Assessment and Comparison Of The Quality Of Digital Ortho-Images Generated From Digital Aerial Images And From Scanned Analogue Aerial Images

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Key words: Orthoimages, digital aerial images, scanned aerial photographs, quality assessment, geometric precision, radiometric quality.

SUMMARY

In the last decade, the use of digital cameras in photogrammetry becomes important. The quality of their images and their derived products is judged as high. However, the question to be asked is: until what degree these products are better than those created from analog cameras? In this paper, we compare the quality of orthoimages generated from digital images and scanned analogue photographs. Both the geometric and radiometric qualities of the generated orthoimages are assessed. The used data are scanned analogue aerial photographs and digital aerial images of the same studied area. Orthoimages were generated from the two data types. To assess the geometric quality, we compare the resulting orthoimages to a reference spatial database. For radiometric evaluation, several techniques of image processing are used. The obtained results show that the orthoimages extracted from digital images provide a radiometric quality two times better than the ones extracted from scanned aerial photos. For the geometric quality, digital images provide a slightly better quality on accuracy compared to scanned aerial photographs. During the photogrammetric process, the digital aerial images present advantages especially with respect to the flexibility and the quality of the conducted aerotriangulation and the generated DTM.

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1. INTRODUCTION

In the last decade, the use of digital cameras in photogrammetry becomes important. The quality of their images and their derived products is judged as high. However, the question to be asked is: until what degree these products are better than those created from analog cameras? In this paper, we evaluate the contribution of the digital aerial images to improve the geometric and radiometric quality of generated orthoimages. In this sense, the adopted methodology is divided into two parts: the generation orthoimage process and the orthoimages quality assessment process.

2. METHODOLOGY

2.1 Orthoimage generation process

The orthoimage generation process consists of five steps: interior orientation, exterior orientation, DTM generation and edition, orthoimages generation and mosaic creation (figure 1).

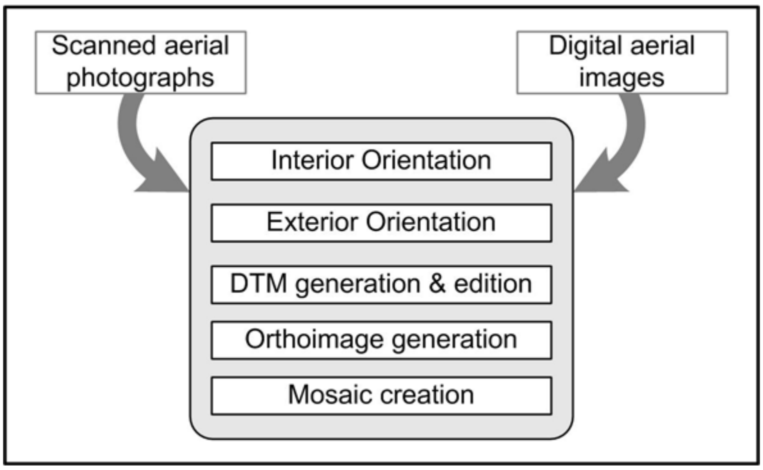

Figure 1. Orthoimage generation process

2.2 Orthoimage quality assessment process

The orthoimage quality assessment process concerns the evaluation of the geometric precision and the radiometric quality of the studied orthoimages. This process consists of quantitative and qualitative approaches. The figure 2 presents the adopted checks for geometric and radiometric quality assessment.

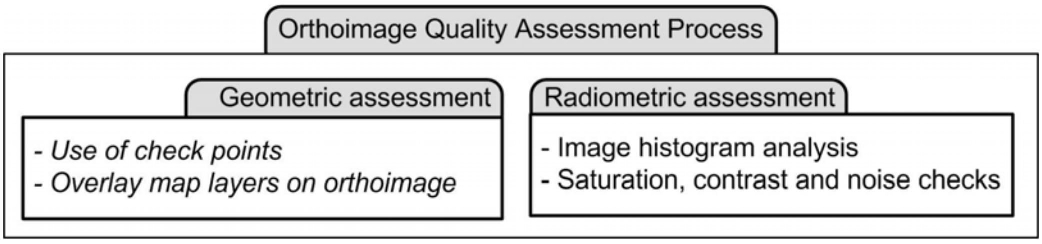

Figure 2. Orthoimage quality assessment process

2.2.1 <u>Geometric precision assessment:</u>

For the quantitative geometric precision assessment, check points are used to estimate the geometric precision of generated orthoimages. These points are acquired from independent source and are well distributed on the orthoimage. For each point, a discrepancy measure is determined. A global RMS is computed in order to estimate the geometric accuracy of the orthoimages.

