ELIMINATION OF COLOR FRINGES IN DIGITAL PHOTOGRAPHS CAUSED BY LATERAL CHROMATIC ABERRATION

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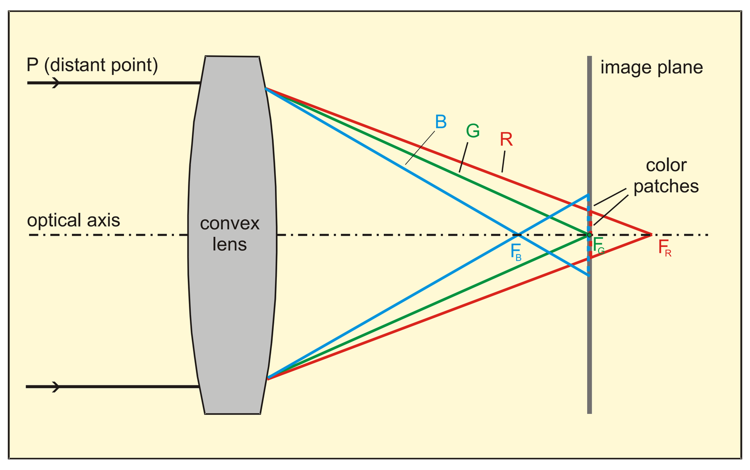
Abstract: In this poster we focus on the elimination of the effect of lateral chromatic aberration within a post-processing step after image acquisition. Since the usage of digital consumer cameras (SLR or compact cameras) in documenation and mapping of cultural heritage is becoming more and more wide-spread, the present topic should be discussed in more detail. Color fringes are inherent to all analog and digital color photographs taken by cameras for which chromatic aberration is not sufficiently corrected for. The width of color fringes, mainly introduced by lateral chromatic aberration, is smallest around the image center and greatest in the corners of the photographs. The authors have developed a computer-based procedure to precisely determine the geometric distortions of the red and blue image channel (plane) in comparison to the green reference channel. The poster also describes how these measurements can be carried out using a commercial software, i.e. PhotoModeler 5.0. In a first approximation the three RGB channels differ in scale, i.e. they are radially displaced. The in-house developed software *DistCorr* has been modified in order to eliminate lateral color fringes by appropriate re-scaling of the R and B channel.

1. INTRODUCTION

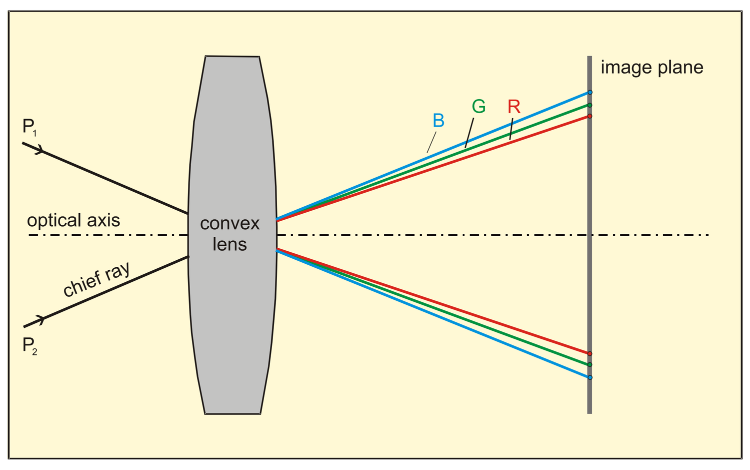
The elimination of (lateral) chromatic aberration as a post-processing step in digital photography is exhaustively discussed in the World Wide Web (WWW). Scarce information is available, however, from a photogrammetric point of view.

2. THE NATURE OF CHROMATIC ABERRATIONS

Chromatic aberrations are due to the dependency of the refractive index (n) of the camera lens on the wavelength. Two types of chromatic aberrations must be considered.



