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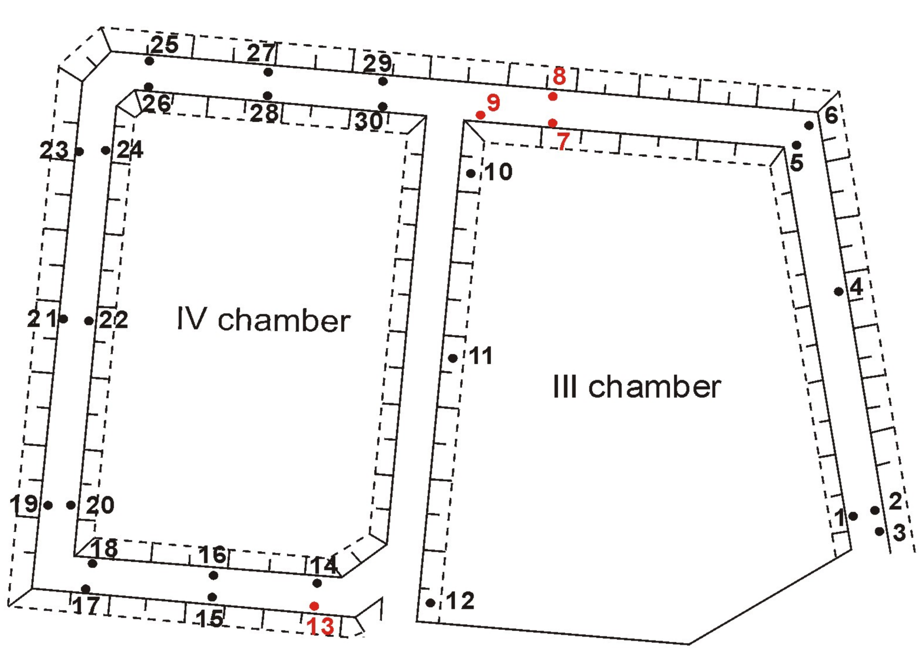
THE VERTICAL GEODETIC NETWORK MODELS IN THE ASPECT OF DETERMINING DEFORMATION PARAMETERS BY MEANS OF NEURAL NETWORKS

The state of a neural network deformation in the geodetical research of displacements was presented in the paper. This state was determined by means of neural networks. The non-linear tendencies were written in the form of a mathematical model. These tendencies have been the basis for the description and the synthetic characteristic of the observed displacements. The following activities were taken into consideration while analyzing the non-linear models of displacements:

- determination of a hypothetical structure of a model
- estimation of numerical values for the given structure
- checking the model adequacy (its structure and the estimated values)

The optimization task was carried out by means of neural networks and classical algorithms.

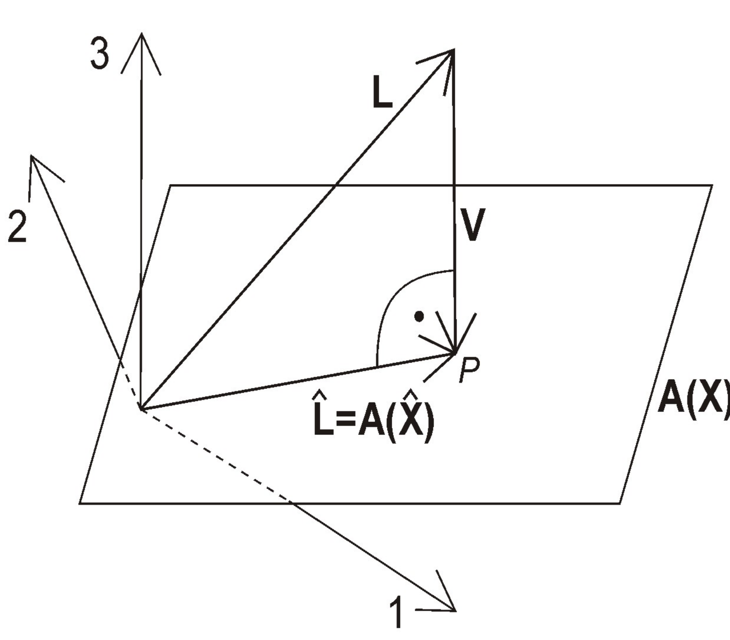
1. The object research.



