Features of Structure Identification the Macromodels for Nonstationary Fields of Air Pollutions from Vehicles

N. Ocheretnyuk, I. Voytyuk, M. Dyvak, Ye. Martsenyuk

Abstract - **The main problems of application the genetic algorithms for structure identification of interval difference operator associated with setting its parameters are shown.**

Keywords – **Method of structure identification, Difference operator, Genetic algorithm.**

I. INTRODUCTION

Nowadays the task of determination the real volumes of atmosphere contamination by the harmful pollutions from vehicle is actual. This task gets solution by macromodeling the fields of concentrations the air pollutions.

In a number of publications the task of structure identification of such macromodel for the stationary fields is considered and the genetic algorithm for synthesis of model structure is offered [1]. But the question of parameter's choice for this algorithm isn't investigated; and most macromodels are built only for the stationary fields. Exactly, reasonable actuality of this scientific research is motivated by it.

II. STATEMENT THE TASK OF STRUCTURE IDENTIFICATION AND FEATURES OF ITS SOLVING

Let's consider a case, when nonstationary field of harmful pollutions concentrations from vehicle can be described by such difference operator:

$$v_{j+1,k+1} = \vec{g}^{T} \cdot \vec{f}(v_{0,0},...,v_{0,k},...,v_{j,0},...,v_{j,k},u_{0,0},...,u_{j,k}),$$
$$k=0,...,N-1,\ j=0,...,J-1, \qquad (1)$$

where $\vec{f}(v_{0,0},...,v_{0,k},...,v_{j,0},...,v_{j,k},u_{0,0},...,u_{j,k})$ is a vector of basis functions; $v_{j+1,k+1}$ is the forecast characteristic in j+1 point of space in k+1 moment of time; $\vec{u}_k = (u_{0,0},...,u_{j,k})^T$ is the known vector of input variables; $\vec{g}$ is an unknown vector of parameters.

The unknown vector of parameters $\vec{g}$ of difference operator is estimated on the conditions of including of the forecast values in the corresponding interval of experimental data. Then we get such interval system of nonlinear algebraic equations (ISNAE):

$$v^{-}_{j+1,k+1} \le \vec{g}^{T} \cdot \vec{f}([v_{0,0}],...,[v_{0,k}],...,$$
$$[v_{j,0}],...,[v_{j,k}],u_{0,0},...,u_{j,k}) \le v^{+}_{j+1,k+1} \qquad (2)$$

Existing methods based on the GMDH method are not suitable for the structure synthesis, as they are based on criterion of minimization the average square derivation between experimental data and forecast by means of a difference operator.

In case of using the interval data next criteria of model optimality are applied: criterion of adequacy (when the structure of model is known for verification of adequacy as a difference operator it is necessary to check compatibility of ISNAE, it means the presence of at least one solution); criterion of completeness (sets influence of additional input factors (controls) on forecast properties of this model); criterion of accuracy (sets the middle width of the forecast corridor); criterion of complication (based on minimization of amount the input variables and model parameters).

Description of genetic algorithm: 1. Generating the set (with power L) of structure elements (genes). 2. Casual generating of chromosomes that sets corresponding structures λ_s, where $s=1,...,S$. 3. Estimation the quality of the generated structures and selection the population with "the best" individuals which is based on criteria of optimality. If the optimal structure is found then go to the end of algorithm. 4. The structure individuals are crossed in a population. After that, go to step 3.

The basic disadvantage of this algorithm is the absence the methodology of choice the optimal values of parameters (L, S), which provides the presence of solutions of this task (suboptimal structure of difference operator) with minimum computing complexity.

III. CONCLUSION

The analysis of tasks the structure identification of interval models as a difference operator was conducted. It was established that a basic instrument for the solving of this task is a genetic algorithm. The basic problems of application this algorithm were shown. Further researches should be conducted in direction to deep cognition the dependence between time complexity and the parameters of genetic algorithm with purpose of their optimization.

REFERENCES

[1] I. Voytyuk, M. Dyvak and V. Nemish, "Method and genetic algorithm for structure identification of interval difference operators in the tasks of environmental monitoring", *Collected Works of Donetsk National Technical University Series "Information, cybernetics and computer science"*, vol. 14 (188), pp. 8-17, 2011. (in Ukrainian)

Natalia Ocheretnyuk –Ternopil National Economic University, 9 Yunosti Str., Ternopil, 46000, UKRAINE,
E-mail: natasha_26_11_88@mail.ru