

### CCD

## Study on the Range Measurement using Thermal Infrared Image Fusion Technique with Real CCD Image

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150

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604

CCD 2 2

CCD

CCD CCD FOV CCD FOV가

CCD CCD CCD CCD

FOV CCD 2 CCD

. 2 CCD

가

THV510 FOV X 18.3 ° X 9.15 °

1/2" CCD 14.59 ° X 10.97 ° FOV 25mm/ f1.8

PuINIX TM-7CN CCD AGEMA

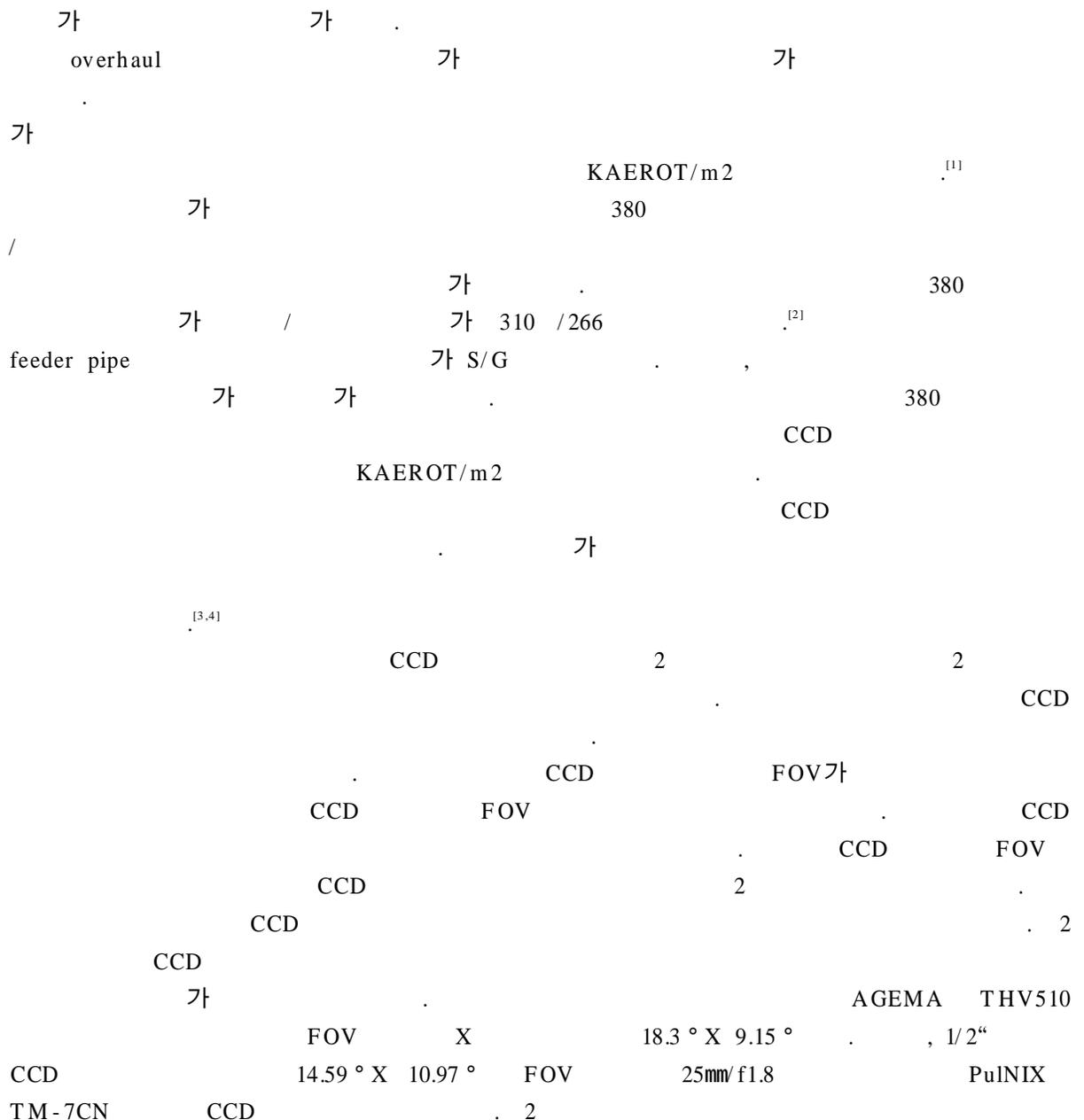
### Abstract

In this paper, range measuring technique using 2 different sensor information sources - the thermal infrared image used for observation purpose and the real image of CCD - and the distance between the THV510 thermal infrared camera and the TM-7CN B/W CCD camera is described. The THV510 thermal infrared camera and the TM-7CN CCD camera are arranged in parallel with certain distance. The thermal infrared iamge at the left is used in extracting feature of the observing object with abnormal thermal characteristics, while the CCD image at the right is used in featuring object with the same thermal characteristics. In this way, the disparity

between the 2 images at the left and right is calculated. The range is calculated by trigonometry by using the disparity value and the physical distance between the THV510 and the TM-7CN. It shows that this calculation have little error in comparison with the distance measurement method using the parallel stereo camera with same 25mm/f1.8 lens.

