

Study relationship between (MRTD) for different targets with contrast in image

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Abstract:- The minimum resolvable temperature difference (MRTD) is currently considered as the most important parameter of thermal imaging system MRTD enables us to estimate probability of detection, recognition, and identification of military targets knowing MRTD of the evaluated thermal camera .In this research we study relationship between Minimum Resolvable Temperature Difference (MRTD) for several target with difference spatial frequency and consider contrast in image by using program VIRTEST

Keyword:- Thermal Imaging Spatial Frequency and Imaging Processing.

I. INTRODUCTION

Thermal Infrared energy is emitted from all objects that have a temperature greater than absolute zero. Our eyes are not sensitive to the reflective infrared ($0.7 - 3 \mu$) or thermal infrared energy ($3 - 14 \mu$) .Military standards determining testing the thermal imaging systems usually specify that MRTD values for a set of spatial frequencies of the tested imager must be lower than certain values if the imager is to pass the test [1]. MRTD has been also the most important parameter of commercial thermal cameras used in non-destructive thermal testing (NDTT) for at least last decade [2]. Nowadays it proves its usefulness in evaluation process of thermal cameras to be used in automotive industry. The MRTD is a subjective parameter that describes ability of the imager-human system for detection of low contrast details of the tested object. It is a function of a minimum temperature difference between the bars of the standard 4-bar target and the background required to resolve the thermal image of the bars by an observer versus spatial frequency of the target. The measurement results of a typical military thermal camera for airborne surveillance Due to subjective character of MRTD measurement of thermal cameras the biggest source of uncertainty of measurement results is usually low repeatability of observer indications. MRTD variability as high as 50% are often cited from laboratory-to-laboratory with 20% variability reported in one laboratory [3] It seems that apart from the observer variability, non-standardized equipment and measurement methodology are other significant sources of the dispersion of measurement results. However, for sure observer variability is one of the main sources of uncertainties of MRTD measurement results. Training observers using real test equipment and real thermal cameras is time consuming and costly.

II. MATERIAL AND METHODS

Thermal imaging system(s) (TIS) extend human vision beyond the visible region of the electromagnetic spectrum. In principle, TISs detect the variation in thermal radiation in the scene and form a visible real image of this variation [4] .Figure (1) depicts the elements of a typical thermal imaging.

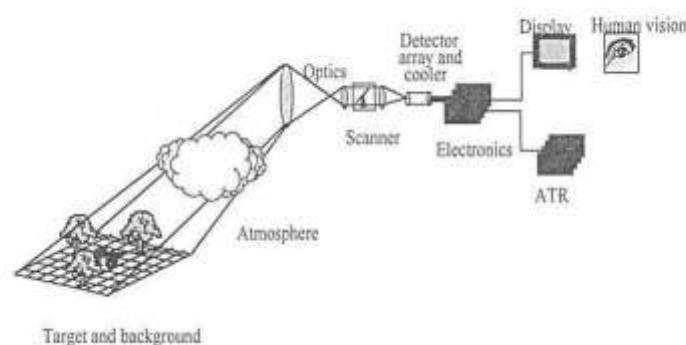


Figure (1) thermal imaging system

All objects with a temperature above absolute zero emit thermal radiation. The rate of radiation depends on the temperature and the surface characteristics of the object. Scene includes objects of interests (targets) and the background that interferes with the TIS's function by concealing the targets [5] We take several targets with difference spatial frequency and change MRTD to obtain the best image VIRTEST generates images of standard 4-bar targets closely resembling images seen by operators of measuring systems used to test thermal cameras during MRTD measurement. The user can choose spatial Frequency of the 4-bar target, temperature difference. Like in case of real measuring systems the user chooses the temperature difference, when he recognizes the bars. MRTD curve is automatically drawn on the bases of the user decisions .figure (2) show program VIRTEST

