CALIBRATION AND VALIDATION ACTIVITIES IN THE SCOPE OF HYPER-I-NET: THE RSL APPROACH

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Calibration and validation (*calval*) is a crucial procedure for all remote sensing instrumentation, no matter what application it is conceived for. The quality of the final products – and therefore the 'correctness' of answers to scientific questions using this data – depends strictly on the sensor calibration and product validation.

Basically, calibration is compulsory in order to convert raw (Level 0) data, recorded as digital numbers (DN), to physical units (Level 1 data), taking in account all possible disturbance sources (i.e. noise, artifacts, non uniformities, aberrations, sensor deterioration) encountered during the complete acquisition chain and sensor life time. A thorough calibration is thus indispensable to provide reliable and reproducible spectro-radiometric measurements. In general the data calibration step is performed in a first processing procedure, i.e., the processing of the data from Level 0 to Level 1.

Subsequently, higher-level products can be generated using advanced scientific algorithms leading to products such as atmospherically corrected surface radiance/reflectance or specific application parameters generally divided in the main disciplines, e.g., snow, water, atmospheric, land and vegetation. Examples for these parameters are snow grain seize, chlorophyll content in water or vegetation, aerosol load in the atmosphere or the detection of minerals and soil types. The procedure, which serves as feedback loop to improve the data quality of these higher-level products is called validation.

With tensing sensor requirements in all three domains (spectral, spatial, and radiometric) of the remotely sensed data, technologies and the understanding of user needs have to be improved significantly leading to new generation of imaging spectrometer designs [1, 2, 3] and improved *calval* methodologies [4]. This is why *calval* is a very a heterogeneous discipline, accounting for sensor design including optics and electronics, aerospace engineering, remote sensing, geosciences, computer sciences, signal processing and Earth observation related products.

The notable next development steps [5] in the field of imaging spectroscopy include especially the improved match of sensor design and user needs via a better understanding of design challenges and user needs.

The design challenges comprise the following items:

(1) meeting the accuracy requirements of the user community,

(2) filling the lack of standard methodologies for *calval* of hyperspectral methods, algorthims and products,

(3) delivering reliable (i.e., comparable) higher-level data products.

On the other side the key items of user needs can be formulated as [6].

(1) introducing standard methods and processing schemes,

(2) delivering hyperspectral data with known performance and error propagation,

(3) spending more efforts on data pre-processing, including ortho-rectification, atmospheric corrections and in-flight calibration.

By no means, filling this lack will automatically lead to standardized methods and processing schemes to enable a comparison of higher-level data products in a better way. An example leading in this direction is described in [7].

Recently, the Hyperspectral Imaging Network (HYPER-I-NET) was established to build an interdisciplinary European research community focusing on imaging spectroscopy [8]. The network is currently formed by a multidisciplinary team composed of fifteen highly experienced European partner organizations, although the network is entirely open to collaborations with other international partners in the topic area of hyperspectral imaging research. The main objective of the network is to create, for the first time in Europe, a powerful interdisciplinary synergy between the domains of expertise mentioned above, and use it to break new grounds in several key areas.

Within the HYPER-I-NET activity, the work of the group RSL includes the review of newly developed calibration methodology, which are linked to detailed instrument characteristic in order to reduce the overall uncertainties of the hyperspectral imaging spectrometers. Therefore, inventory of methodology and transfer of knowledge of the research achievements is immediately transferred through training and standardization around all partners of the consortium. The tasks of RSL in detail are:

- Conducting an inventory of existing calibration equipment and methodologies; inventory of methods and processors for onboard, laboratory and vicarious calibration and assimilation;
- Training (short courses, lectures) on advanced calval procedures and methodologies;
- Performing inter-calibration experiments of ground equipment (in laboratory, during field campaigns).

Concluding, the long-term experience of RSL researchers in the *calval* discipline together with the background of the highly experienced scientists within the HYPER-I-NET leads to a reduction of fragmentation of research activities inherent to hyperspectral data processing in Europe. It will also advance a step further than the state-of-the-art in this area by introducing techniques for standardization and validation of hyperspectral methods and products.

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