The software and algorithms for hyperspectral data processing

Anhelina Shyrayeva (1), Anton Martinov (2), Victor Ivanov (3), and Leonid Katkovsky (4)

(1) A. N. Sevchenko Research Institute of Applied Physical Problems of the Belarusian State University, Belarusian State University, Minsk, Belarus (linashiryaeva@gmail.com), (2) A. N. Sevchenko Research Institute of Applied Physical Problems of the Belarusian State University, Belarusian State University, Minsk, Belarus (antonmartenov@gmail.com), (3) A. N. Sevchenko Research Institute of Applied Physical Problems of the Belarusian State University, Belarusian State University, Minsk, Belarus (victor.al.ivanov@gmail.com), (4) A. N. Sevchenko Research Institute of Applied Physical Problems of the Belarusian State University, Belarusian State University, Minsk, Belarus (katkovskyl@gmail.com)

Hyperspectral remote sensing technique is widely used for collecting and processing -information about the Earth's surface objects. Hyperspectral data are combined to form a three-dimensional (x, y, λ) data cube. Department of Aerospace Research of the Institute of Applied Physical Problems of the Belarusian State University presents a general model of the software for hyperspectral image data analysis and processing.

The software runs in Windows XP/7/8/8.1/10 environment on any personal computer. This complex has been has been written in C++ language using QT framework and OpenGL for graphical data visualization. The software has flexible structure that consists of a set of independent plugins. Each plugin was compiled as Qt Plugin and represents Windows Dynamic library (dll). Plugins can be categorized in terms of data reading types, data visualization (3D, 2D, 1D) and data processing

The software has various in-built functions for statistical and mathematical analysis, signal processing functions like direct smoothing function for moving average, Savitzky-Golay smoothing technique, RGB correction, histogram transformation, and atmospheric correction. The software provides two author's engineering techniques for the solution of atmospheric correction problem: iteration method of refinement of spectral albedo's parameters using Libradtran and analytical least square method. The main advantages of these methods are high rate of processing (several minutes for 1 GB data) and low relative error in albedo retrieval (less than 15%). Also, the software supports work with spectral libraries, region of interest (ROI) selection, spectral analysis such as cluster-type image classification and automatic hypercube spectrum comparison by similarity criterion with similar ones from spectral libraries, and vice versa.

The software deals with different kinds of spectral information in order to identify and distinguish spectrally unique materials. Also, the following advantages should be noted: fast and low memory hypercube manipulation features, user-friendly interface, modularity, and expandability.