LIFETIME STABILITY STUDY OF A NIR HYPERSPECTRAL IMAGING SYSTEM

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To obtain meaningful data record when working with NIR hyperspectral imaging, continuous and consistent calibration efforts are needed. This requires a robust calibration and validation plan to ensure data continuity from measurement-to-measurement and day-to-day over a specific project. Effective calibration depends on thorough planning, careful execution, effective monitoring, verification and validation [1]. However, NIR hyperspectral imaging is often proposed as a rapid and reliable method to quantify and discriminate different elements in complex samples [2], which sometimes becomes difficult due to the inherent camera instability. This phenomenon was observed during a study aiming to discriminate winter wheat roots from crop residues using a push-broom system and Support Vector Machines (SVM) as discrimination algorithm [3]. Images of a reference sample containing only winter wheat crop residues were regularly taken to follow spectral measurement stability. Less than 75% of spectra were correctly predicted in 82% of the cases, which may lead to large quantification errors.

The study performed consists to an approach for lifetime stability of a hyperspectral imaging system based on calibration methodologies. NIR hyperspectral imaging instruments are usually calibrated against a set of recognized physical standards. It is important to perform calibrations on a regular basis and provide a means for long-term system performance analysis. For this, NIR absorbance variations and calibration performance evolution along 9 days of measurement have been followed. Every 10 minutes, images of the black conveyor belt, a white ceramic used for the minimal absorbance calibration and the winter wheat crop residue reference sample were taken. Absorbance calibration was made with different frequencies, namely at the beginning of the day, every 2 hours and every 30 minutes. Each calibration rate was replicated during 3 days. This is performed by measuring the white ceramic absorbance and by occulting the lens, and should permit to create a zero reference. The results however showed a systematic decrease of this value, the white ceramic absorbance value becoming more and more negative. This is probably due to the non-Gaussian impulsive behaviour of the ceramic [4]. This trend was mostly observed at the beginning of the day and new calibrations reduced the absorbance value fall. Furthermore, the absorbance reference value stabilisation allowed a better discrimination of roots and crop residues spectra.

This study highlighted the importance to measure instrument instability and to regularly make absorbance calibration steps in order to improve spectral discrimination performances.

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