

# A study on Near Infrared Spectroscopic and Night Vision Device Image analytic methods in military uniform

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## 1. INTRODUCTION

Functional stealth military uniform refers to the uniform that serves effectively as a camouflage in the nature. Day time camouflage refers to the phenomenon in which the visible ray's reflectance of the surrounding environment and that of the military uniform are aligned by each wave. Night time camouflage refers to the phenomenon in which the near infrared ray's reflectance of the surrounding environment and that of the military uniform are aligned by each wave.

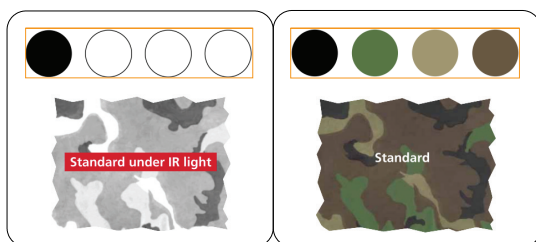


Fig. 1. Camouflage of day time and Night time

A night vision device is designed to detect and distinguish a target object easily when it is difficult to see things with the naked eye at nighttime. Detecting individual objects depends on reflectance value of materials at near-infrared ray[1]. Reflectance value represents of grey scale with a night vision device and it can detect invisible objects[2]. Therefore, when observing two different objects with the same color, we can discriminate two objects by the aid of the night vision device if the materials have different reflectance values at near-infrared ray. Such night vision devices are utilized for camouflage textiles. Since camouflage textiles are made for the purpose of disguising under natural environment, the data base of reflectance value on the surrounding natural environment has become crucial to manufacturing camouflage textiles[3].

This research intends to analyze the information concerning the picture image that is visible through the Night Vision Devices and to conduct the measurement on the NIR reflectance when it comes to the diverse military uniforms from foreign nations in the world.

## 2. EXPERIMENTALS

### 2.1. Materials

As for military uniform, Korean digital camouflage (P 20/2 5844 1/1 60" IR P/R), US camouflage (CD/N(53/47)20, CD/N(53/47)12 11973 4/1 56/7" WR P/R) and Greece camouflage (CM/P(80/20)36/2, M/P(80/20) 30/2 10256 RIB 60" PP IR P/R) were used.

### 2.2. Analysis of reflectance value

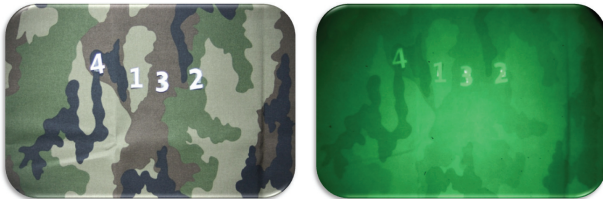
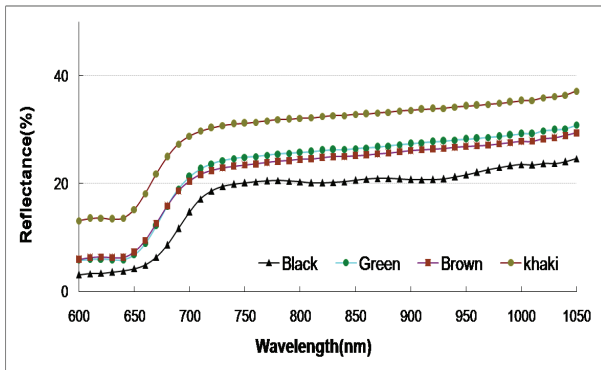
Using a Micro flash MF 45 IR(Datacolor), reflectance values of near-infrared ray in 700-1050nm were measured, and that was calibrated by using barium sulfate tile. For sample with irregular surface (like rock or bark) that involves the possibility of optical loss during measurement, the reflectance value of infrared was measured after grounding the sample into powder. In addition, five locations were set within the test pieces, and reflectance values were measured there at the interval of 10nm.