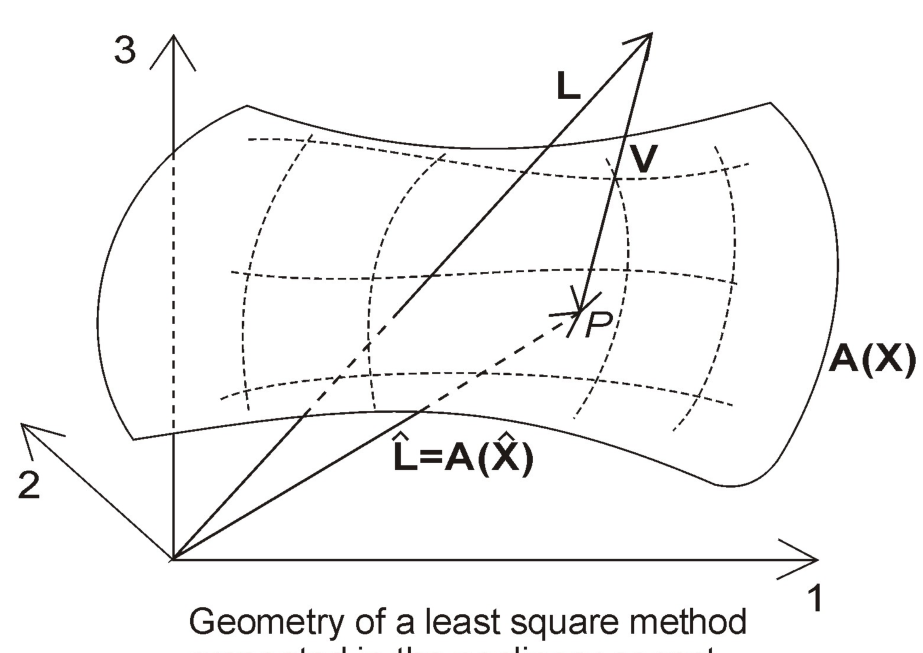
The network characteristics:

- object localization: KGHM Głogów
- time observation: 2001-2004 (S.Gibowski)
- 30 controlling points located on the earth dam crone
- 68 observations every year
- method observation (precise levelling)
- instrument: Ni 007
- points of reference system: 7,8,9,13 (marked red on the figure)

