Multimodal data analysis of Raman spectra and dermatoscopic images for the diagnosis of skin cancer

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Accurate diagnosis of the cancer type and early diagnosis are key factors in the successful treatment of neoplasms. The modern trend in the development of optical diagnostics is the use of Raman spectroscopy methods (which identify the chemical features of the tumor based on spectral data) and dermatoscopy (which makes it possible to detect and visualize surface heterogeneities). The paper is devoted to developing combined method for diagnosing skin cancer based on Raman spectra and dermatoscopic images of skin tissue. Experimental skin Raman spectra were recorded with a spectral resolution of 0.2 nm in the range from 837 to 920 nm using a portable setup that includes a laser source with a central wavelength of 785 nm. A total of 338 spectra were used: 113 keratosis, 67 malignant melanoma, and 158 pigmented nevus spectra. Dermatoscopic images of this data set were obtained using a prototype multispectral digital dermatoscope. The dataset consists of a total of 314 images: 104 malignant melanoma, 200 pigmented neoplasms (keratosis and pigmented nevi).

Machine learning methods, in particular, logistic regression and convolutional neural networks, were used to analyze the registered data. Classification models for the main diagnostic cases have shown an increase in classification accuracy compared to the analysis of Raman spectra or dermatoscopic images alone. The studied approaches to the analysis of spectral data can be further used as part of the software for automated screening diagnostics of skin pathologies in order to detect tumors at an early stage of development.