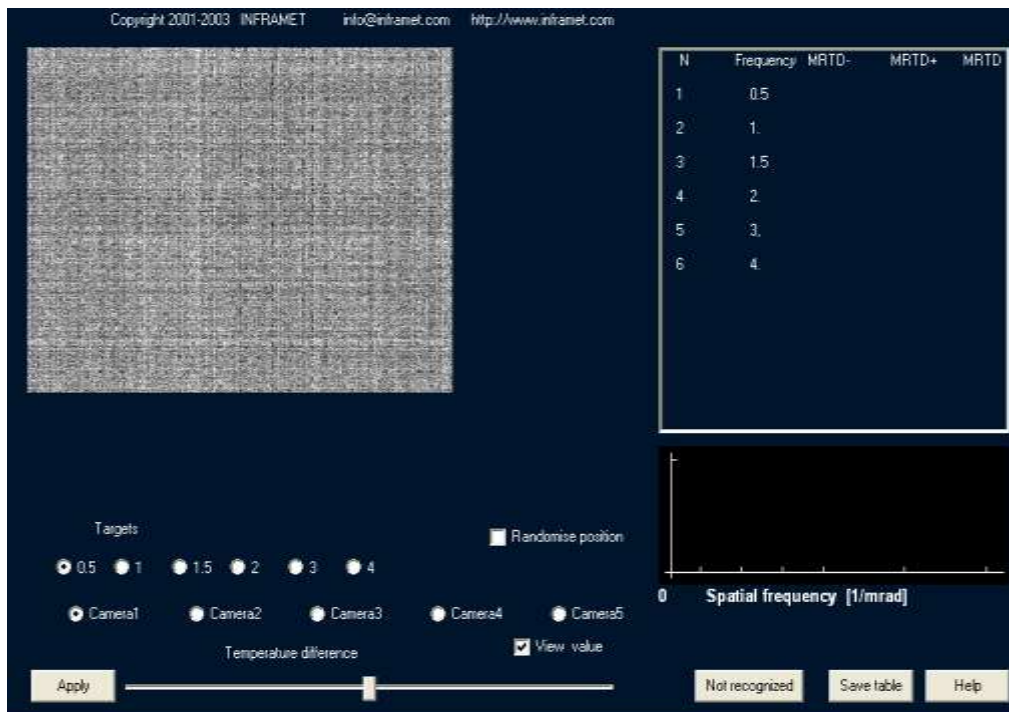


Figure (2) program VIRTEST

III. THE RESULT AND DISCUSSION

The spatial frequency in program show in table (1) with - MRTD, +MRTD and MRTD average
 Table (1) spatial frequency with MRTD

Frequency	MRTD-	MRTD+	MRTD average
0.5	-1.61	1.74	1.672
1	-1.52	1.59	1.556
1.5	-1.50	1.49	1.494
2	-1.40	1.36	1.378
3	-1.24	1.22	1.226
4	-1.14	1.17	1.158

frequency Shown in table (1) by getting the best image resolution since it is not possible to simultaneously achieve high spatial and thermal resolution .neither is a good measure of the overall IR imaging system performance .A single quantity, called the minimum resolvable temperature difference, MRTD, measures both performance factors simultaneously MRTD is determined experimentally and therefore takes into account all of the various theoretical and real –world factors that matter .the measurement is done by The value of MRTD appears in table we get on it from program for every spatial slowly heating a test pattern at some range from the detector . These figures show the best image for every spatial in program

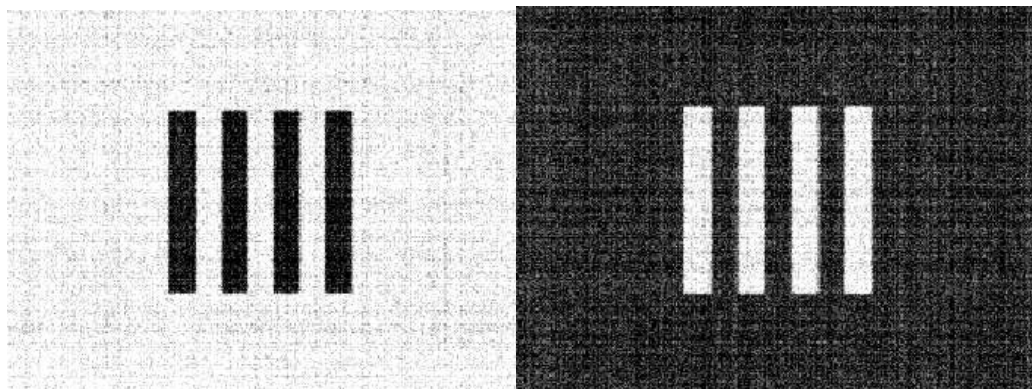


Figure (3) with spatial frequency (0.5)

