INFORMATION - STATISTICAL APPROACH TO INVERSE OPTICAL PROBLEM SOLUTION FOR 3D DISPERSE SYSTEMS WITH NANO AND MICRO PARTICLES

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I. INTRODUCTION

In nature, a class of objects called three-dimensional (*3D*) disperse systems (DS) is widely spread. For *3D* DS the dispersive mediums are most often air or water, and the disperse phase consists from particles of different origin [1]. In our study the particle sizes of *3D* DS can vary from nanometers to about ten micrometers. Earlier [2-7] it was reported that a set of optical parameters of the so-called second class (obtained as a result of processing experimental data without involving any a priori information about *3D* DS) is unique for each *3D* DS and implicitly reflects characteristics of *3D* DS: shape, refractive index of particles, distribution functions of number and mass of particles in size, etc. In other words, the characteristic of any *3D* DS can be represented as *ND* vector in the *N*-dimensional space of optical parameters of the second class. In this set there are parameters specific to the *3D* DS components. On the basis of theory and experiment it is possible to predict these specific parameters for a certain component. In the previous papers it was discussed the *3D* DS polymodality problem [4], optical characterization of *3D* DS mixtures [5], the use of unique optical vectors for monitoring the aggregation process [7]. This part of study is connected with creation of algorithm based on the information-statistical methodology [8-11], which can help in search of the most informative data for particles of interest.

II. RESULTS AND DISCUSSION

One of the promising directions for studying the information content of various optical parameters for determining the component composition of natural *3D* DS is the information-statistical theory of observation interpretation [8-11]. The algorithms and programs developed on the base of this theory can allow identifying the components which presence in *3D* DS is the most probable. The probability of the component of interest presence is determined from the experimental quantitative values of the optical parameters of an unknown *3D* DS. For determination of these probabilities, it is necessary to have the representative so-called "training data" in the knowledge bank for each of the possible components of *3D* DS. On investigating model mixed *3D* DS, it is possible to analyze the algorithm efficiency even against the background of strong interactions of components and with various physical and chemical effects on the system. With increasing the component number in a complex *3D* DS, the number of parameters should also increase. It should be noted that a uniform representation of the input and output data provides the ability to add new parameters to those obtained earlier. Judgment about the reliability of the results allows the most informative unique parameters to be selected. The set of parameters from optical methods as: refractometry, absorbance, fluorescence, light scattering (integral and differential, static and dynamic, unpolarized and polarized) can be unique for each monocomponent *3D* DS. At the same time there are also general features. At the analysis of unknown polycomponent *3D* DS the comparison of measured parameters with known ones can help to identify the system under study. For this purpose a software package MULTALT [10] was used providing the process of interpretation and visualization of intermediate and final results with estimation of decision probability. The methodology was tested on mixed in different proportions experimental dispersions consisted of two monocomponent *3D* DS: kaolin clay and bacteria Echerichia coli. This approach can be of vital importance for the development of natural *3D* DS control on the presence of dangerous impurities.

III. CONCLUSIONS

For differentiation of *3D* DS constituents in mixtures the dimension of *ND* vectors can be enlarged due to the involvement into consideration different measurement conditions such as wavelengths, angles and apertures of measurements, polarization, etc. Calculations are based only on experimental data and can be performed online.

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