2. The geometry of a least square method in the linear and nonlinear aspect.

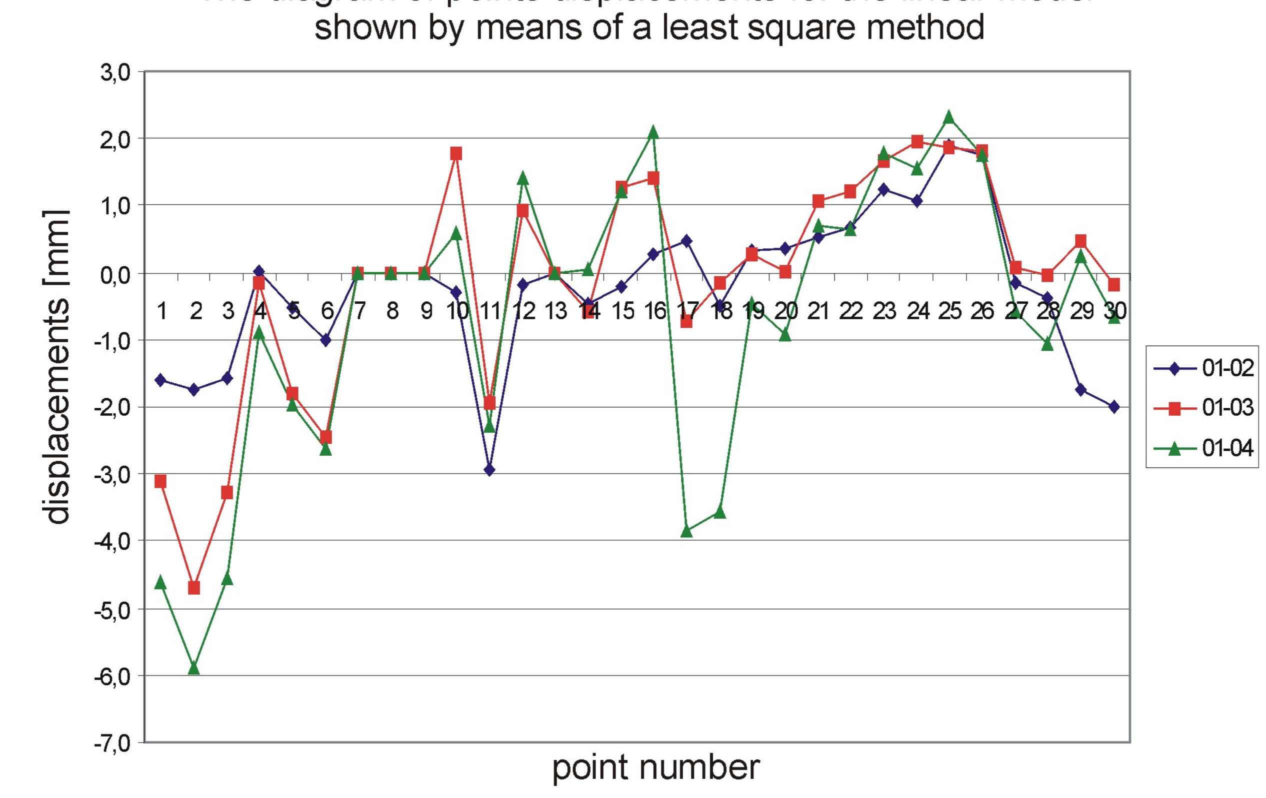


Geometry of a least square method presented in the linear aspect



Geometry of a least square method presented in the nonlinear aspect

The diagram of points displacements for the linear model shown by means of a least square method



3. The applied neural network.

The neural network with a circular structure

$$\frac{dx}{dt} = -\eta \nabla E(x) = -\eta A^T(Ax - l)$$

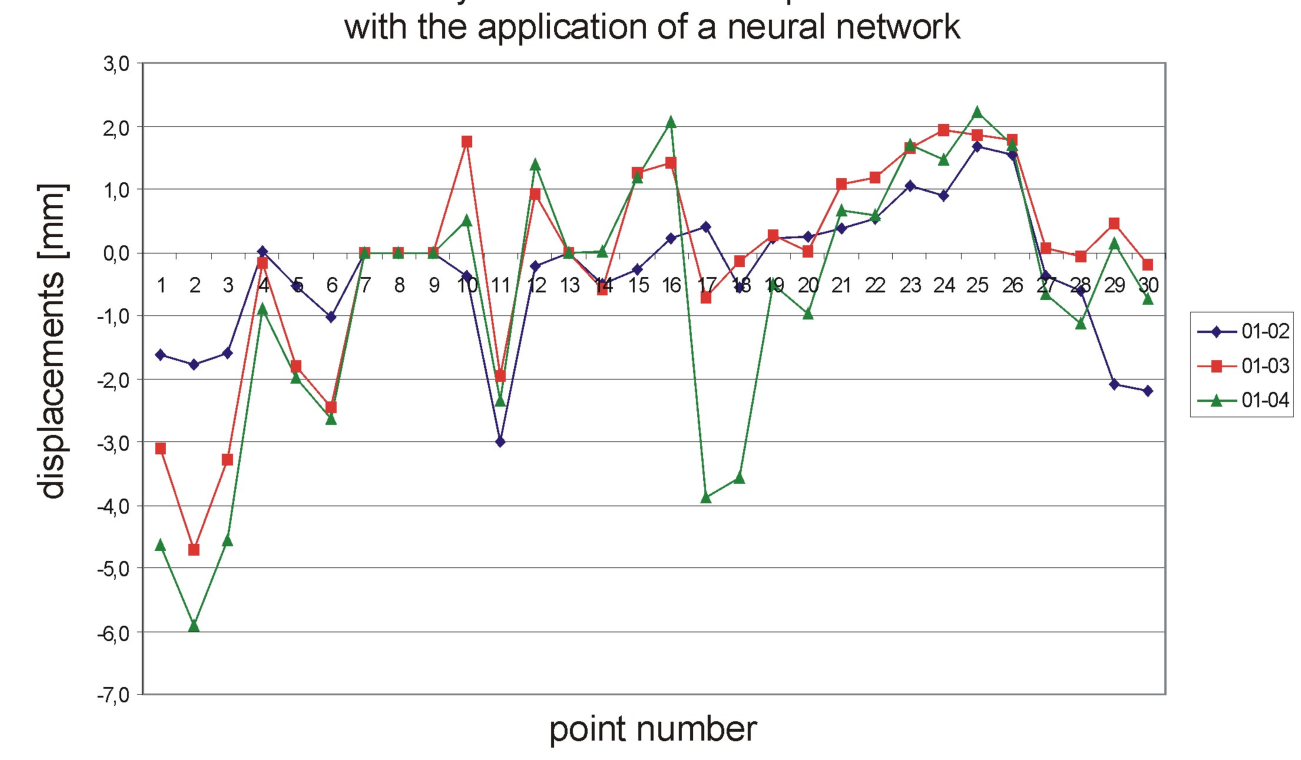
η - the neural network learning coefficient