Longitudinal (axial) chromatic aberration



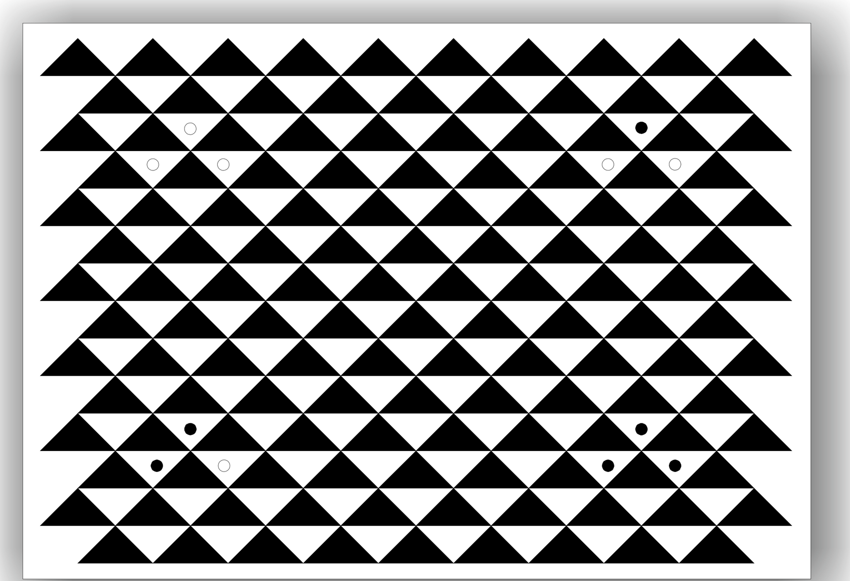
Lateral (oblique) chromatic aberration

3. MEASUREMENT OF LATERAL CHROMATIC ABERRATION

The general task is to co-register the R and B channels onto the G channel by measuring corresponding points in the three color channels (planes). As a result, displacement vector fields describing the geometric differences between the three RGB channels can be obtained.

3.1 Least-squares-matching between color channels

This approach uses the highly accurate least-squares-matching (LSM) technique for transferring points from the G channel to the R and B ones.



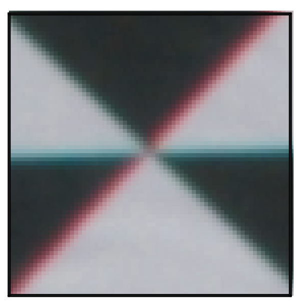
Planar calibration field of PhotoModeler 4.0

← Nikon D100 camera

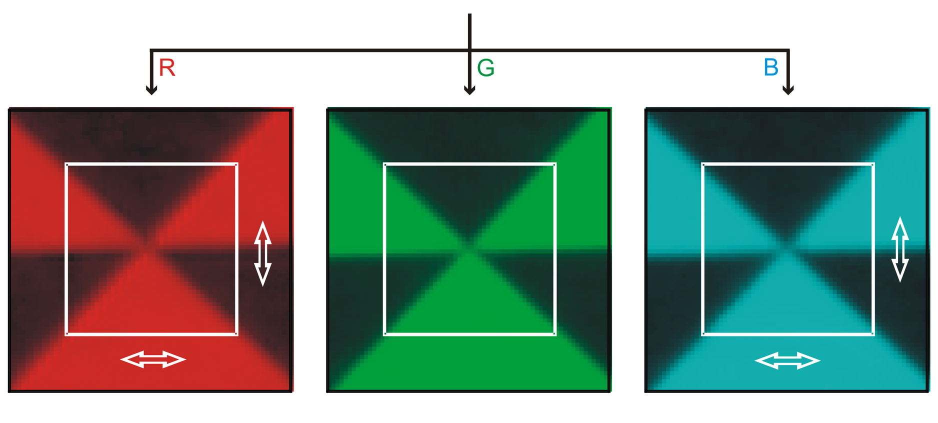
One or more photographs are taken.

