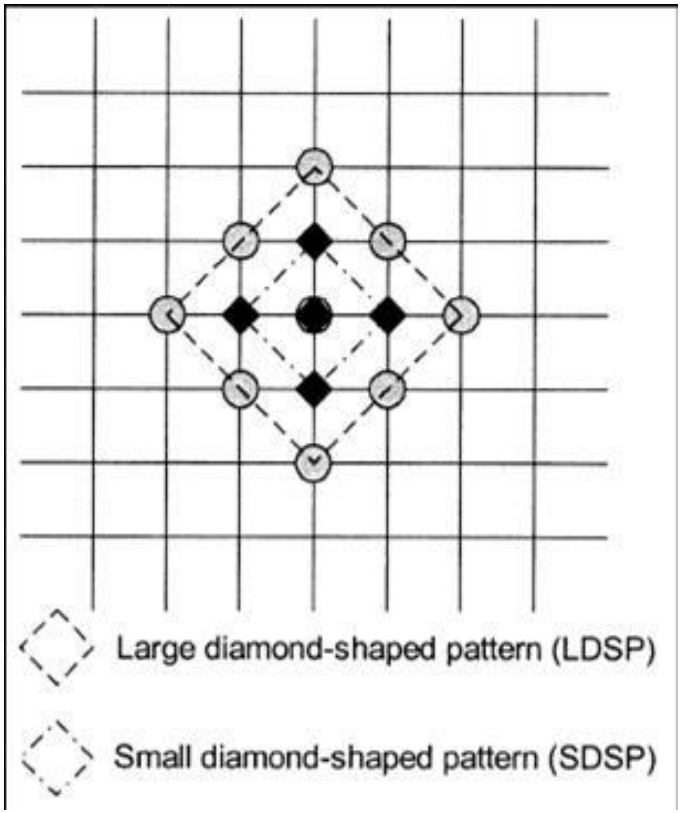

Fig. 1. Two kinds of DS pattern

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Two Kinds of Search Pattern

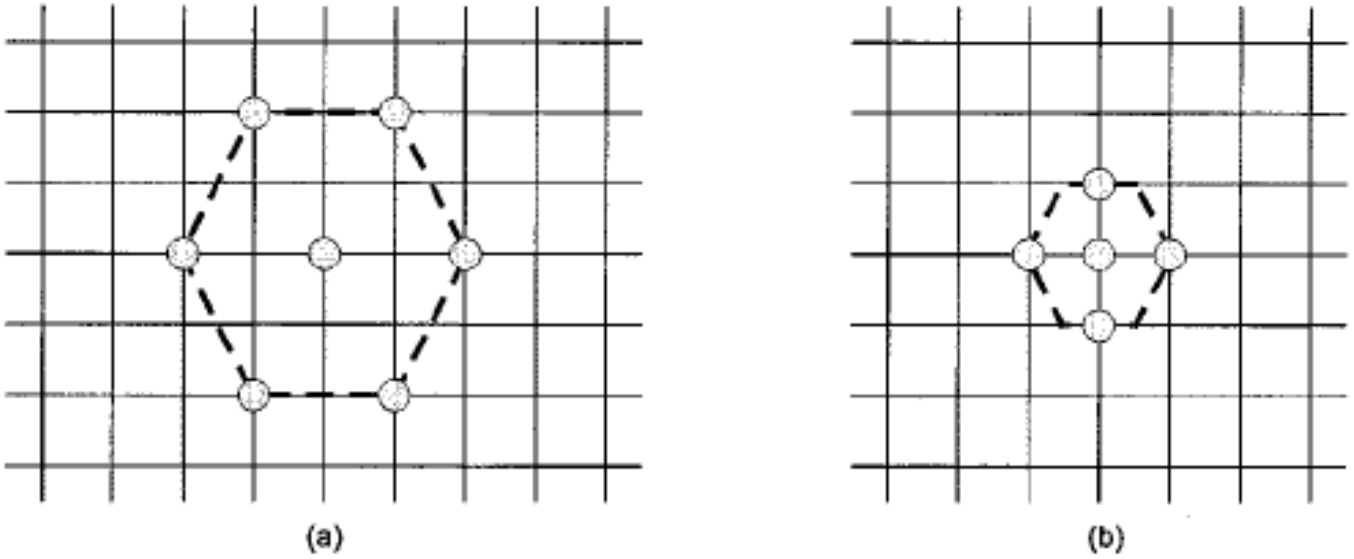

Fig. 2. HEXBS: (a) large HEXBS pattern, (b) small HEXBS pattern

Step 1

- Check the seven checking points of the large HEXBS
  - If the minimum block distortion (MBS) point is found to be at the center, proceed to Step 3 (Ending)
  - Otherwise, proceed to Step 2 (Searching)

Step 2

- With the MBD point in the previous search step as the center, a new large HEXBS is formed
- Three new candidate points are checked
