

Research on Maneuvering Target Stealth Method Based on Image Information

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Abstract—Stealth technology was an effective means to improve the viability of ground maneuver target. The stealth method of maneuvering target was studied preliminarily based on the visual and infrared images in this paper. For the visual camouflage, methods of stealth technology based on pattern painting was proposed, and effective images of simulating satellite reconnaissance, of which the method of digital pattern painting had better effect. For the infrared camouflage, infrared camouflage method was studied preliminarily by using infrared radiation characteristic and infrared exposure characteristic of target and background.

Keywords-maneuvering target; stealth; visual image; infrared image; pattern painting

I. INTRODUCTION

Stealth technology is known as low-detection technology or target feature control technology. It changes the characteristics of the target information which can be detected, making that it is hard to detect or shorting distance of detecting. Stealth technology mainly includes radar stealth technology, infrared stealth technology, visible stealth technology and sound stealth technology [1-5].

Ground maneuvering target is the main attacking target because of its maneuverability. The stealth methods are different because the detection methods are different for maneuvering targets in different environments.

In order to getting better stealth effect of ground maneuvering target, the contrast of target and background in different detection was reduced. Therefore, the camouflage methods based on visual and infrared image were proposed in this paper, which provided method references for further research on stealth capability of ground maneuvering target.

II. VISUAL CAMOUFLAGE METHOD

Visual detect is one of major threats in battlefield of military equipment. Visual exposure characteristics of target are mainly reflecting in its size, shape features, spectral reflectance difference between target and background, etc.. For both static and dynamic target, it took some stealth methods such as camouflage net, vehicle clothe and vehicle body pattern painting, and some other measures such as lighting, smoke, false target, etc.. Research on visual signal control focused on pattern painting stealth, which was one of most effective stealth methods for static and dynamic target with anti-visual detecting.

It reduced target significance with paint, pigments and other materials to absorb electromagnetic waves. Traditional distortion pattern painting had certain limitation, while new type of digital pattern painting had superiority, which can apply into military vehicle and can verify the practicality by simulation analysis [6-7].

The land area of our country is large, in which there distributing of variety topography. Therefore, the characteristics of different geographical disguise must be considered when maneuvering target move in the region, such as desert, jungle, highway, etc.. This paper analyzed camouflage characteristics in the region of desert, which also adapted to other topography.

A. Camouflage Mode

Maneuvering target adopted distortion pattern painting current day, which was often durable and couldn't quickly change within a short time. In order to improve the adaptability to different region when moving on large-scale and long-distance, this paper adopted camouflage net with both sides, which a pattern painting adapting certain topography and geomorphology on one side. This method could increased the utilization of camouflage net, also could reduce the carrying capacity. There could be another pattern painting on the target itself.

B. Pattern Painting Design

The pattern painting adapted was shown as figure.1.

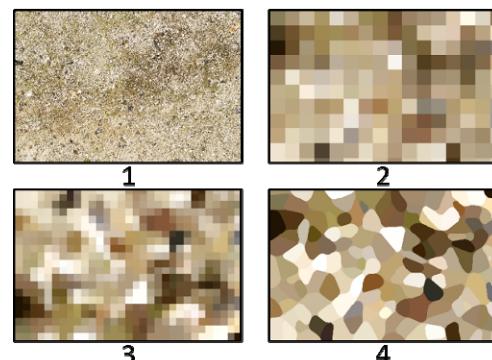


FIGURE I. PATTERN PAINTING DESIGN

The other three kinds gained from the first kind by processing in Photoshop, so that the visual difference

producing from color was minimized and the camouflage effect was mainly producing from the pattern painting type. The four types of pattern painting were mapped into the vehicle model. The four camouflage effect images were rendered by using the camera simulating detecting satellite, shown as figure.2.

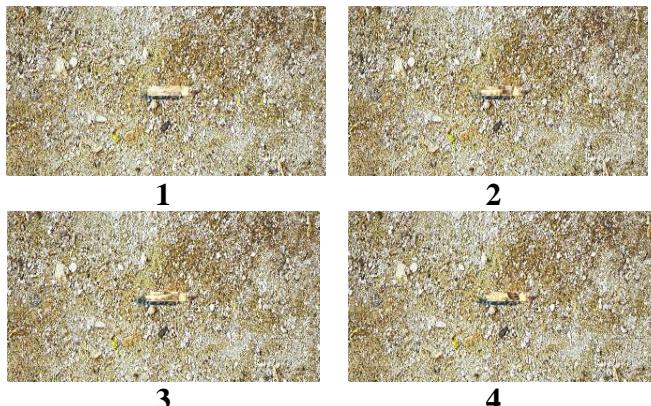


FIGURE II. CAMOUFLAGE EFFECT IMAGES

It could be seen by contrasting that the camouflage effect using digital pattern painting was distinctly better than using distortion pattern painting and original pattern painting.

C. Evaluation of Camouflage Effect

It needed to compare the advantages and disadvantages of several algorithms when designing pattern paint camouflage. It also needed to evaluate the camouflage effect to determine whether need to remind after implementation of target camouflage. Therefore, camouflage effect evaluation technology had become an important part of camouflage technology. For evaluating visual camouflage effect, it needed to compare the similarity of target and background. Usually, the color histogram could be used for compare the similarity of visual images. However, as the image type of color was too much, there was very complicated to directly use the original color histogram calculation.

It could use main color histogram to compare the similarity of image when evaluating camouflage effect, which extracted the main color feature of the image. The main color feature was small but could reflect the main color features of the image. The main color histogram described only the statistical characteristic not the spatial distribution information of color, which could describe the color dispersion degree to give the difference of color distribution information in two images. It was more scientific to evaluate camouflage effect by using this theory on color spatial distribution information entropy.

III. A PRELIMINARY STUDY ON INFRARED CAMOUFLAGE METHOD

Infrared imaging seek guidance had the advantages of high precision of guidance, strong anti-interference ability, quasi-all-weather work, long-range strike and automatic decision-making ability with capture, identify, lock and track targets under complex background conditions. It is an important guidance in current day. Therefore, it is a very urgent and

important problem about that how to improve the survivability of maneuvering target by camouflage technology.

In this paper, the maneuvering target was modeled, and the target infrared image was obtained by correlation algorithm. The infrared radiation control technique and stealth protection of ground maneuvering target were discussed by analyze theoretically the infrared radiation characteristic of target and background. Firstly, the infrared radiation temperature change and the main infrared exposure characteristics of the maneuvering target were analyzed and tested in order to reduce the probability of detection. Secondly, According to the existing stealth technologies, combining with the target exposure characteristics in current conditions of infrared reconnaissance, methods of reducing the target exposure characteristics were explored by thermal suppression technology and stealth structure design to change the emissivity distribution and radiation distribution on target surface.

IV. CONCLUSION

This paper studied the stealth method of ground maneuvering target from visual camouflage and infrared camouflage. For visual camouflage, some pattern painting design was proposed to improve stealth capability. It can be seen from experiment result that the effect on digital pattern painting was the best. For infrared camouflage, the methods of reducing exposure characteristics were studied preliminarily. From the producing of infrared image, combing the target and background's infrared exposure characteristics, it could be take the methods of changing infrared radiation distribution, controlling thermal suppression and improving target structure.

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