The model of the thermal infrared camera used for this study is THV510 made by AGEMA, and its horizontal and vertical FOV is 18.3 ° X 9.15 ° . The CCD camera is PulNIX TM 7CN having the structure of the 1/2" CCD camera.

1.



2.

CCD FOV

FOV X 18.3 ° X 9.15 ° THV510 IR 70mm 1 THV510

CCD THV510 70mm 1 THV510

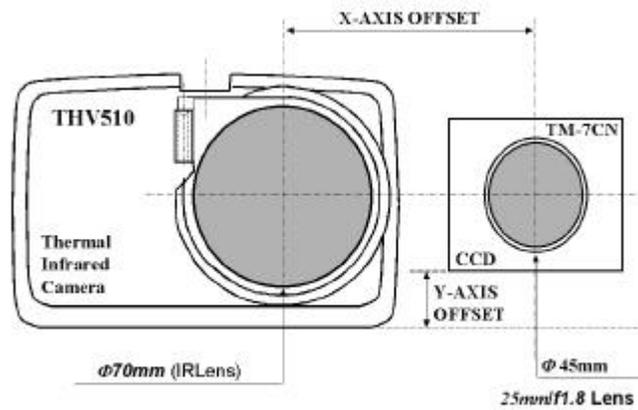
AGEMA THV510

KAEROT/m2 1 KAEROT /m2

CCD

113, 25mm 1 THV510

[5]



1.

1. THV510

Parameter	Specifications
FOV [HXV]	18.3 ° X 9.15 °
Spectrum Range	3 5 μm
Detector Type	160 Elements InSb FPA
Infrared FOV [HXV]	1.0 X 1.3 mrad
IR Field rate	15Hz
Temperatutre Range	RANGE 1: 0 40 RANGE 2: 0 80 RANGE 3: 0 120
Focal Length	0.7m
Detector Cooling	Thermo Electric (Peltier Effect)
Thermal Sensitivity	0.1 @ 30
Image Size [HXV]	512 × 320 [HXV]

1/2" CCD  
 CCD  
 CCD  
 6.54 X 4.89mm  
 FOV

PuNIX TM-7CN  
 THV510  
 TM-7CN  
 2 1/2"

TM-7CN CCD  
 1/2" CCD  
 CCD

TM-7CN CCD  
 FOV  
 CCD  
 FOV  
 X

2. FOV

	FOV
12mm	29.9 ° X 22.6 °
16mm	22.62 ° X 17.06 °
20mm	18.18 ° X 13.69 °
25mm	14.59 ° X 10.97 °
35mm	10.45 ° X 7.84 °
50mm	7.32 ° X 5.50 °

2 THV510  
 20mm, 25mm  
 THV510  
 FOV  
 CCD  
 25mm  
 THV510  
 O'P'

FOV  
 f<sub>CCD</sub>  
 CCD  
 TM-7CN CCD  
 (4)

