CORRELATION ANALYSIS BETWEEN INNER ORIENTATION PARAMETERS OF DIGITAL CAMERAS AND TEMPERATURE

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ABSTRACT:

The diversity of modern digital cameras is noticeable. No matter the geometry of the sensitive surface, most of digital imaging sensors are based on semiconductors elements that are, by their nature, affected by temperature changes and this type of sensor will provide results with low noise level at lower temperatures. Changes in temperature and pressure, also affect the camera optical system. Most of the high performance photogrammetric cameras in use, are not only based in a single sensor, but also in more complex acquisition systems, such as multiple heads cameras and linear scanning systems. The calibration of these cameras can be performed with different approaches, primitives (points, straight lines, etc), as well as with different models for correction of systematic errors. One aspect that deserves additional researches is related to the effect of temperature changes on the IOP (Inner Orientation Parameters). No matter the temperature changes, it is important to know if its effects are significant or not. In aerial surveys, it is important to further consider that there is a vertical thermal gradient that can affect the camera and their components, in particular the lens system. This temperature difference between the ground and flight height can reach several degrees and can be estimated from the flying height and the average vertical thermal gradient of the atmosphere. In the case when calibration had been performed in conditions different from the flight mission, the estimated IOP can not correspond to those IOP in the flight mission and some corrections can be considered. In some modern systems a Temperature Dependent Model (TDM) is already being used. Thus, the aim of this paper is to evaluate the effects of temperature changes in the IOP of two digital medium format cameras, from different manufacturers, and to perform correlation analysis. For this purpose, four groups of images with different environment temperatures (around 20^{o}C of difference between minimum and maximum) were acquired in a terrestrial calibration field. The coordinates of image points of circular targets were measured in semi-automatic mode, achieving measurements with sub-pixel precision. After the calibration of each camera with self calibrating bundle adjustment, for each epoch (with different temperatures for each one), it was possible to estimate correlation between each IOP group and temperature. Also, different groups of parameters were used and evaluated using in-house developed software. According to the obtained results it was possible to observe that the correlation coefficient between temperature and all IOP were greater than 70%, depending on the groups of IOP used. In some specific situations the correlation coefficients between the focal length and temperature were higher than 90%. Based on these experimental evidences, it was possible to infer that the correlation between the temperature and some IOP is significant and allow us to suggest the modeling of these IOP according to the temperature and also to evaluate if the observed variations are due to changes in temperatures, or are related to random variations in the observations.

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