Special section on image spectroscopy and hyperspectral imaging

Report

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Editorial

Special Section on Image Spectroscopy and Hyperspectral Imaging

Imaging spectroscopy can be defined as the quantitative and qualitative characterisation of both a surface and the atmosphere using geometrically coherent spectro-radiometric measurements, i.e. by measuring the continuous, upwelling spectral radiance in each spatial pixel. Although it is difficult to sharply define which sensors are hyperspectral, it is often assumed that they should have at least 10 spectral bands and a narrow bandwidth (typically a few tens of nm or less for the VIS and NIR). Systems with more than 200 spectral bands, and bandwidths of a few nm have been realised, providing information in the VIS, NIR, SWIR, MIR and TIR regions of the electromagnetic spectrum.

Image spectroscopy and hyperspectral imaging has gained importance the last period. A number of airborne and spaceborne systems have been deployed or are planned, commercial remote sensing and image processing software systems provide more support and extended functionality for such data, while the practical use of hyperspectral data in both commercial and military applications has increased.

Operational airborne systems include AVIRIS (JPL, NASA), DAIS 7915 (DLR), CASI and CASI 2 (Itres, Canada), HyMap (Integrated Spectronics, Australia), ROSIS (DLR), AISA (Specim, Finland), HYDICE (NRL, USA), EPS A and H Series (GER, USA), ASAS (GSFC, NASA), SMIFTS (Hawai'i Institute of Geophysics and Planetology). Spaceborne systems include MERIS on Envisat (ESA), MODIS and ASTER on EOS-Terra (NASA), MOS on IRS-3P (India), Hyperion on EO-1 (NASA), CHRIS on PROBA (ESA) and COIS on NEMO (US Navy). Other hyperspectral sensors have been deployed for the study of other planets or comets. Most of the above systems are civilian, out of which some are commercial (CASI, HyMap, AISA, EPS). Often there is a synergy between airborne, spaceborne and also field-based spectroscopy, while data from image spectrometers are often integrated with data from other sensors, especially with multi-sensor satellite missions. New airborne and spaceborne hyperspectral systems are planned for the near future.

Since 1998 imaging spectroscopy has been used or has supported various applications like determination of calibration, validation and simulation variables, atmospheric signatures, vegetation, geology, soils and minerals, inland water quality and limnology, snow and ice, air quality in urban areas, estuary mapping, assessment of river floodplains, detection of hydrocarbonate micro-seepage etc.

The increased interest in imaging spectroscopy is reflected also by the Terms of Reference of various ISPRS Working Groups (I/4 "Advanced Sensor Systems", III/6 "Multi-Source Vision", VII/1 "Fundamental Physics and Modelling") and the activities of the Special Interest Group (SIG) "Imaging Spectroscopy" of EARSeL, a Regional ISPRS Member, which is also organising a series of workshops on Imaging Spectroscopy.

Initially and on the occasion of the Imaging Spectroscopy workshops organised by EARSeL, the aim was to publish a theme issue on this topic. The idea was to solicit good papers from the Imaging Spectroscopy workshop held on 11-13 July 2000 at ITC, the Netherlands and have them revised and published in a theme issue. Due to various difficulties, only 4 revised papers from this workshop were collected, and thus these papers are presented in this PRS issue as a Special Section.

Hakvoort et al. report on methods for the retrieval of water quality parameters within the frame of a production chain of water quality maps at Rijkswaterstaat using the EPS-A airborne hyperspectral sensor. They assess the accuracy of the methods and estimate the influence of various error sources, and provide results using benchmark datasets. Strub et al. use directional data set of bare soil and Alfalfa acquired using the FIeld GOniometer System (FIGOS) during the DAIS Experiment 1999 (DAISEX'99) campaign within the general aim to preprocess and validate ground-based directional remote sensing data, with a special emphasis on the spectral component and the diurnal dynamics of multiangular ground-based observations of these two object class types. The study is a step towards the generation of BRDF databases for the validation and calibration of air- and spaceborne remote sensing data. Staenz et al. evaluate surface reflectance retrieved from AVIRIS and CASI data using the atmospheric radiative transfer (RT) codes ATREM, CAM5S, and MODTRAN4 and compare the retrieved surface reflectances with ground-based reflectances acquired with a GER3700 spectroradiometer. The errors of the three RT codes are compared for varying gas absorption, as well as their execution time. Bojinski et al. present SPECCHIO, a WEB-accessible spectrum database based on a relational data model for storage and management of heterogeneous spectral data and metadata and online data inspection and following the principles: independence of file format, flexibility to attribute changes, establishment of relations between data, content-based search capability, common interfaces and scalability.

From this position I would like to thank the Guest Editors of this Special Section, A. Skidmore and F. van der Meer, both with ITC, Netherlands, M. Schaepman, University of Zurich for some valuable comments regarding this editorial, as well as the authors for their contribution.

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Editor-in-Chief