$A \in R^{m,n}$ - the matrix of coefficients of the system of equations correction

$x \in R^n$ - the vector of parameters

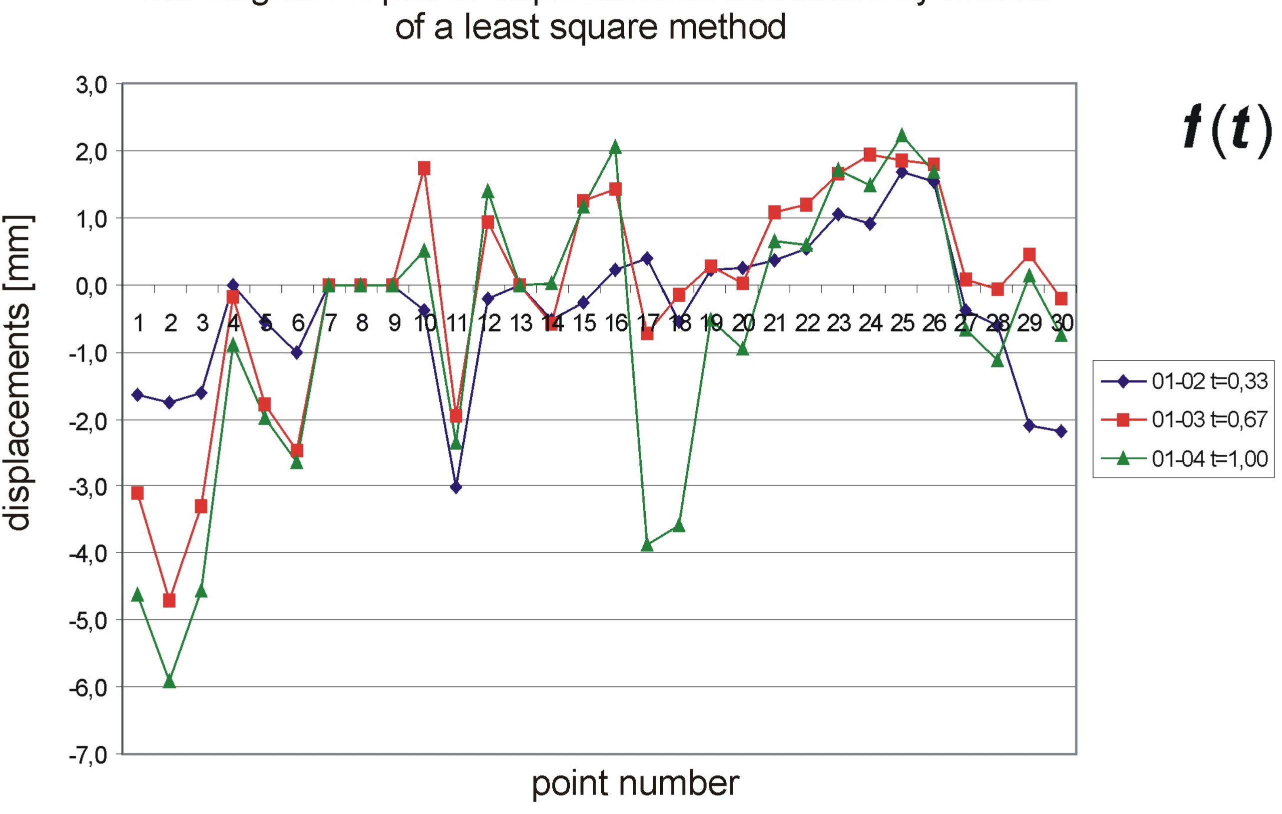
$l \in R^m$ - the observation vector

The diagram of points displacements for the linear