Camera:	digital SLR camera
Sensor:	CCD array
Resolution:	3008 x 2000 pixel
Pixel size:	7.8 x 7.8 micron
Color:	Bayer pattern

window size
70 x 70



← Measuring of corresponding points in the RGB channels by means of LSM

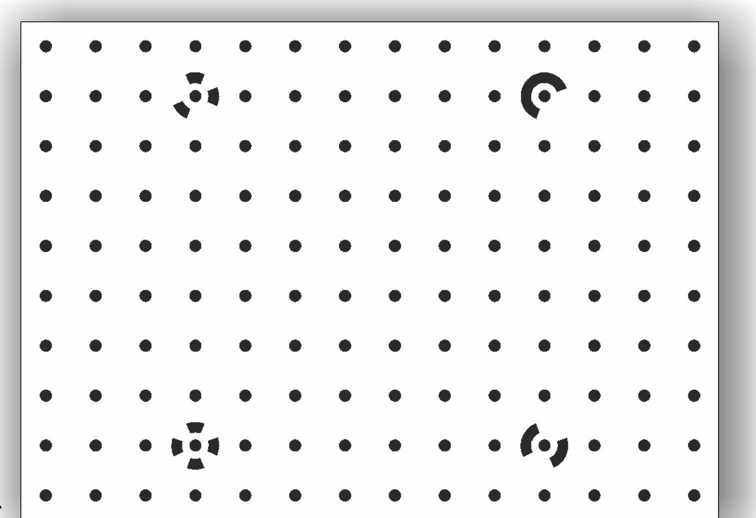


- The color photographs must be split up into their single channels.
- The G channel is selected as the geometric reference source.
- In this channel all corner points are automatically detected.
- These points were then transferred into the R and B channels using LSM.
- Chromatic displacement vectors (pointing from G to R, and G to B) are obtained.

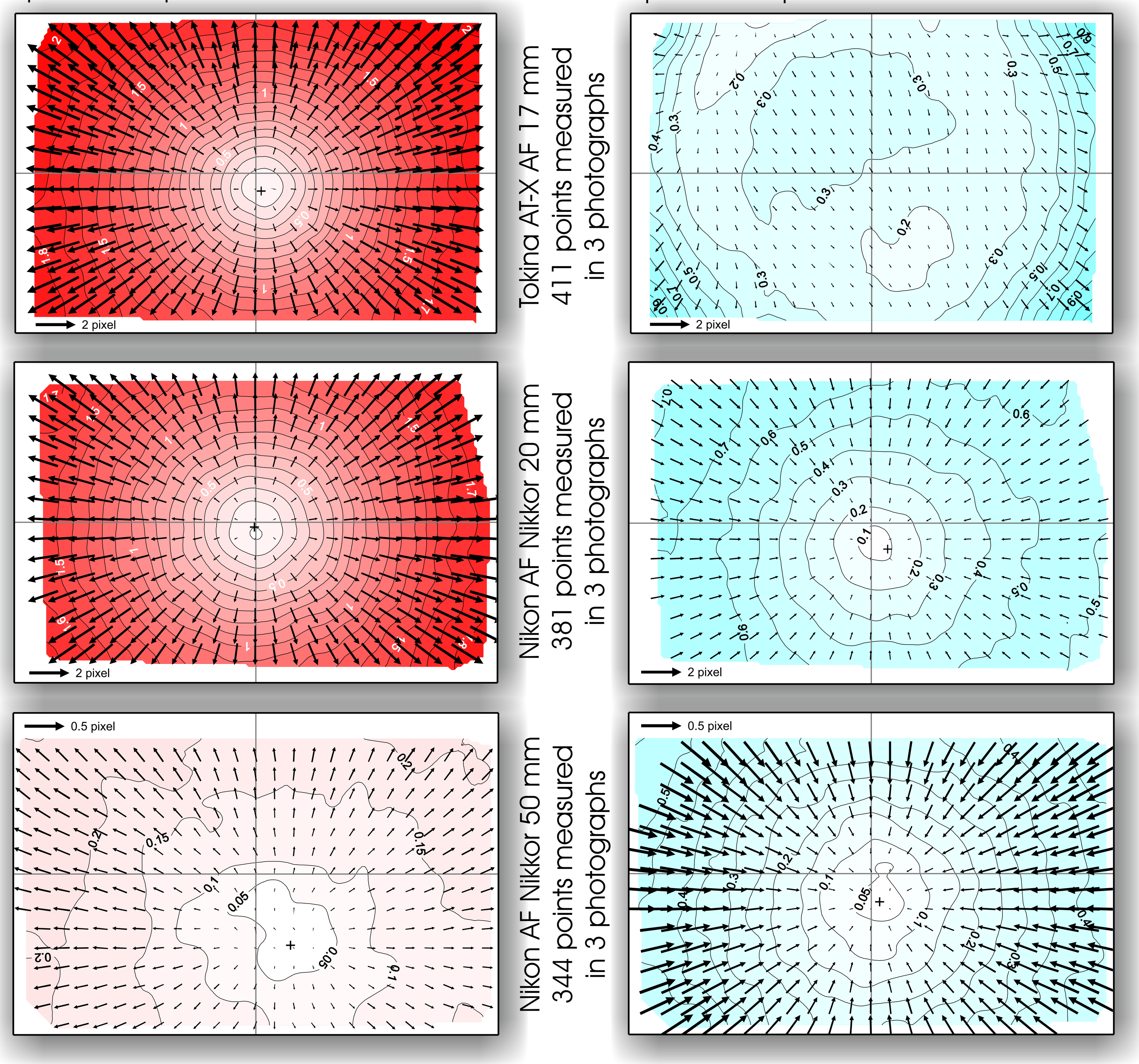
3.2 Automated feature detection (using circular targets)

