A LINEARIZATION OF THE NONLINEAR LEAST SQUARE PROBLEM

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A broad class of functions, which require solution of nonlinear equations are often met in the fitting preocedure. These problems can be solved by iteration, but sometimes difficulties of finding an appropriate initial value of the searched parameter may arise in connection with this method.

Using the difference equations, many cases can be transformed into linear ones. If we require, that a given function is a good representation of the measured dependence then the usual condition should be fullfiled

$$\sum (y_i - f(x_i))^2 = min$$

In the case, when the function $f(x)$ satisfies the diference equation, in which the searched parameters enter linearly, we can formulate the minimizing condition as:

If the given set of measured values can be represented by a function $f(x)$, *and this function satisfies a corresponding difference equation, than also the measured values should satisfy the difference equation as well.*

As an example the case when $y_i = f(x_i) = Ae^{-ax_i} + Be^{-ax_i}$ will be demonstrated. The sum of two exponential functions satisfy the following difference equation $y_{i+2} - uy_{i+1} + vy_i = 0$, where $u = e^{-a} + e^{-b}$ and $v = e^{-a} \cdot e^{-b}$. The minimizing condition is then

$$\sum (y_{i+2} - uy_{i+1} + vy_i)^2 = min$$

Now u and v enter linearly, so they can be easily determined. When e^{-a} and e^{-b} are known, with the second minimization

$$\sum (y_i - Ae^{-ax_i} - Be^{-bx_i})^2 = min$$

A and B are found.

The same procedure can be developed for Gaussian function, which is of practical importance in fitting the spectra obtained by *Ge(Li)* detectors.