  - If the MBS point is found to be at the center, proceed to Step 3 (Ending)
  - Otherwise, repeat this step continuously

Step 3

- Switch the search pattern from the large to the small size of the HEXBS
- The four points covered by the small HEXBS are evaluated to compare with the current MBD
  - The new MBD point is the final solution of the motion vector

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Example for HEXBS Algorithm

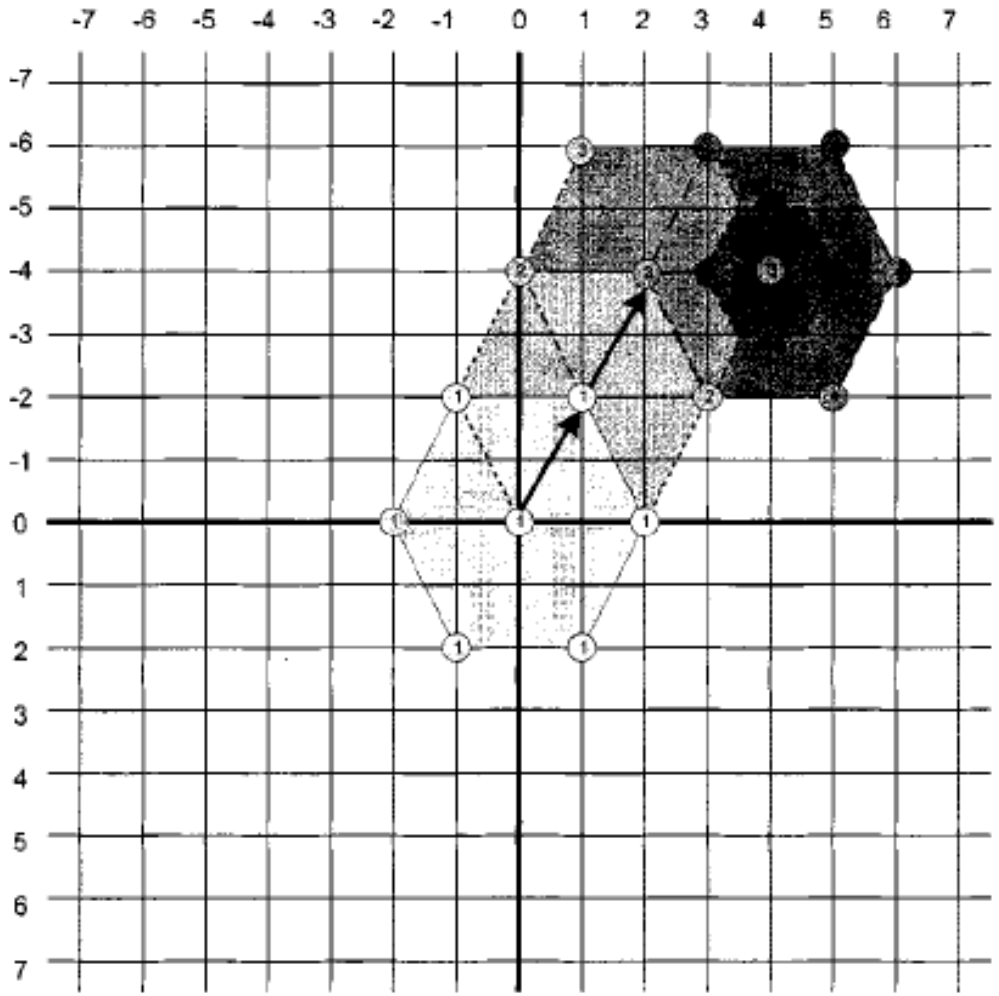

Fig. 3. Example for HEXBS Algorithm

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Experimental Results (1/3)

