RECENT ACTIVITIES IN THE HYPERSPECTRAL IMAGING NETWORK (HYPER-I-NET): A EUROPEAN CONSORTIUM FOSTERING IMAGING SPECTROSCOPY RESEARCH

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1. ABSTRACT

Imaging spectroscopy [1], also known as hyperspectral imaging, is concerned with the measurement, analysis, and interpretation of spectra acquired from a given scene (or specific object) at a short, medium or long distance by an airborne or satellite sensor. The Hyperspectral Imaging Network[1] (HYPER-I-NET) [2] is a four-year Marie Curie Research Training Network[2] designed to build an interdisciplinary European research community focusing on this technology, which has opened new perspectives in many Earth Observation related applications [3]. The network is currently formed by a multidisciplinary team composed of fifteen highly experienced European partner organizations, and the theme of the network is at the confluence of heterogeneous disciplines, such as sensor design including optics and electronics, aerospace engineering, remote sensing, geosciences, computer sciences including high performance computing, signal processing, and Earth Observation related products. In particular, activities in this network intend to cover all the different aspects that comprise the entire hyperspectral data processing chain, ranging from sensor design and calibration/validation [4, 5] to advanced data processing [6], and science applications [7].

Although hyperspectral imaging has been a very active area recently, we believe that no sufficient attention has been given to research activities covering the entire data processing chain and, as a result, we feel that the abilities in this area are fragmented throughout various specialized research teams and companies, a fact that has largely resulted in the lack of data standardization and validation procedures. In this regard, the proposed network aims at providing a timely and unique opportunity to bridge the gap between the operational procedures of hyperspectral imaging and the development of techniques for efficient data exploitation and management. As a result, our planned activities are specifically directed towards overcoming the boundaries between traditionally disjoint disciplines such as sensor design, data processing and application insight. Resulting from this effort, we expect to introduce new standardized frameworks for hyperspectral data processing and validation.

In this paper, we outline the activities that have been carried out in the four main areas covered by HYPER-I-NET during the first two years of the project:

1. *Hyperspectral sensor specification*. The main goal of this activity is to investigate the sensor requirements for various applications and develop new sensor specifications. For this purpose, the tasks carried out comprise the analysis of application needs in terms of derived parameters and variables in different application fields such as agriculture, forestry, geology, phenology/limnology or urban management, with the ultimate goal of compiling spectral databases to determine the spectral response related to the individual variables and parameters and to translate the observed needs into performance requirements of new hyperspectral sensors by developing a dedicated hyperspectral instrument model (optical layout and transfer, noise, etc.)

2. *Processing chain definition and implementation*. The main goal of this activity is to settle the basis for the generalization of a well-defined hyperspectral data collection and processing chain that might serve as a standardized procedure for processing this type of data in Europe. For this purpose, the tasks carried out comprise the definition of a processing

[1] http://www.hyperinet.eu
[2] http://cordis.europa.eu; Contract number MRTN-CT-2006-035927

chain able to address needs from scientific applications and constraints imposed by sensor design, and the preliminary implementation of the processing chain steps. The expected outcome of this activity is a series of standardized hardware/software processing techniques able to deal with the intrinsic complexity of the data, along with a detailed processing chain definition and implementation report.

3. *Calibration, validation and definition of standardization mechanisms*. This activity is focused on the calibration/validation of hyperspectral sensors and the result from various processing steps of the processing chain described above. This is a crucial step to reduce the overall uncertainties introduced by hyperspectral imaging instruments. For this purpose, the tasks carried out comprise an inventory of existing calibration equipment and methodologies as well as an inventory of methods and processors for onboard, laboratory and vicarious calibration and assimilation, interaction with scientists and researchers.

4. *Science applications*. This activity is aimed at compiling relevant applications and methods applied using imaging spectrometer data, and creating a product catalogue of both. The main task carried out in this activity comprise the definition of an algorithm theoretical baseline document (ATBD) listing methods used for selected applications, complemented partly by available models and source code.

Along with a detailed description of the progress made in the four main areas listed above, this paper also describes the training activities carried out during the first two years of the project. Being an educational project, HYPER-I-NET is particularly focused on the training of young researchers in the four above-mentioned topic areas, and it is the goal of the project to provide young researchers involved in the network with the required background and expertise on the multiple disciplines involved in hyperspectral imaging.

2. REFERENCES

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