TEMPORARY TEST BED CONSTRUCTION FOR AIRBORNE HYPER SPECTRAL DATA

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ABSTRACT

In this study, temporary test beds for airborne hyperspectral data were designed and proposed. The various materials, sizes, arrangements and types were considered for several algorithms and applications. The 1st test bed included 7 materials with different grid sizes. The 2nd test bed included 13 materials and was divided into three parts according to materials, size and types. The hyperspectral data were acquired by AISA and CASI sensors with different spatial and spectral resolutions. We verified that the hyperspectral data could provide pure and mixed pixels in each test bed and be used to test various algorithms.

1. INTRODUCTION

Hyperspectral data based on multi-platforms such as terrestrial, airborne and spaceborne have been primary sources for many research applications. In the case of hyperspectral data, the test bed is very important to calibrate for accurate hyperspectral data and to apply algorithms related to them \(^{(1)}\). However, most test bed data of airborne hyperspectral sensors are only designed for calibrating the reflectance value vicariously \(^{(2,3)}\). Previous researches also used various materials for calibration and validation. A permanent test field using sand, fiber material and variously-sized and -colored gravel in various shapes was constructed for digital photogrammetric systems \(^{(4)}\). Shimoni et al. \(^{(5)}\) installed the validation site in a chessboard style and acquired the hyperspectral data including mixed pixels with two to four different materials in the boundary.

In this study, various materials, sizes, arrangements and types were considered for several applications such as radiometric calibration, image fusion, classification, target detection, change detection, feature extraction, spectral unmixing, spectral matching, endmember extraction, etc. The kinds of materials and arrangement could be used to test algorithms were related to a spectral library. Size and type were related to spectral unmixing and endmember algorithms \(^{(5)}\). Two test beds having different characteristics were designed and constructed for acquiring the hyperspectral data by AISA and CASI sensors, respectively.

2. DESIGN AND CONSTRUCTION OF TEST BED

2.1. First test bed

In the 1st test bed, 6 materials (grass, tartan turf, green fabric, slate, white gravel, black gravel) were installed on the ground. There was thus a total of 7 materials including the background composed of soil were existed. Some materials contained entirely different spectral information, while others were partially similar. For example, although grass, tartan turf and green fabric have similar color in the visible wavelength range, each spectral information indicates different patterns in the infrared and longer wavelength range.

Figure 1 shows the type, size and arrangement of each material. The six pure material zones, two mixed material zones by chessboard type and one randomly mixed gravel zone were installed in squares of 4m, 1m and 0.5m. However, the several zones including gravel were smaller because gravel is expensive, labor-intensive, and difficult to move and install. All materials were located in a grid pattern. Lattice spacing of each zone and size was 4m to separate completely between materials in the airborne hyperspectral image.

2.2. Second test bed

In the 2nd site, we considered a wider area and more varied case with more materials and types. The 2nd site were consisted of three parts: banner printed by dyeing (A-1), real materials with the same size (B-1), and real materials of different sizes (B-2) (Figure 2).
The banner was a 6×5 matrix and the size of the grid was 4.5m. 24 grids in the banner were dyed with a pure RGB color combination and chemically mixed zone. White, red, green, blue, black, and gradations of these colors were chosen. 6 grids of the banner were a physically mixed zone similar to a chessboard according to a material mixing ratio (Figure 3).

More materials such as dry grass, cement board, camouflage nets and plywood were added in the real materials parts. In addition, mixed three types according to ratios of materials were designed for the chessboard. The cement board and plywood were added instead of slate as in the 1st test bed. In particular, seven different camouflage nets were adopted to verify their effect for algorithms and applications in the military field. The grid size was 4.5m in B-1, and 4.5m, 1.5m, and 0.5m in B-2. All real materials were installed on the white banner.

3. HYPERSPECTRAL DATA ACQUISITION

The 1st test bed was installed in Yeongam, South Korea and hyperspectral data was acquired by an AISA sensor on 1 December 2012. The AISA hyperspectral image was comprised of 128 spectral bands between 0.4–1.0 μm, with spatial resolution of 1 meter per pixel (Figure 4). The 2nd site was installed in Cheongwon-gun, South Korea. Two kinds of CASI hyperspectral data were acquired on 22 June 2013 (figure 5). The spatial resolutions of the CASI data were 0.5m and 1.5m, while the spectral resolutions were 96 and 48 bands, respectively. The 1st and 2nd test beds included tarps and each hyperspectral dataset was converted to a reflectance value with a spectral library acquired simultaneously with a spectrometer in the field.

The pure zones in each test bed could make pure and mixed pixels with a background (soil or banner) on the grid boundary. The mixed zones could provide physically mixed pixels with several materials. In the printed banner, the characteristics of physically and chemically mixed spectral information could also be compared. For these reasons, hyperspectral data of the test bed could be used to test various algorithms such as endmember extraction, spectral unmixing, image fusion and change detection. The acquired hyperspectral images show that the hyperspectral data acquired in our two test sites could be used and applied as reference data for verifying algorithms.

4. CONCLUSION

In this study, temporary test beds were designed and constructed for airborne hyperspectral data in South Korea. A total of 7 materials existed in the 1st test bed. The 2nd test bed consisted of the printed banner and real materials of same and different sizes. The hyperspectral data were acquired by AISA and CASI sensors with different spatial and spectral resolutions.

The acquired data show our two test beds could be used for verifying and validating various algorithms related to hyperspectral data such as endmember extraction, spectral unmixing, image fusion, classification, and change detection. In the future, more practical and valuable test beds will be designed and the sample data will be provided for international researchers.
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6. REFERENCES


