Project name: Development of a mathematical apparatus for the use of hyperspectral images for phytosanitary inspection of grain crops in aerospace photography

Relevance: the study is limited to a large volume of hyperspectral images, sometimes amounting to hundreds of gigabytes. To simplify the research tasks, it is necessary to archive hyperspectral images, which fully give a complete picture of the detection and monitoring of diseases, rather than multispectral ones.

In this regard, one of the urgent tasks is the archiving of aerospace data. Therefore, the project is aimed at the research and development of software that allows compressing hyperspectral images, in order to reduce the volume occupied by them, using new mathematical and adaptive compression algorithms.

Objective: To analyze the use of hyperspectral images to identify a specific disease of grain crops in the development of optimal mathematical solutions and software by effectively compressing the information flow while maintaining a high archiving coefficient, the number of ranges, without loss of image quality in order to reduce the volume of information flow.

Expected and achieved results:

As a result of the research, the need to create methods that are currently used in managing the storage of large archives of aerospace data was justified. The available developed lossless compression methods and algorithms for hyperspectral images are analyzed, which can be improved by reducing their computational efficiency and increasing the compression ratio due to significant preprocessing steps. A mathematical apparatus based on a difference-discrete transformation for compressing hyperspectral images has been developed and adapted. Hyperspectral image compression algorithms have been developed and modified.

As a result, software has been developed designed to compress hyperspectral data, taking into account the characteristic features and qualitative indicators of hyperspectral cameras for phytosanitary inspection of grain crops. The obtained research results will be used in the Center of Geoinformation Technologies of the Kazakh Agrotechnical University of Nur-Sultan.

Members of the research group:

Supervisor: Asiya Zhumabaevna Sarinova, PhD, Scopus – 3 Hirsch Index, Scopus Author ID - 56662216400, Web of Science Researcher ID - P-6633-2017, ORCID 0000-0003-4254-376X.

Members of the research group:

Pavel Dunaev Alexandrovich is a performer, Candidate of Technical Sciences in the specialty "Telecommunications systems, networks and devices".

Bekbaeva Aigul Myktybaevna - Performer, Master of Science in Geoinformation Mathematics

List of publications and patents published within the framework of this project:

1. Assiya Sarinova, Pavel Dunayev, Aigul Bekbayeva. Methodology for developing algorithms for compressing hyperspectral aerospace images used on

board spacecraft. Awaiting publication December 2021. COXON magazine "Proceedings of the University" map.

2. A.Zh. Sarinova, P. A. Dunayev, A.M. Bekbayeva, Y. Zh. Sarsikeyev, K. M. Sansyzbay Hyperspectral image compression algorithms for phytosanitary inspection of agricultural crops in aerospace photography. Journal of Theoretical and Applied Information Technology. Scopus. Accepted and awaiting publication by 2021.

3. A.Zh. Sarinova, P. A. Dunayev, A.M. Bekbayeva, Y. Zh. Sarsikeyev, A.D. Mekchtiyev Development of compression algorithms for hyperspectral aerospace images based on discrete orthogonal transformations. Eastern-European Journal of Enterprise Technologies. Scopus. Accepted and awaiting publication February 2022.

4. Sarinova A.Zh., Dunaev P. A., Bekbaeva A.M. Discrete-cosine transformation for compression of hyperspectral images in phytosanitary control of grain crops. Accepted and awaiting publication December 2021. XX International Conference named after A.F. Terpugov "Information Technologies and Mathematical Modeling" (ITMM - 2021).

5. Sarinova A.Zh., Dunaev P. A., Bekbaeva A.M. Features of compression of hyperspectral images on board the spacecraft. Published in the XIII All-Russian Scientific and Technical Conference with international participation "Robotics and Artificial Intelligence" (RII-21).

Information for potential users:

Sarinova A.Zh., Dunaev P. A. Developed recommendations for the application and dissemination of the results of research work and Methodological instructions for the use of the software package "Compression of hyperspectral images for phytosanitary inspection of grain crops in aerospace survey", 40 p.

Additional information:

Sarinova A.Zh. Received one certificate for the state registration of the computer program "HSI for phytosanitary control".