model shown by means of a least square method with the application of a neural network



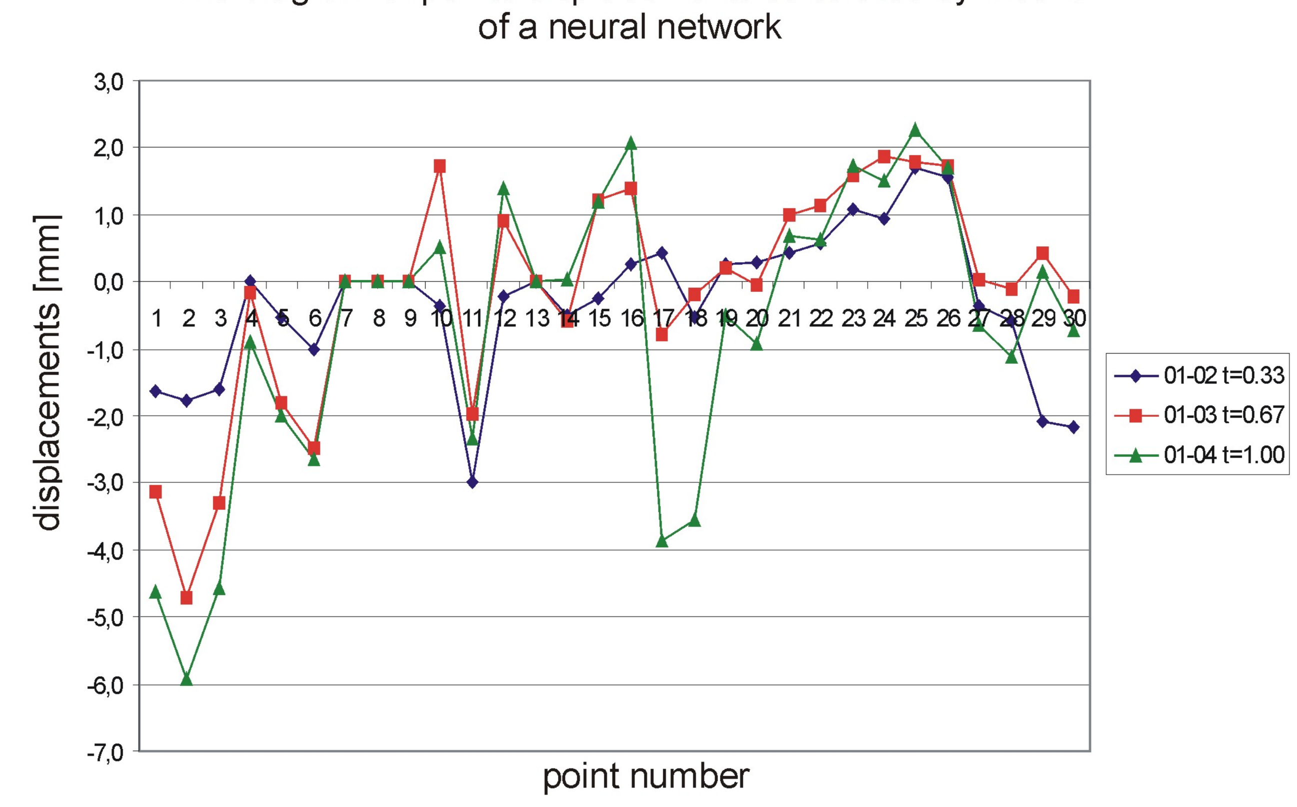
4. The displacements obtained according to applied kinematic models for classical solutions and by means of a neural network.