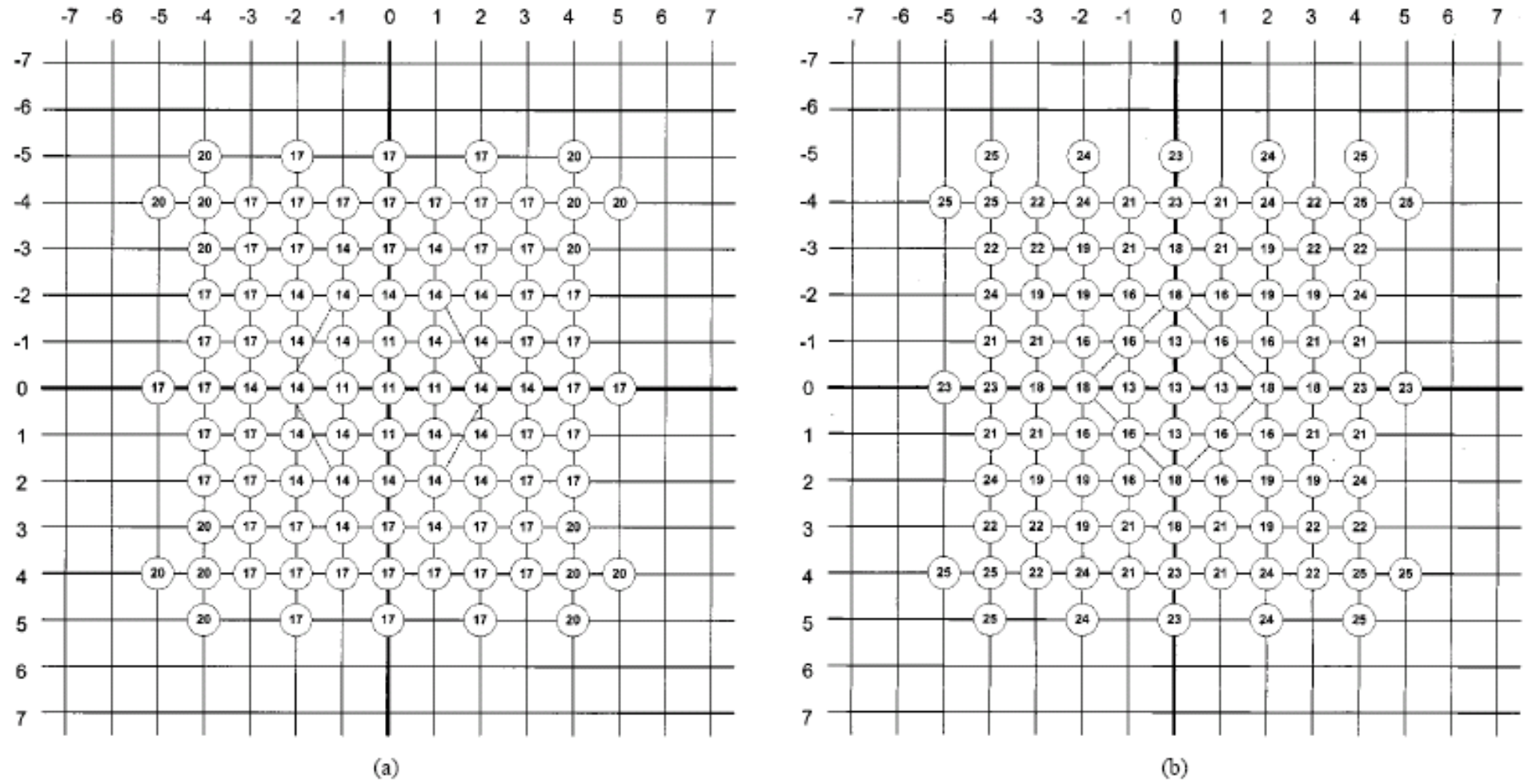

Fig. 4. (a) Minimum possible number of search points for each motion vector location by proposed HEXBS algorithm. (b) Minimum possible number of search points for each motion vector location by DS algorithm.

Experimental Results (2/3)

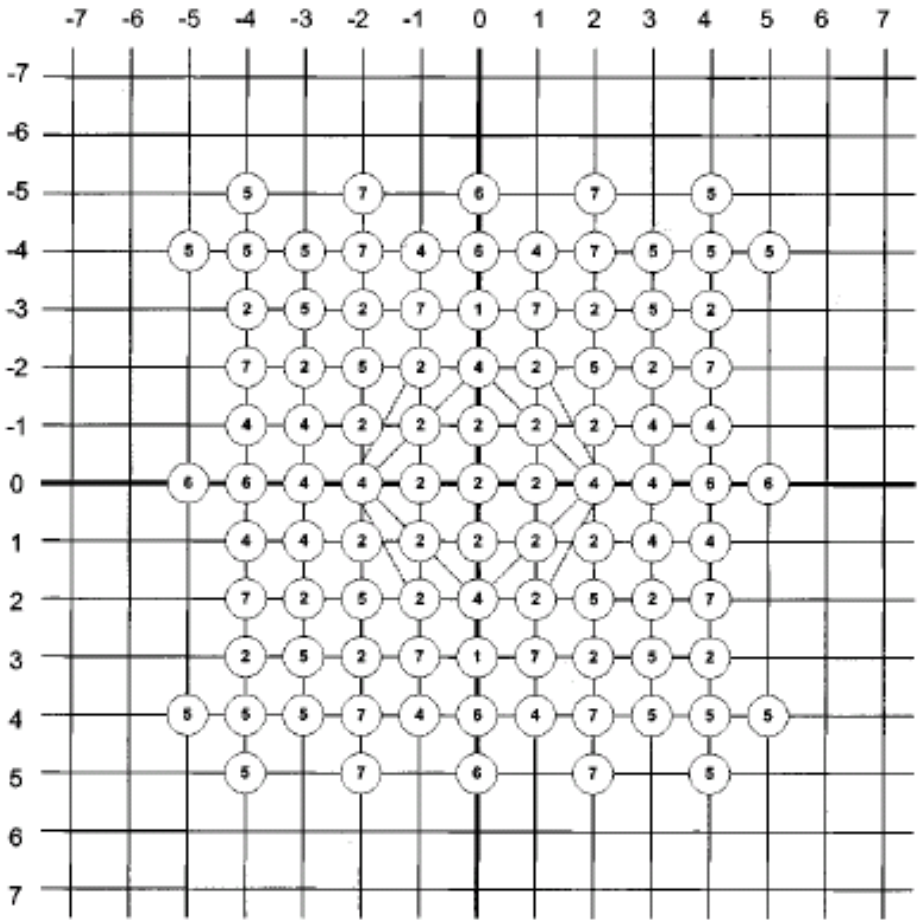

Fig. 5. Number of search points saved by HEXBS compared with DS for each motion vector location.

Experimental Results (3/3)

Table 1 Average Number of Search Points per Block With Respect to Different Methods and Different Video Sequence

	Salesman	Coastguard	Tennis	Garden	Football	DanceWolf
NTSS	18.084	21.358	22.713	27.481	23.813	23.960
4SS	17.355	19.687	19.855	21.661	20.559	20.586
DS	13.065	16.365	16.909	20.750	19.020	18.855
HEXBS	**10.761**	**12.827**	**13.005**	**15.375**	**13.910**	**13.816**