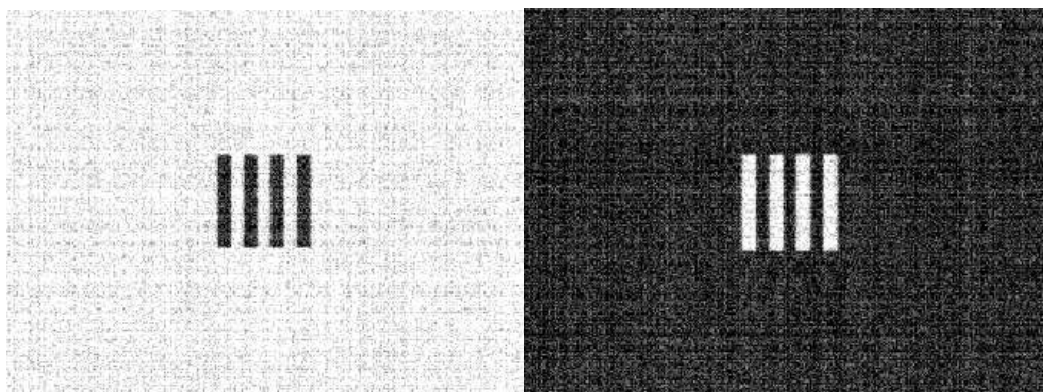


Figure (4) with spatial frequency (1)

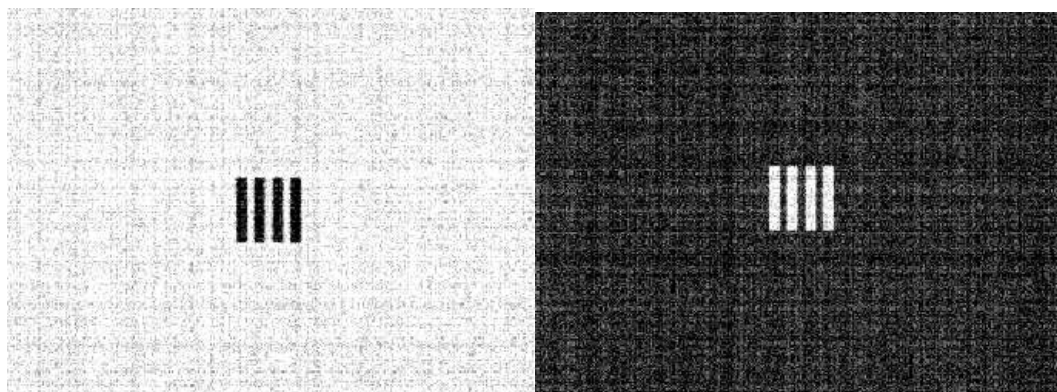


Figure (5) with spatial frequency (1.5)

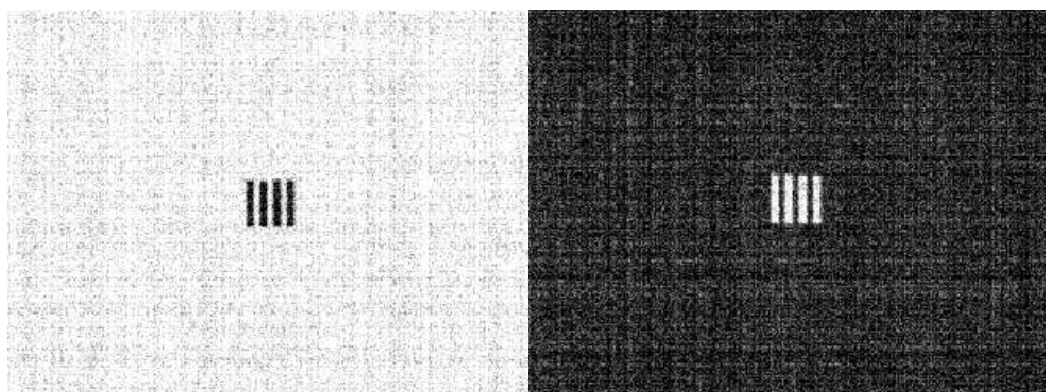


Figure (6) with spatial frequency (2)

