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あらまし　　センサ　　一の　　き　と　　ら　CCD
wUplhHstS.wrsswU84oT:wz
TohowGTsTTcJ–wrsstwtGsffiCU
oqxtsffiffiCpx　　4×4 xwzphrSzh
::owtmobffipxrgqozws-b
qptbqsw:owtSbtts
:otStporgpxth
ThtwsgbqpSsqbh
hgtffiwh
キーワード　　センサ　　熱源位置推定　空間的特性

Localization of point heat sources using a low resolution infrared sensor array

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Abstract　A low resolution infrared sensor array is expected to be applied for the analysis of human behaviors in various places, because it can circumvent privacy problems. However, it cannot localize heat sources with high accuracy, because it consists of a very small number of infrared sensors. Accordingly, it is difficult to obtain sufficient information for analyzing human behaviors from a low resolution infrared sensor array. This report proposes a method to localize heat sources with high accuracy by using a low resolution infrared sensor array. The proposed method uses spatial characteristics of the infrared sensors which are measured beforehand to create sensor array outputs for various locations of heat sources with a low cost. To localize the heat sources, the method searches for the nearest sensor outputs in the sensor outputs database. We report the validity of the method through an experiment using actual sensor data.

Key words　Infrared sensor array, point heat detection, spatial characteristic

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1. ま え が き

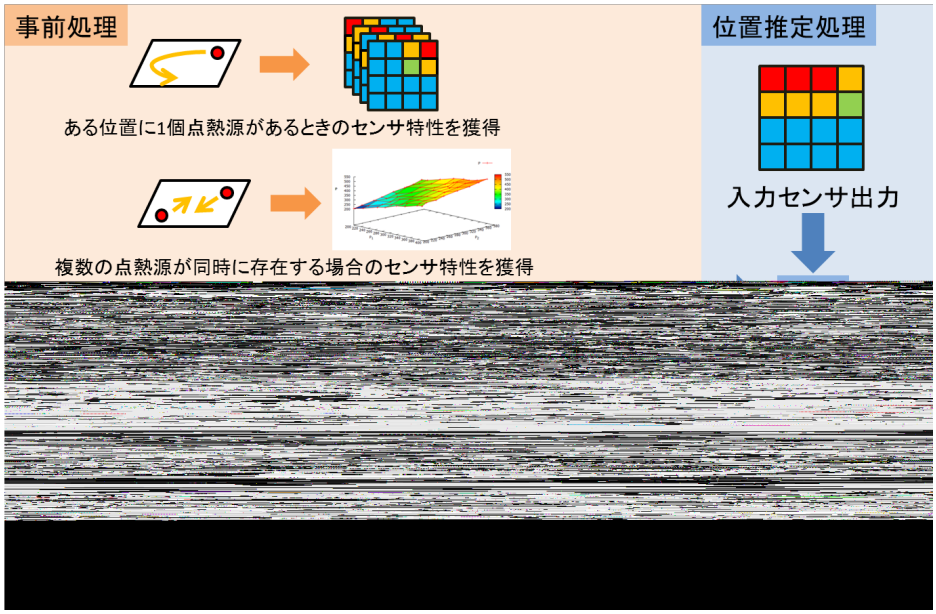
ンな の ス セキ ス
の な センサ
ま まな ら [1] CCD off.
ffbqD——
ff—ff
q [2]— 1
ff.ro bq
—f—
ffffrSCo
ffrS—q
—offff—
—H
CCD ffiSff.r
8ff4o—
o—r
CqffrS
oSoffbq—S
ff.ff 9q ffbq—
ffqoqf—ffrS
oSoffb[
o— 4×4
ffrS [4] o
ffmoCb
o—ffrS
off b mo [5]
—b—9Sff
ffcoqo—offb
ffrSCo—
—ffcSo
ffbq—b
mffcoffb
ffmoo [6] —b
ffcq—
bffcSff
offc
q—ffcq
q—
ffc—bff
—Sffqo
—Sff
mooSc—S
—omoo
ff—ffrSo
oSffbqqb
ffab——b
offmo—b
—ffo
bbq—ffcS
ffqb— 2 mo— 3
bgmo—
4 gLS—o7— 5 —]ff
gCb

2. 提 案 手 法

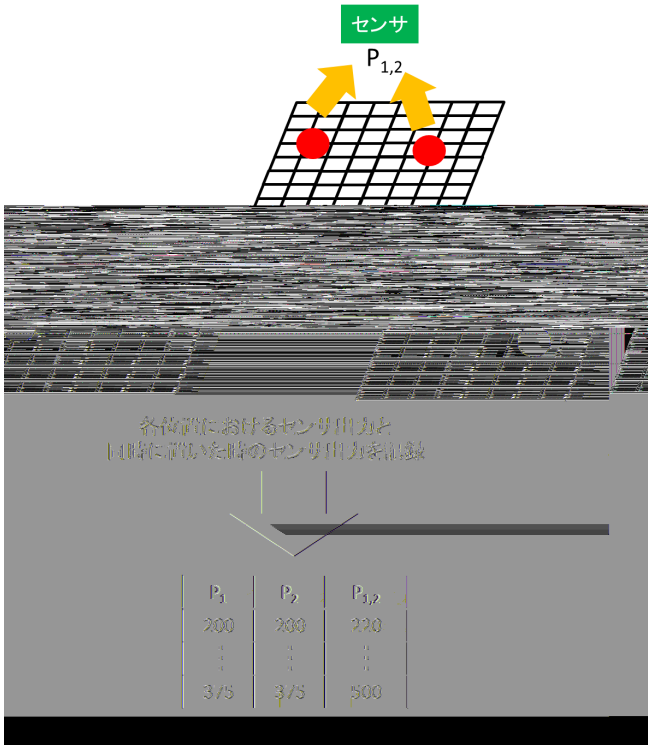
提案手法 の 1 bff
o— 1 — 2
— 3off 3 mrg
1q 2rg
1 —ff 1
oqoff
bb
2— 1
bo—offS
b
3off—ff—
ffgbq
ooff
—rgmo