The diagram of points displacements calculated by means of a least square method

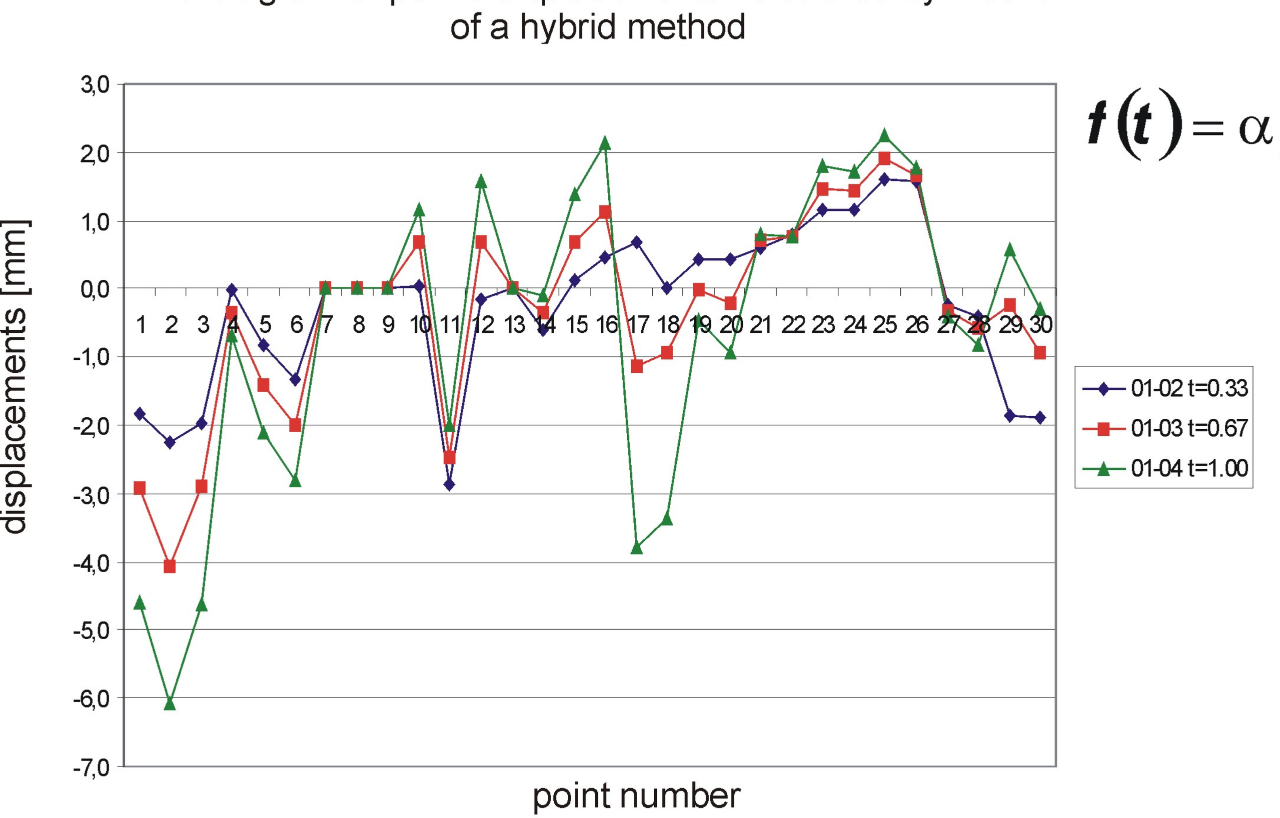


$$f(t) = \alpha_{i0} + \alpha_{i1}(t - t_0) + \alpha_{i2}(t - t_0)^2$$

The diagram of points displacements calculated by means of a neural network



The diagram of points displacements calculated by means of a hybrid method



$$f(t) = \alpha_{i1} + \alpha_{i2}\exp(-\beta t)$$

$$f(t) = \frac{\alpha_{i1} t}{\alpha_{i2} + t} + \frac{\alpha_{i3}}{t}$$

The diagram of points displacements calculated by means of a neural network