

キーワード , Locally Likely Arrangement Hashing, Spectral SIFT

The Proposal of Encoding Marker using Local Feature for Posture Estimation

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Abstract The proposed marker has the following three aspects, (i) the marker is easy-to-find under a cluttered background (ii) the marker is calculable for its posture (iii) the marker size can be small. The proposed marker is composed of a random dots pattern, and uses Spectral SIFT for a dots detection. Besides it uses an area ratio of triangles which are composed of dots as a geometry feature from a random dots pattern and retrieves the features speedily by Locally Likely Arrangement Hashing (LLAH) so that the correct marker is identified. Moreover a data is encoded to scale sizes of dots in the marker by using Spectral SIFT. We show the above by our experiments.

Key words Random Dot Markers, Locally Likely Arrangement Hashing, Spectral SIFT

1. まえがき

AR Toolkit [2]
ID

[1]

[3]

Locally Likely Arrangement Hashing
LLAH [4]

AR Toolkit

2

Spectral SIFT [5]

" " "

"

LLAH

1Hz

4

5

2. 先行研究：ランダムドットマーカ

LLAH [4]

(A)

(B)2

(C) /
(D)

ABCD

$$\frac{P(A, C, D)}{P(A, B, C)}$$

P(A,B,C)

A B C

p

p 4

4

(1)

$$(r_{(0)} \ r_{(1)} \ \cdots \ r_{(mC_4-1)})$$

Fig. 1(b)

3. 提案：Spectral SIFT を用いたドット検出

SIFT

[6] 2

SIFT

SIFT

DoG

$$\begin{array}{cccc} n & m & (m \leq n) & P_{m(0)} \\ P_{m(1)} & \cdots & P_{m(nC_m-1)} & n \\ & & & m \\ & & m & \end{array}$$

LLAH

Fig. 1(a)

m (m>4)

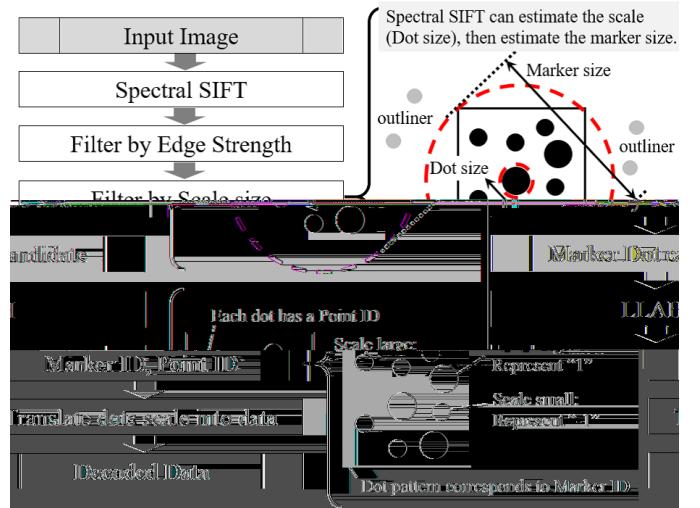
SIFT

Spectral SIFT
Scale Normalized LoG

Spectral

1:

Fig. 1 Feature representation and its stability



2:

Fig. 2 Detection procedure of proposed marker

4

4

$$(r_{(0)} \ r_{(1)} \ \cdots \ r_{(mC_4-1)})$$

Fig. 1(b)

3. 提案：Spectral SIFT を用いたドット検出

SIFT

[6] 2

SIFT

SIFT

DoG

$$\begin{array}{cccc} n & m & (m \leq n) & P_{m(0)} \\ P_{m(1)} & \cdots & P_{m(nC_m-1)} & n \\ & & & m \\ & & m & \end{array}$$

LLAH

Fig. 1(a)

m (m>4)

SIFT

Spectral SIFT
Scale Normalized LoG

Spectral

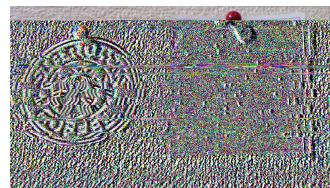
Spectral SIFT

Spectral SIFT

2

1

2



(a) An input image

(b) After the binarization

Fig. 2

Dots Markers

Spectral Random

3.1 エッジの強度による判別フィルタ

$$|Det(\mathbf{H})| > 100 \quad (2)$$

$$Det(\mathbf{H}) = D_{xx}D_{yy} - (D_{xy})^2 \quad (2)$$

$$\mathbf{H} \quad \text{DoG} \quad (3)$$

$$\mathbf{H} = \begin{bmatrix} D_{xx} & D_{xy} \\ D_{xy} & D_{yy} \end{bmatrix} \quad (3)$$