FOV  
 f<sub>IR</sub>  
 THV510  
 f<sub>CCD</sub> / f<sub>IR</sub>

FOV  
 2 THV510  
 25mm  
 THV510

가 20mm 25mm  
 25mm/f1.8  
 TM-7CN  
 TM-7CN CCD  
 THV510

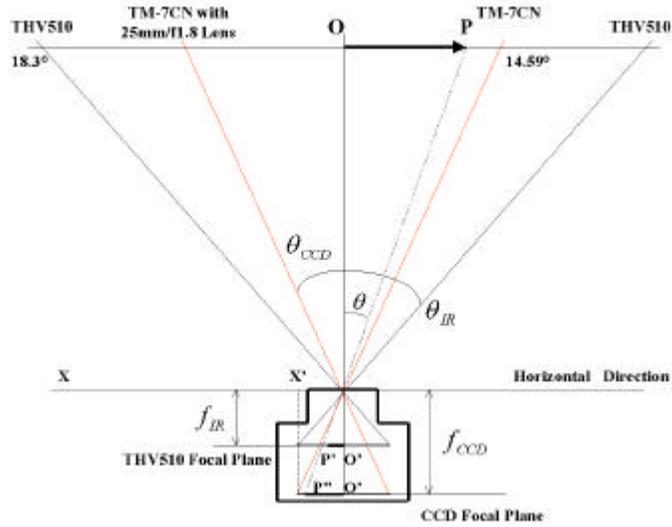
$$O'P' = f_{IR} \cdot \tan \theta \quad (1)$$

$$O'P'' = f_{CCD} \cdot \tan \theta \quad (2)$$

$$f_{IR} \cdot \tan \theta_{IR} = f_{CCD} \cdot \tan \theta_{CCD} \quad (3)$$

$$O'P' = O'P'' \cdot \frac{\tan \theta_{CCD}}{\tan \theta_{IR}} \quad (4)$$

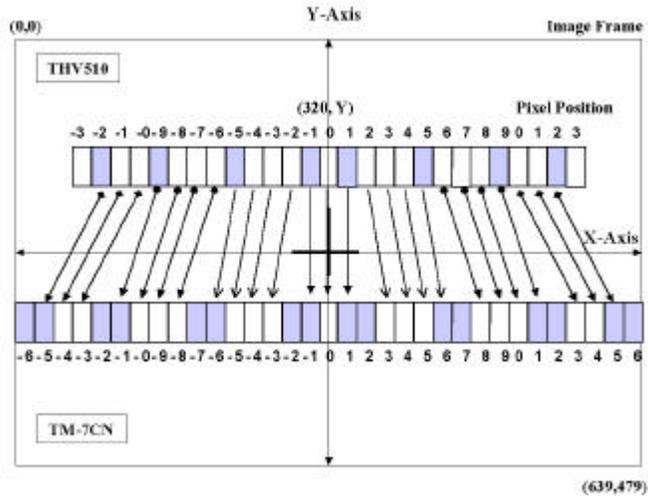
,  $\theta_{CCD}, \theta_{IR}$  TM-7CN CCD THV510  
 510 CCD 1.26  
 THV510 CCD FOV (4) 가  
 3 3  
 320, 321, 322 TM-7CN 320, 321, 322  
 3 TM-7CN 가 THV510 3



2. CCD FOV

3. THV510 CCD FOV

THV 510	TM-7CN	THV 510	TM-7CN	THV 510	TM-7CN	THV 510	TM-7CN
320	320	400	421	480	521	560	622
1	1	1	2	1	<del>3</del>	1	3
2	<del>3</del>	2	3	2	4	2	4
3	4	3	4	3	5	3	<del>6</del>
4	5	4	<del>6</del>	4	6	4	7
5	6	5	7	5	<del>8</del>	5	8
6	<del>8</del>	6	8	6	9	6	<del>630</del>
7	9	7	9	7	530	7	1
8	330	8	<del>431</del>	8	1	8	2
9	1	9	2	9	<del>3</del>	9	3
330	<del>3</del>	410	3	490	4	570	<del>5</del>
1	4	1	4	1	5	1	6
2	5	2	<del>6</del>	2	6	2	7
3	6	3	7	3	<del>8</del>	3	638
4	<del>8</del>	4	8	4	9	4	<del>638</del>
5	9	5	<del>440</del>	5	540	5	<del>638</del>
•							
•							
•							
399	419	479	520	559	621	639	<del>639</del>



