Computational experiment on laser diffractometry of erythrocytes

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In our work [1], we proposed an algorithm for measuring the characteristics of the erythrocyte distribution by size using laser diffractometry of a blood smear. With this algorithm, it is possible to measure the mean diameter of red blood cells, as well as the width and asymmetry for distribution of red blood cells by size. We tested this algorithm by numerical experiment. For this purpose we used the model of a bimodal ensemble of erythrocytes. First, we solved the direct problem of diffraction and found the diffraction pattern arising from the scattering of a laser beam on a blood smear. Then, the angular distribution of light scattering in the diffraction pattern is measured and three distribution parameters are evaluated: the angular coordinate of the first light scattering minimum, the relative intensity of the light in the minimum, and the curvature of the angular distribution of the scattered light in the minimum. After that, according to the algorithm formulas, the values of the distribution of erythrocytes by size were verified and the found values were compared with the initial given values. Thus, the accuracy of the algorithm is estimated, and the area of its applicability is determined in relation to the possible heterogeneity of the ensemble in size. The numerical experiment demonstrate that the error of the algorithm increases with the growth of the heterogeneity of the ensemble. So, with a width of distribution of erythrocytes by size of 14%, the error in measuring sizes does not exceed 8%, and at 18.8%, the measurement error changes by 17.5%. The results obtained can be used to create laser diffractometers of erythrocytes with extended functionality.

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1. S.Yu. Nikitin, E.G. Tsybrov, M.S. Lebedeva, A.E. Lugovtsov, A.V. Priezzhev. Possibility of measuring asymmetry of the red blood cell size distribution by laser diffractometry of a blood smear. *Quantum Electronics,* 52(7):664–670, 2022.