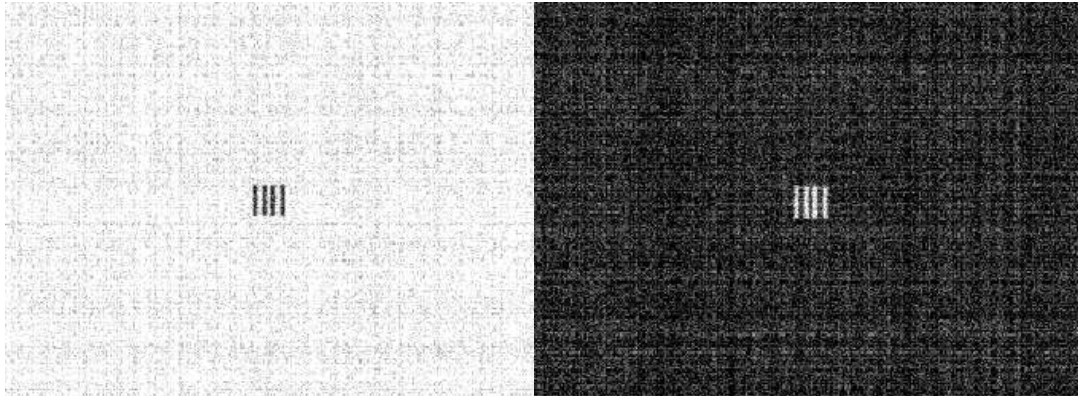


Figure (7) with spatial frequency (3)

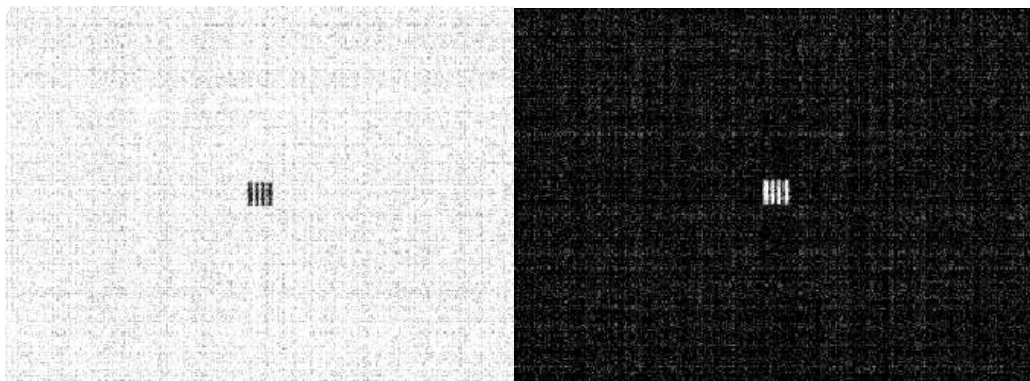


Figure (8) with spatial frequency (4)

From these figures and table we obtain the relationship between the minimum Resolvable Temperature Difference and spatial frequency show in figure (9)

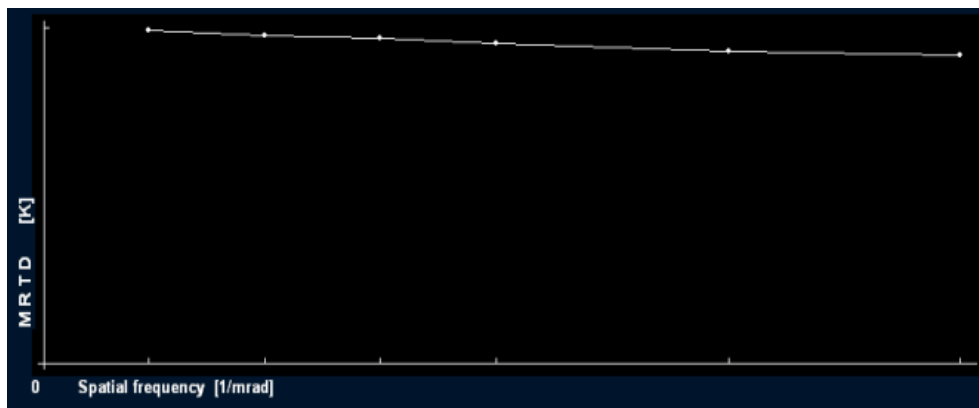


Figure (9) relationship between MRTD and spatial frequency

It is clear from result the minimum Resolvable Temperature Difference (MRTD) high value of the contrast accurate with less value of MRTD in other case with increasing of spatial frequency leads to decreasing in the target region that it leads to decreasing the infrared radiation we conclude MRTD its inversely proportional with the area of target this research imaging the shapes of the targets for different value of spatial frequency with the increasing and decreasing MRTD to obtain the best image by using VIRTEST program

IV. CONCLUSION

Under this study we conclude that the VIRTEST is a computer program that enables simulation of measurement process of the most important parameter of thermal imagers minimum Resolvable Temperature Difference MRTD it is an excellent tool for training operators of test systems to be used for measurement of MRTD of thermal imagers .from the result above we concludes that the contrast decrease with increasing spatial frequency

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