LINE SPECTRA PROCESSING,
HUMAN MEMORY, LINGUISTIC, AND PSYCHOLOGY PROBLEMS

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Identification of peaks is a very important stage in the computer processing of line spectra obtained as primary experimental data in physics, chemistry, biology, medicine, and other sciences. The quality of a peak search program is defined as the dependence of the conditional probability D of true peak discovery on the ratio A/Bkgr with the condition that the conditional probability F of false peak discovery is constant (A/Bkgr is ratio of peak area A to background Bkgr, i.e. the signal-to-noise ratio). The best identification program is the program with the largest value of D for the same F and A/Bkgr. When an operator and a computer program use the same information about the spectrum a “good” program identifies peaks better than a skilled operator. Thus, the creation of new peak search programs is not an issue now. As a currently important problem remains the programs standardization and interpretation of peak search results. The question also arises why operator performance is as demonstrated during the experiments. Why do skilled operators identify peaks with $F=0.012\pm 0.004$ and dilettantes with $F\approx 0.3$? Answers are outside the scope of physics or mathematics proper and belong to human psychology. Hence, the problem of identification of peaks in line radiation spectra is closely connected with the problem of human intelligence study [1].

Bridge connected these problems can be artificial neural network (ANN) theory. In [2] neural network algorithm for identification of single peaks is proposed and implemented in the form of PC computer code PsNet. This algorithm imitates in part operation of human visual system. PsNet can identify peaks better than other programs, and D(A/Bkgr) dependences for different versions of PsNet reproduce in full such dependences for skilled operators. Hence, the ANNs from [2] - by the language used as usual by neurosciences - provide the description of some human visual system performance quantitatively in full. This is the first example of description quantitatively in full, exactly in full, of neuropsychology experimental data obtained as a result of testing human subjects visual system.

It may be hope that the proposed approach will be fruitful as a method for other human cognitive functions quantitative description too. Indeed, ANNs from [2] were used as a base for the new model of memory [3] (equally either in human or in machine), a new model of human brain recognizing simple visual patterns under the conditions of statistical uncertainty [4], and the first quantitative model of the tip-of-the-tongue psycholinguistic phenomenon [5]. Progress in the understanding of human brain activity achieved with the help of the models [2-5] can lead to the determination of the limits of human ability to solve some specific recognition problems. As a result can be obtained the limits of quality of computer identification programs which solve the same recognition problems as an operator. The limit of quality for single-peak-search programs was found for example.

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