3. THV510 CCD FOV

640

506

TM-7CN FOV

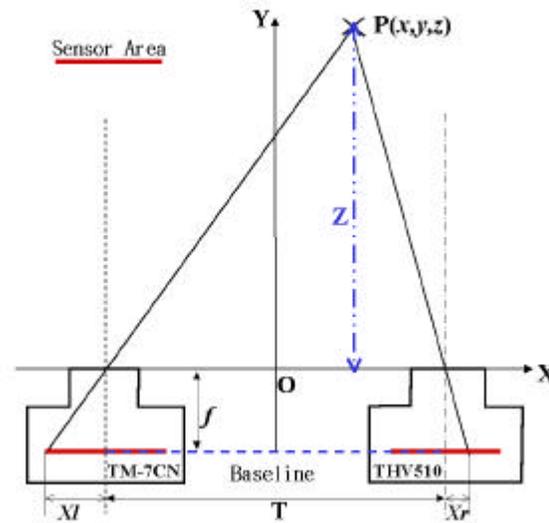
3 THV510

3.

THV510 TM-7CN CCD FOV

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4



4.

4 2

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P

Z

(8)

$$\frac{X_l}{f} = - \frac{T/2 + x}{Z} \quad (5)$$

$$\frac{X_r}{f} = \frac{T/2 - x}{Z} \quad (6)$$

$$\frac{X_r - X_l}{f} = \frac{T}{Z} \quad (7)$$

$$Z = f \frac{T}{D} \quad (8)$$

(8)  $D$   $2$   $X_r - X_l$  ,  $T$   $2$   
 $T$   $D$   
 CCD THV510 TM-7CN  
 CCD FOV  $2$   
 $5, 6$

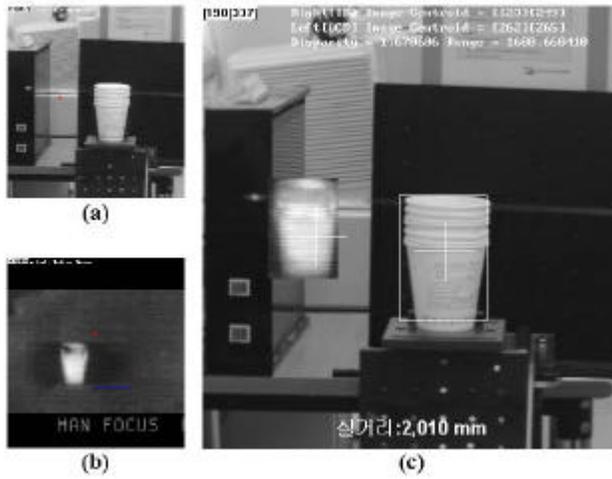


5.

