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USING PARALLEL PROCEDURES FOR THE SEARCHING OF THE EXTREMUM FOR THE DECISION OF THE INVERSE PROBLEMS PREDICTION OF THE DEFINING CHARACTERISTICS OF THE COMPOSITE MATERIALS

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Abstract. It is considered the question about development and using of the parallel procedures for the searching of the extremum of the multivariable factors to efficiency for decision of the inverse problems of prediction defining parameters composite materials on the base complicated models.

1. Introduction

At development of the different structures, the machines and mechanism of one of the massive problems is a problem of the making the reliable methods of the quantitative estimation of the capacity to work structures from polymeric and composite materials [1, 2]. Composite materials, as a rule, are constantly found under influence steady-state and dynamic loads, on which is in addition superimposed influence extreme factor external ambience.

In accordance with this significant urgency has a problem of the development of the mathematical methods of the decision of the inverse problems of the forecasting defining features of the composite materials at influence of the working loads and extreme factor of the external ambience.

2. Statement of the problem the forecasting defining features composite materials

When the experimental data t is enough adequately display the structure of the dependencies of the change defining characteristics composite materials, but experimental data are received with small inaccuracy, that unessential distort the regularities of the behaviour real dependencies, the problem of the reconstruction of the models parameters can be reduce to decision of the following extreme problem:

$$J\left(u^*\right) = \min_u J\left(u\right). \tag{2.1}$$

Vector of the parameters $u^* = \left(u_1^*, u_2^*, ..., u_n^*\right)$, that deliver minimum of the factor efficiency $J(u)$ (2.1), defines the dependency of the change defining characteristics composite material from influence extreme factor external ambience and working loads.

In accordance with this significant urgency presents the development and modification of the efficient methods of searching for of the absolute extremum of the multivariable factors

to efficiency with account specific particularities of the problems of the forecasting of the change defining characteristics composite materials at influence extreme climatic factors and working loads.

3.Parallel methods of searching for of the extremum for decision of the inverse problems of the forecasting defining characteristics composite material in complex statement

The expansion of the area application of the composite materials, improvement of their structure, brings about complication of the dependencies defining characteristics of the composite materials from different factors of the external ambience.

This brings to the essential complication of the problems of the forecasting defining characteristics, in consequence of significant complication of the mathematical models that describe dependency of the defining characteristics from factors of the external ambience.

In accordance with this appear need in development and improvement methods of the searching of the extremum for the decision of the inverse problems of the forecasting defining characteristics composite materials in complicated statement.

The generalization existing approach to decision of the problems of searching of the extremum under decision of the problems of the forecasting defining characteristics composite materials in complicated statement can be reached on base of the transition to parallel procedures of the decision making, when for decision of the problem is simultaneously used several methods.

On the base developed earlier methods, which description is presented in works [3-5], is designed multifunction approach for decision of the problems of the forecasting defining characteristics composite materials in complicated statement.

We consider the most efficient creation of the multifunction approach presenting itself collection of the several methods for decision inverse problems of the forecasting defining characteristics composite constructions.

Let - $M_1, M_2,...,M_k$ - a collection of the methods, designed for decision of the inverse problems of the forecasting defining characteristics of the composite structures, each of which is efficient for it is enough narrow special class of the inverse problems of the forecasting, described models with determined by structure [3-5].

Each of methods M_r, $(r=1,...,k)$ shall consider iteration nonlocal, multistep intended for searching of the minimum multiextremal function, method of consequent searching, for building following (p+1) approach $u^{p+1,r}$ $(p=0,1,2,...;r=1,2,...,k)$ necessary to have information on importances of the factor efficiency and got approach on previous s steps.

In considered general event each of methods M_r can be described operator function L_r , allowing build (p+1) approach on base of information, got on previous s steps:

$$u^{p+1,r}=L_r\left(u^{p-s+1},R(u^{p-s+1}),u^{p-s+2},R(u^{p-s+2}),...,u^{p},R(u^{p})\right),\ (r=1,...k;\ p=0,1,2,...). \qquad (3.1)$$

Since methods $M_1, M_2,...,M_k$ are built on different principles, that next approaches $u^{p+1,r}$ $(r=1,2,...,k)$, built on base of these methods can greatly differ.

For collection, built points $u^{p+1,1},u^{p+1,2},...,u^{p+1,k}$ shall build convex shell Ω_{p+1}:

$$\Omega_{p+1}=conv\{u^{p+1,1},u^{p+1,2},...,\ u^{p+1,k}\}. \qquad (3.2)$$

Convex shell Ω_{p+1} can be presented in the manner of ensemble convex combination vectors $u^{p+1,1},u^{p+1,2},...,u^{p+1,k}$:

$$\Omega_{p+1}=\{u\in E_n:\ u=\sum_{i=1}^{k}\alpha_i u^{p+1,i},\ \sum_{i=1}^{k}\alpha_i=1,\alpha_i\geq 0\}. \qquad (3.3)$$

As (p+1) approximation to absolute minimum of the factor efficiency is taken the decision, delivering minimum factor to efficiency on ensemble point, belonging to convex shell $\mathbf{\Omega_{p+1}}$ (refer to Fig. 1):

$$u^{p+1} = \arg\min_{u \in \Omega_{p+1}} J(u). \tag{3.4}$$

The velocity to convergence considered multifunction method, founded on parallel using forming its methods $M_1, M_2, ..., M_k$, not lower, velocity to convergence each of forming its methods. In the event, when decision of the extreme problem (3.4), connected with searching of the minimum of the factor efficiency R(u) on convex polyhedron $\mathbf{\Omega_{p+1}}$ (refer to Fig. 1), will allow to find greatly more efficient decisions, than decisions, built each of component multifunction approach of the methods, which correspond to the top of the convex polyhedron $\mathbf{\Omega_{p+1}}$, that obviously that velocity convergence considered multifunction approach can be greatly increased in contrast with velocity of convergence forming its methods $M_1, M_2, ..., M_k$.

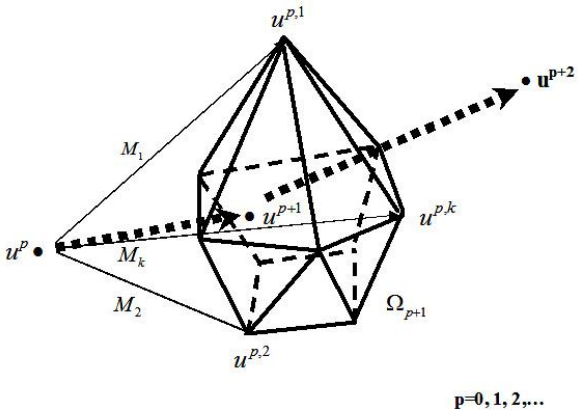

Fig. 1. Scheme of the multifunction method of searching of the extremum, founded on parallel using forming its methods $M_1, M_2, ..., M_k$.

One of the important value considered multifunction approach is a possibility of essential increasing its efficiency as a result of *cut-in* in its composition of the new methods.

Considered multifunction approach, connected with parallel under-changing forming its methods $M_1, M_2, ..., M_k$ can be effectively applying for decision complicated inverse problems of the forecasting defining characteristics composite structures, described models of the complex structure, when there is basis to consider that using existing methods does not allow to build really global-optimum decision.

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