PhotoModeler 5.0 offers excellent tools for precisely measuring image coordinates of circular targets. Image coordinates of all measurements can be exported for further external processing, e.g. computing of displacement vectors.

Modified calibration field of PhotoModeler 5.0 →



Interpolated displacement vectors: R channel — Interpolated displacement vectors: B channel



Tokina AT-X AF 17 mm
411 points measured
in 3 photographs

Nikon AF Nikkor 20 mm
381 points measured
in 3 photographs

Nikon AF Nikkor 50 mm
344 points measured
in 3 photographs

4. MODELING

Both channels R and B must be resampled to geometrically fit the G reference channel. Appropriate modeling of the geometric distortions measured must first be performed. In a first attempt we selected a simple 3-parameter coordinate transformation. Image shift and scale difference were calculated by means of least-squares adjustment for each combination of image channels.

5. ELIMINATION OF CHROMATIC ABERRATION

The elimination of the effect of chromatic aberration is done by an additional feature of our in-house developed computer program *DistCorr*. In a first release, distortions can be simply modeled by re-scaling of the channels R and B using the linear term of the radial-symmetric lens distortion formula.

6. EXAMPLES

The elimination of the effect of chromatic aberration is routinely carried out in all close-range photogrammetric projects were high-quality color (RGB) images are needed.

original photograph — color fringes eliminated

Color photograph (Nikon D100, 20 mm lens), painted facade of a medieval building, Graz, Austria

↑ Three examples for the elimination of color fringes in digital photographs. Window size 150 x 150. Image chips shown were cropped from areas near the image corners.

7. CONCLUSIONS

In this poster we described a procedure of how to accurately measure, model and eliminate color fringes in digital photographs caused by lateral chromatic aberration. The results obtained are highly promising even using a very simple geometric model. Further developments will be focused on better modeling of the chromatic displacement vectors measured. Practical experiments will be carried out in order to address the dependency of the model parameters on object distance and focusing.