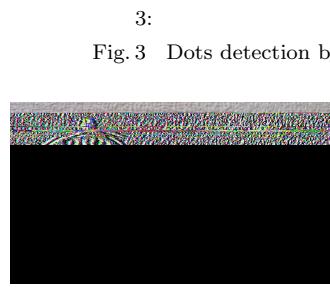
3.2 ドットのスケール推定による判別フィルタ

Spectral SIFT

2

(c) After the labeling

(d) The result of marker detection



(a) An input image

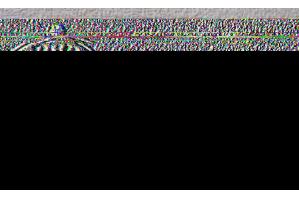
(b) After Spectral SIFT

$$T(=8)$$

outliner

3:

Fig. 3 Dots detection by Random Dots Markers



(a) An input image

(b) After Spectral SIFT

3:



(c) After the filter by edge

(d) After the filter by dots scale

4. 実験と結果

1280 720

USB

2.5cm

11

8

3

1 -1

4.1 ドットの検出方法の比較実験

(e) After LLAH processing

(f) The result of marker detection

4:

Fig. 4 Dots detection by Spectral Random Dots Markers

Fig. 4(c)

Fig. 4(d)

Spectral SIFT

SIFT

Fig. 3 Fig. 4

Spectral

LLAH

Core i5

Spectral SIFT

1Hz

LLAH

Fig. 4(b)

Fig. 3(d)

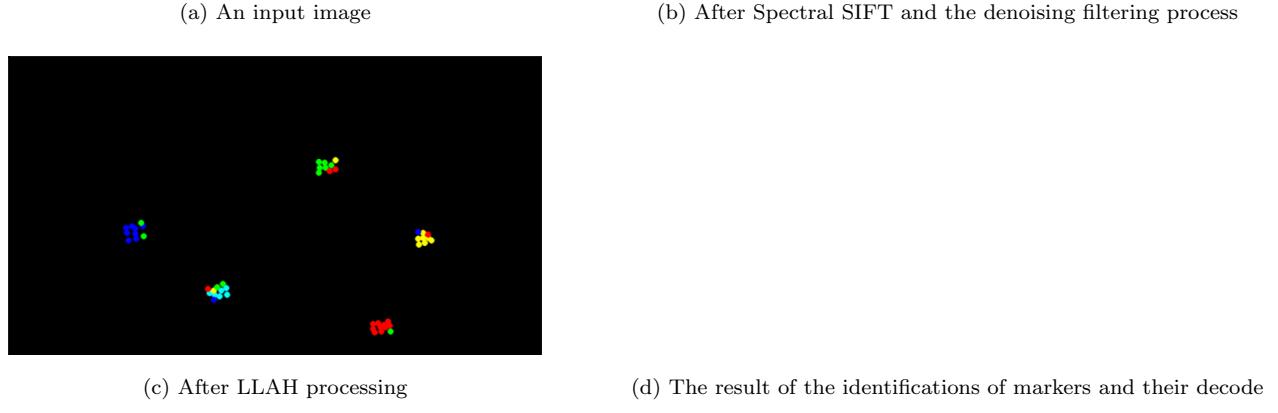
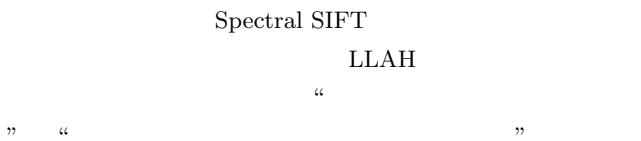


Fig. 6 Marker's decode by various placements
6:
RANSAC
ID
LLAH

5. まとめ



5:

1

Spectral SIFT

LLAH

"

"

Fig. 5 1 byte representation by Spectral Random Dots Markers

4.2 様々なマーカ配置におけるロバストなデータデコード

Fig. 6 5

70cm

Fig. 6(d)

Fig. 6(b)

[1]

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LLAH

Spectral SIFT

Fig. 6(c) LLAH
ID

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