6(a) TM-7CN CCD  
 THV510  
 CCD  
 TM-7CN  
 THV510 TM-7CN CCD  
 1,688mm

6(b) 가  
 6(b)  
 TM-7CN

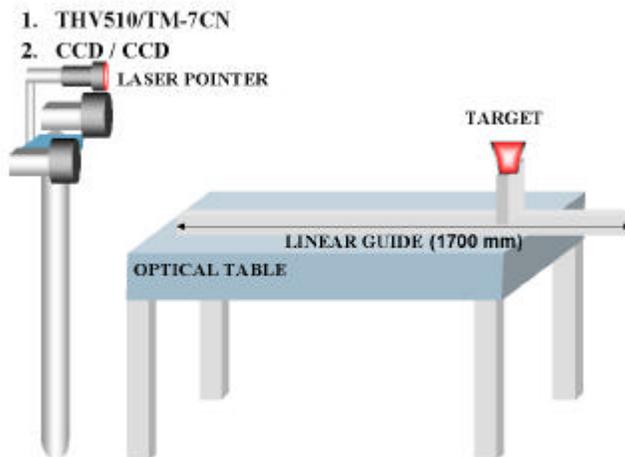
6(c) THV510  
 2  
 2,010mm



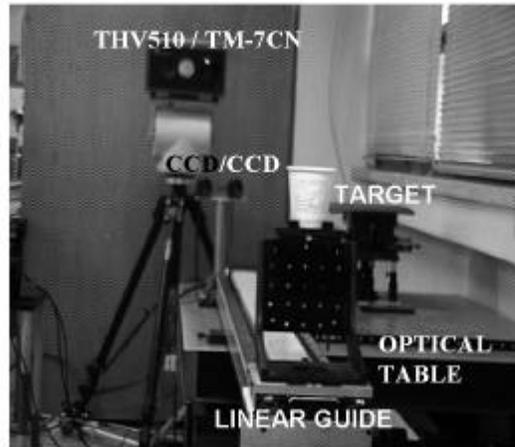
6.

4. 가

THV510	TM-7CN	CCD	가	THV510/
TM-7CN		2	CCD	
.			8, 9	.
	Linear Guide			7
/CCD	CCD/CCD			1,700mm

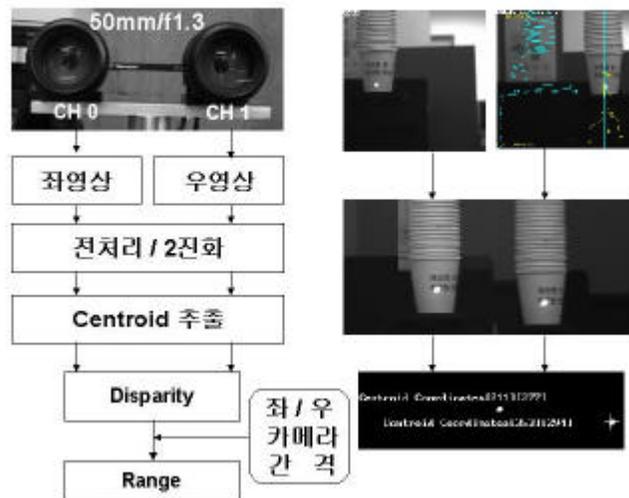


8.



8.

8 가 가 SGM AC  
 2 CCD THV510 FOV 25mm  
 50mm  
 THV510/TM-7CN CCD 7  
 CCD/CCD CCD  
 2  
 9



9. CCD/CCD

4, 10 THV510/TM-7CN CCD CCD/CCD  
 CCD/CCD 25mm, 50mm AVENIR CCTV  
 10 X Y  
 THV510/TM-7CN ( )

CCD+CCD @25mm

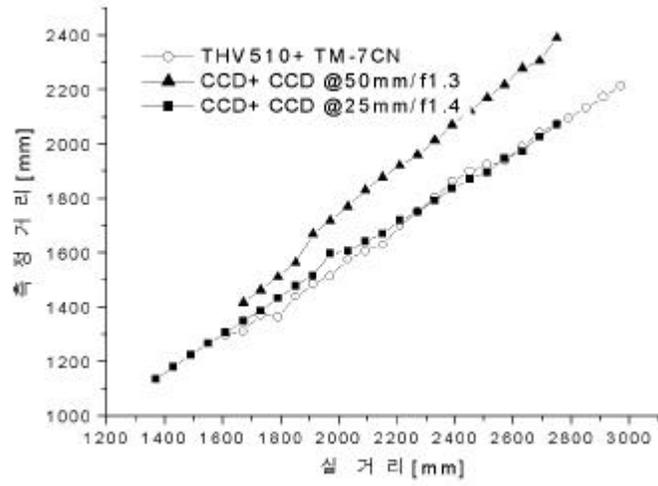
( )