The qualitative geometric precision assessment consists of overlaying several layers of map data on the orthoimage and inspecting the result visually in order to detect differences between the two data. Used Map layers are roads, land boundaries, buildings, hydrography …

2.2.2 <u>Radiometric quality assessment:</u>

Several techniques of image processing are used in the radiometric quality assessment process: image histogram analysis, saturation check, contrast measure and noise check. In image histogram analysis, the pixel distribution is analyzed and the dynamic is computed for each orthoimage. For the saturation check, the saturation image is determined and the values are analyzed and compared to a threshold. For the contrast assessment, the coefficient of variation of the digital numbers values is calculated. To quantify noise in an orthoimage, the standard deviation of the image values is computed in selected homogeneous areas. The same areas are selected in the two sets of studied orthoimages. For all these radiometric quality tests, we adopted the thresholds proposed by Kapnias *et al.* (2008).

3. APPLICATION

3.1 Used data and studied area

Two sets of data are used : the first concern digital aerial images and the second scanned aerial photographs. The two sets of images cover the same aerea (Region of Essaouira, Morocoo). The necessary data for orthoimages generation are also avalaible. We used LPS (Leica Photogrammetry Suite) for execute the operations of orientations, DTM generation, orthoimages and mosaics creation.

After applying the orthoimage generation process on the two sets of data, two orthoimage mosaics are generated (figure 3), one from scanned analogue photographs and the other from digital images.

Figure 3. The two generated orthoimages mosaics from scanned photographs (at left) and from numeric images (at right)

3.2 Results of orthoimage quality assessment process

3.2.1 Geometric assessment process results

In the quantitative geometric assessment (Check points), the calculated RMS using orthoimage from digital images doesn't exceed 5 cm than the RMS determined from the orthoimages generated from scanned images. The overlay of the map layers on the generated orthoimages shows a concordance between the two data (figure 4). No significant discrepancy was observed.

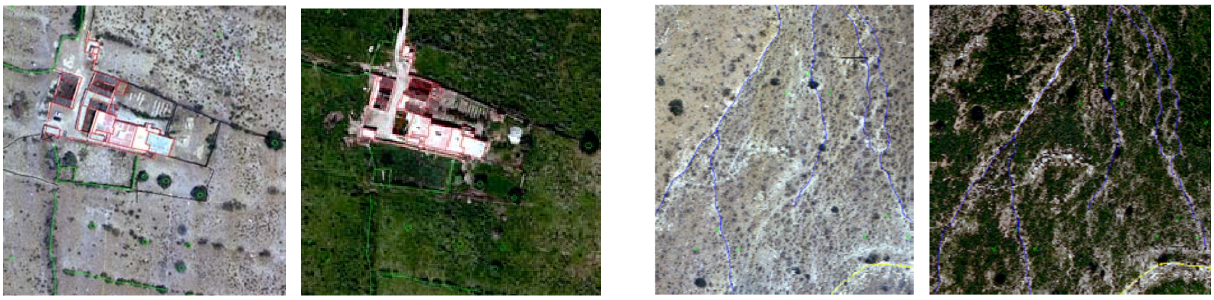

Figure 4. Overlay map data on the two orthoimages

3.2.2 Radiometric assessment process results

In the visual examination, we observed some scratches and artefacts in the orthoimage generated from scanned photographs. The analysis of the image histograms of the studied orthoimages has shown that the available dynamic range is used. The saturation values for the two orthoimages are less than the adopted threshold (0,16 % for orthoimage from digital images; 0,49 % for orthoimage from scanned photographs; the threshold is 0,5). The calculated contrast for each image band doesn't exceed 20 % fixed as threshold. Considering the noise check, the orthoimage generated from scanned photographs is two times noised than the orthoimages generated from digital images. These results confirm the visual image analysis: the quality of the orthoimage issued from digital images is better than the one generated from scanned photographs.

3.3 Discussion

From the obtained results, we can say that the two types of orthoimages have relatively the same geometric precision but different radiometric qualities. From the results of the geometric precision assessment process, we can say that in our case there isn't a significant amelioration in the geometric precision by using digital aerial images. The results of noise and saturation checks for the digital orthoimages are better than those for scanned photos. Also, the contrast is higher for the first images than the second ones. We should mention that the two sets of data have been acquired in different season. These different acquisition conditions influence the radiometric characteristics of the images.

The radiometric quality of the scanned images is also affected by the film quality and by the film development and scanning process. In our case, there were scratches on the used photos. These artefacts have an impact during the orthoimage generation process and some automatic operations don't lead to acceptable results. It's the example of automatic collection of tie points or DTM generation. In the case of digital image, these operations can be done with satisfactory results due to their higher radiometric quality. So, the process time for orthoimage generation is reduced in the case of digital images in comparison with the scanned photos.

4. CONCLUSION

In this paper, we applied an orthoimage quality assessment process in order to estimate both geometric precision and radiometric quality of orthoimages generated from digital images and from scanned photos. The comparison between the two types of orthoimages doesn't show any difference in the geometric precision. But, the digital images allow the generation of high radiometric quality orthoimages.

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