2.1 センサの空間的な特性の獲得

センサの空間的な特性の獲得とし ま 1 o
ff—
qff0off—ff0b
bq
—offb
boffb 1
offbq7—
off—bq
ffbqDf—ff
Cb—fbo
ffbqqf—
offb— 1
offbro
off—fqffS
b
2 ffb 1 o
bqq7—qff0
ooffoffbff
ffc—o 1 ffq
P_1 1 ffq P_2
P_1 P_2
$P_{1,2}$ P_1 P_2
3 mo—7
P_1 P_2 P_3 $P_{1,2,3}$
3 b 3 (a)—(b)
a—
o 2 — $P_{1,2}$ P_1 P_2
2
$w^{(2)}$ $\alpha^{(2)}$ P_1,P_2



1　fiOwv



2　:wfi:fiofitObwfiQwfi

DpKfi　　P_1　P_2

$$P_{1,2} = w^{(2)}(P_1 + P_2) - \alpha^{(2)} \tag{1}$$

—　　$P_{1,2,3}$　　$w^{(3)}$　$\alpha^{(3)}$

2.2　センサ出力データベースの作成

センサ出力データベース　　の　熱源の　置
　　センサ　　の出力　　成し　　の　置と
センサ出力の　成　法の　ま　な　　4 bc—
ofgffoffb

(a)

(b)

3　2 xwfi:fiofgofiphwfi
thww

bK　　$\boldsymbol{x}$　1 offb　　i w
　　$f_i(\boldsymbol{x})$ qbff—　　1 o
b　　$\boldsymbol{x}$
$\boldsymbol{x}$
$\boldsymbol{x}$

$$\boldsymbol{X} = (\boldsymbol{x}_n | n = 1, ..., N)$$

ffq　　$\boldsymbol{F}(\boldsymbol{X}) = (F_i(\boldsymbol{X}) | i = 1, ..., p)$

Rb p w..

w. N $wfw.w\alpha w$

i ww $F_i(\boldsymbol{X})$o

$$F_i(\boldsymbol{X}) = w^{(N)} \sum_{n=1}^{N} f_i(\boldsymbol{x}_n) + \alpha^{(N)} \tag{2}$$

— $w^{(N)}$ $\alpha^{(N)}$

=

2.3 熱源位置の推定

熱源位置の推定 センサ ら得ら

カセンサ出力 $\boldsymbol{I} = (I_i | i = 1, ..., p)$ q— 9S

$\boldsymbol{F}(\boldsymbol{X}) = (F_i(\boldsymbol{X}) | i = 1, ..., p)$ —7 ffg

bqoi— p

$w.pw.$ N

1　fiOOwfi)fitAhrg

	O		fiOsg		fiO　LSH	
fiox:　[x]	fiS)　[ ]	fifiS　[ms]	fiS)　[ ]	fifiS　[ms]	fiS)　[ ]	fifiS　[ms]
1	3.19	0.00043	0.82	0.088	0.84	0.0019
2	3.97	0.00056	0.92	16	0.93	0.50
3	2.39	0.00060	1.97	1892	2.16	10

(a) Yrwfiofih　　(b) YXfihfio

8　YXfihww

(a) Yrfio　　(b) lofihfio

(c) Yrwfioft0ofiOtlo“Rh

9　lofihww

xwfi:fiothwfi
ofifiSAtM“pwfisfiQw
fiITMfiSpwfiDfipKTh
xfi:fiowx:　1　361 ff—　2
mo　30 ff—　3 mo　60 ff

—ff
o　1　3 ffbomo
m—o　1　$_{19\times19}C_1$ =
361 ff—　2　$_{19\times19}C_2$ =　64,980 ff—　3
$_{19\times19}C_3$ =　7,775,940 ff
qoffLC
ooffbb—9
Sffqoi ff—
fffcffqoff0ff
ffLqb—b

SffD
— ffg —
LSH ffg—　LSH
bbq7cffgqff=
qSffS
gLff0b—Sqo
ffqrffqffS)
1)—
3m moff　5.2cm obq
b—　1 mffbbr
gff

4.　実験結果・考察

提案手法と　手法　位置推定　の　と位置推定
の　し　間　1 bffcff
qq—ocSo

8

b 8 (a) roffq

— 8 (b) offq

f 8 (a)—(b) 2 m

)qo

oq

So—o 3 q— 2 qq

oSffff 9 ffff

qqo

b 9 (a) roffq

— 9 (b) o

offqf

— 9 (c) roffq

9 (a)—(b) 2 m)

q—ffo

q— 9 (a) q 9 (b)— 9 (a) q

9 (c))g SSD Sum of Squared

Differencebq— 25.1[^{2}]–68.4[^{2}] qoS—

b—off

ffq

mo

— 3 ofgffoffb

o—f 3 ff

)fff—

Srgffqq

—oq

bq

5. ま と め

センサ 熱源の位置

推定 な 手法 提案し 提案手法

獲得し センサの空間的な特性 と 位置

推定 の 提案手法 き (1)

— (2) —

(3) off 3 mrg

—ff 1 o

qoffb

—off

Sffbqbq

off—

ffgbqo

ffoffg—ff

LffCob—

ffgffgqbq

o—ffmSffq

b—o

qmff—fo

9Sq—m

9Somo9S—o

m9S—

謝辞 熱

謝 の

ま センサ 提 し ン

謝

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