가  
CCD

CCD

CCD

가

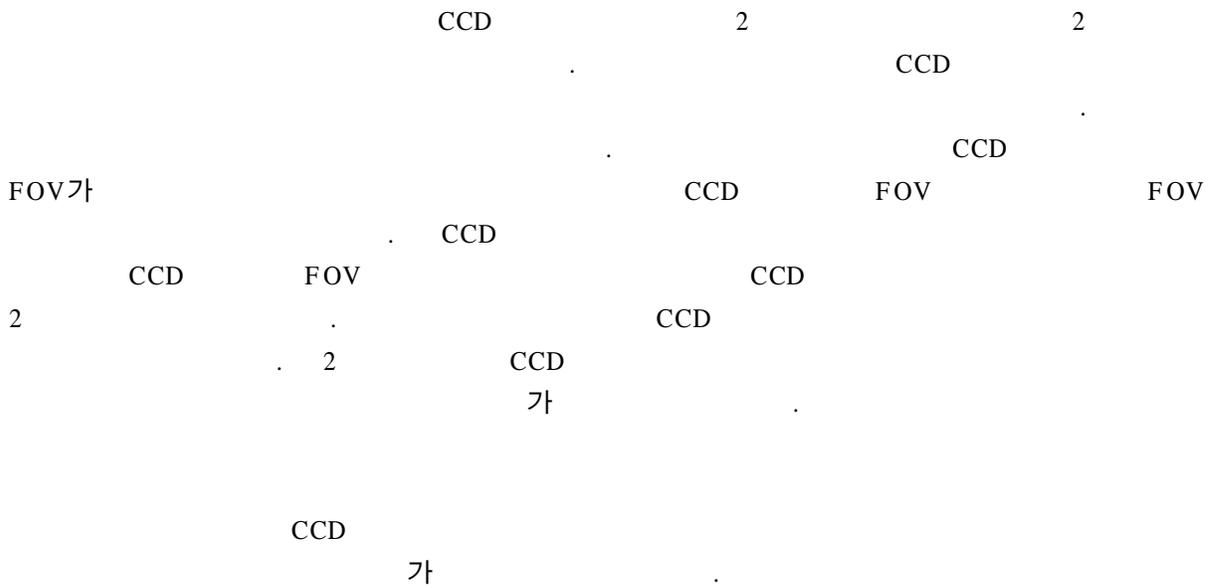


10.

4.

[mm]	THV510+ TM - 7CN	CCD+CCD with 25mm	CCD+CCD with 50mm
2750	2077.21	2070.90	2390.79
2690	2041.07	2028.05	2306.41
2630	1989.19	1973.61	2279.59
2570	1939.87	1947.47	2219.38
2510	1923.97	1897.21	2170.24
2450	1900.33	1873.04	2123.23
2390	1862.89	1837.92	2070.90
2330	1805.58	1793.09	2014.16
2270	1751.68	1750.40	1960.45
2210	1700.90	1719.69	1922.01
2150	1630.03	1670.84	1879.02
2090	1607.70	1642.83	1832.19
2030	1575.33	1606.93	1771.50
1970	1514.35	1598.19	1719.69
1910	1485.60	1515.81	1670.84
1850	1440.03	1477.73	1564.19
1790	1364.68	1434.47	1511.91
1730	1372.66	1387.11	1463.02
1670	1311.31	1348.93	1417.19

5.



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- [2] K.S. Mahil, Conference on Remote Techniques for Nuclear Plant, (British Nuclear Energy Society, Stratford, UK, 1993), 46
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- [4] , , , ( , , 1999), 1090
- [5] Hughes Aircraft, THV-510 ThermoVision Maintenance Manual, (Mahwah Electro-Optics Center, NJ, USA, 1996) Section III
- [6] Toshiba, Lens Manual, ( , , 1996)
- [7] B. K. Paul, Robot Vision, (The MIT Press, Cambridge, USA, 1987), Chapter 13.