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MULTIPARAMETRIC SYSTEM OF BLOOD PLASMA MUELLER-JONES POLARIMETRY FOR BREAST FIBROADENOMA DIAGNOSIS

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Introduction. Breast fibroadenoma is one of the most common diseases among women. The risk of this disease is that it may be transform to malignant neoplasms. Methods and systems of laser polarimetry have proven themselves well in the breast fibroadenoma diagnosis [1].

Also, their application allows to assess the state of individual organs by determining the appropriate state of blood plasma. However, the level of authenticity of differentiation to the «norm» - «fibroadenoma» in these systems is at the level of 80-90%/ Therefore, the search for additional diagnostic features and classification methods is necessary to increasing the diagnosis authenticity.

The **purpose** of the work is to increase the authenticity of the differentiation of optically thin blood plasma samples to the «norm» or «fibroadenoma» of the breast through the implementation of the improved combined Mueller-Jones-polarimetry method.

Methods and materials. The combined Mueller-Jones polarimetry method were proposed which is implemented on the system of two-dimensional laser polarimetry of blood plasma (Fig. 1).

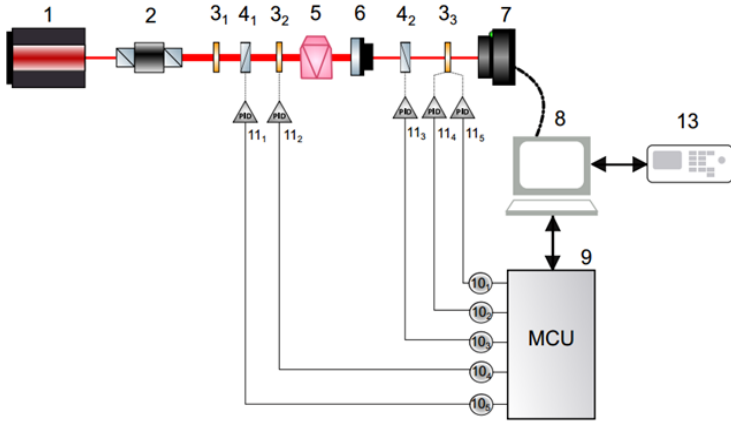


Fig. 1. The system for blood plasma two-dimensional laser polarimetry

Details on the principle of operation and element base are described in [2, 3]. This system allows measurement of the «orientation» and «phase» parameters of the Jones matrix (real $R_{11,22}$, $R_{12,21}$ and imaginary $\chi_{11,22}$, $\chi_{12,21}$ elements) and Mueller matrix $Z_{22, 23, 32, 33}$, $Z_{24,42,34,43,44}$ of the studied blood plasma samples.

As a research material, 100 samples of optically thin blood plasma (50 with «norm» and 50 with «fibroadenoma» of the breast) were selected. Measured Jones- and Mueller-polarization images of blood plasma are processed using a statistical analysis, which results in a set of statistical estimates of 1st-4th orders. These data served as a knowledge base for developing a decision support system based on decision trees.

Results and discussion. With the help of the created decision support system, the classification of samples to the «norm» and «fibroadenoma» was performed. As a result, the diagnostic informativeness and system authenticity (by calculating of sensitivity Se , the specificity Sp and accuracy Ac) was evaluated. For the combined method of Mueller-Jones polarimetry, these values were: $Se=96.07\%$, $Sp=92.15\%$, $Ac=94.11\%$.

Also, the measurement errors of the reference Jones matrices were determined in this work. By measuring the Jones matrix of a linear polarizer with the rotation angle of the transmitting plane and comparing it with the reference junction matrix of this polarizer, the errors of measurement of the Jones matrix were calculated in each pixel of the polarization image. It was determined that the value of the integral absolute error is within 0.004-0.072.

Conclusions. For the first time, interconnections have been established between the changes in the values of statistical estimates of polarization images of blood plasma for the states of «norm» and «fibroadenoma» by the combined method of Mueller-Jones polarimetry. The obtained accuracy of 94.11% differentiation to the «norm» and «fibroadenoma» allows to confirm the high level of reliability of the considered system.

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ЛАЗЕРНА ФОТОПЛЕТИЗМОГРАФІЯ В КОМПЛЕКСНІЙ ОЦІНЦІ КОЛАТЕРАЛЬНОГО КРОВООБІГУ НИЖНІХ КІНЦІВОК

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Вступ. Для дослідження мікрогемодинаміки застосовують транскутанну оксиметрію, лазерну доплерівську флоуметрію, капіляроскопію, сцинтиграфію, інфрачервону термографію [1, 2, 3]. Ці методи відбивають стан компенсаторних механізмів кровообігу кінцівки, що опосередковано дає інформацію про розвиток колатерального кровообігу. Але їх результати не дозволяють відрізнити зміни стану за