### 2.3. Analysis of night vision device

A night vision device is made up of camera/lens/IR lens. For camera cannon(model 450D), lens cannon EF 29~70mm, IR lens NVS 14~3 mono were used.

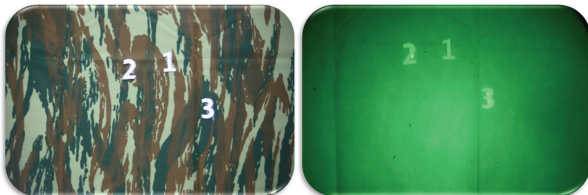
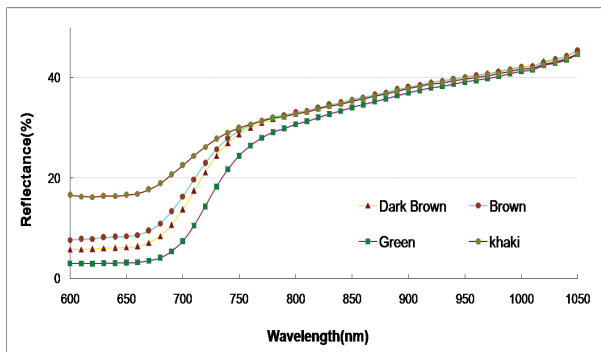
## 3. RESULTS AND DISCUSSION

Fig. 2 showed the measurement results concerning the value of reflectance and the picture image's information of the Night Vision Devices for the US military uniforms. About 20-30% reflectance value is manifested at 800nm or more.



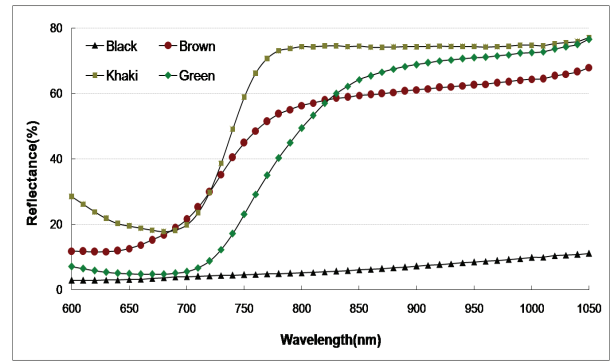
**Fig. 2.** Near-infrared spectra and Night Vision Devices image of US military uniforms.

Fig. 3 showed the measurement results concerning the value of reflectance and the picture image's information of the Night Vision Devices for the Greece military uniforms. About 30% reflectance value is manifested at 800nm or more.



**Fig. 3.** Near-infrared spectra and Night Vision Devices image of Greece military uniforms.

Fig. 4 showed the measurement results concerning the value of reflectance and the picture image's information of the Night Vision Devices for the Korean military uniforms. About 5-75% reflectance value is manifested at 800nm or more.



**Fig. 4.** Near-infrared spectra and Night Vision Devices image of Korean military uniforms.

In case of the US or Korean military uniforms, reflectance values are expressed differently by each pattern of visible color. And expression takes place so that there is a difference in the Night Vision Devices as well, as a result. In case of the military uniform from Greece, however, reflectance value is expressed the same at 800nm or more. Thus, there is a considerable possibility that it maybe detect by observation device when viewed through the Night Vision Devices at night time since there is significant difference with the surrounding environment.

#### 4. CONCLUSIONS

In case of the functional stealth military uniform, it should ensure camouflage both during the day and night time. The color that is manifested in the visible rays and the information that is shown on the Night Vision Devices do not match, and the values of the reflectance for each pattern are expressed in a different way in the Night Vision Devices as well. Night time camouflage through the Night Vision Devices is considered to be very effective when the values of the reflectance for each pattern are various.

#### 5. REFERENCE

- [1] Jerry Workman; *The Handbook of Organic Compounds*, a 3, 79-129(2001).
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- [3] R.J. Mayer; *Infrared Physics*, 5(1), 7-8(1965).