PROBLEM and ALGORITHMS of STRUCTURAL IDENTIFICATION of MULTIVARIABLE STABILIZATION PLANT with an ARBITRARY DYNAMICS (by the example of the helicopter with cargo bracket)

Leonid N. Blokhin[1], Alexandr P. Krivonosenko[2], Vladimir G. Vovk[3], Yuriy N. Bezkorovayniy[4]

National Aviation University,
03680 Ukraine, Kiev, Kosmonavta Komarova ave. 1
|Institute of electronics and control systems, faculty of aerospace control systems
e-mail: fsu@nau.edu.ua

Abstract

Key words: structural identification, multivariable plant

Features of statements and maintenances of the researches, that stages providing creation of new competitive or modernized systems of "stiff" stochastic stabilization of mobile objects in space and orientation with extremely achievable frontiers quality are discussed. A new problem and algorithms of structural identification of required models of dynamics of multivariate object of stabilization with an arbitrariness in dynamics are under stochastic controllable and uncontrollable influences as a base stage of planned works, are considered more detail.

At the present stage of aerospace technics development requirements to quality (accuracy) of navigation processes, management and stabilization of the mobile objects intended for performance of some responsible functions are equally increasing on a number of the objective reasons. As is well known, for example [1], the quality of just listed processes mainly depends on perfection of used onboard cybernetic complexes (measuring, operating, special purpose, etc.) and directly on character and quality of optimal in-line employed navigation stochastic information processing. Modern high technologies of the navigating information, arising at real object motion processing, and optimum control (stabilization) assume aprioristic knowledge of such models of dynamics of control (stabilization) objects in interesting traffic conditions and real stochastic influences on object in stated conditions which describe only the major aspects of investigated processes relative to interesting traffic conditions and quality of their performance.

It is obvious, that one of the basic and effective stages of reception of the necessary primary information on complex dynamic object stochastic signals "input-output" which is required as a priori in problems of structural identification of dynamics models both the most mobile object, and stochastic influences on it on the real move is the stage of conducting of full-scale study of an off-the-shelf object prototype which stabilization system is liable to modernization in future.

Certainly, both regular onboard and ground instrumentation for measurement of required navigation information should be involved during such research.

The stage ends in an information acquisition and primary processing of the collected stochastic navigating information.

The following subsequent stage, at which the models of dynamics of object vectors of signals “input-output” received as a result of full-scaled study are directly used, is a structural identification of dynamics models both subject of inquiry in an interesting conditions of its functioning, and dynamics models of unsupervised stochastic revolting influences on object on the real move.

Here it is necessary to stipulate at once for that fact, that following the primary processing of the navigation information, namely according to the force of mutual correlation of investigated navigation signals, it is possible to judge about expediency and character of an expedient partition of investigated objects dynamics "complete" model on separate quotients for the further proved simplification of procedures of optimal synthesis of objects parts each stochastic stabilization systems.

The subsequent stages of systems modernization, such as synthesis of optimal structures of systems of stabilization of object with already known object (its part) dynamics of models and stochastic perturbations on it, and also the comparative analysis of quality (accuracy) of the modernized and existing stabilization systems are

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[1] Doctor of Science (Engineering), academic of ANMC
[2] candidate of science(Engineering), docent
[3] candidate of science
[4] aspirant

beyond the report. Now we shall briefly consider a new problem and algorithms of stabilization objects structural identification.

Distinctive features of structural identification of models of linear unstable objects dynamics.

Let by analogy with work [2] the problem of identification structure and unstable linear objects parameters is set. Only vectors of stochastic signals "input-output" of stabilized object (fig.1) are measured, and in a considered case the non-stationary deterministic signals x_2 form only a part of a signals output vector x and they settled during the experiment.

The part x_1 of a signals output vector, received during the experiment, represents stationary ergodic multidimensional random process.

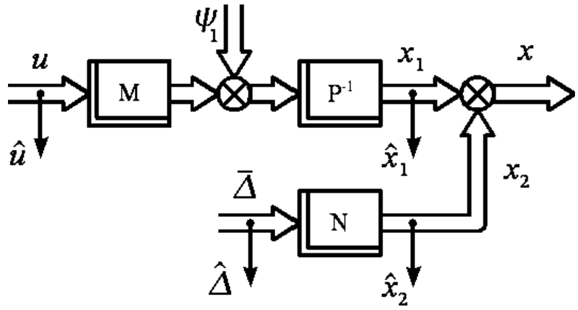


Fig.1 The block diagram explaining the first stage of process of models dynamics identification unstable object.

It is obvious, that the steady part of linear object of identification can be described by the set of the differential equations, transformed according Fourier, a kind

$$P_1 x_1 = M_1 u + \psi_1$$

Where P_1 and M_1 - polynomial matrixes of dimension correspondingly, which structures and parameters are not known; x_1 $-n$-dimensional vector of random signals output , u - m-dimensional vector of input (operating) signals, ψ_1 - n -dimensional vector of random stationary influences with a unknown matrix of spectral density $S_{\psi_1\psi_1}$, N - matrix of transfer functions of an objects part which defines the transformation of deterministic signals only and which the vector of Δ -input δ -functions influences. In the figure block F designates a matrix of transfer functions of the filter, that forming a command vector from a vector of "white" noise, which is also easily settled following the experiment.

As it is already shown [2], probably to transform the structure (fig.1) to a kind (fig.2), entering following keys.

$$\mathbf{P^{-1}M = P_1^{-1}M_1 + NF^{-1}}$$

$$\mathbf{P^{-1} = P_1^{-1}P_2^{-1}}$$

$$\mathbf{P^{-1}\Psi_1 = P_1^{-1}P_2^{-1}P_2\Psi_1 = P^{-1}\Psi}$$

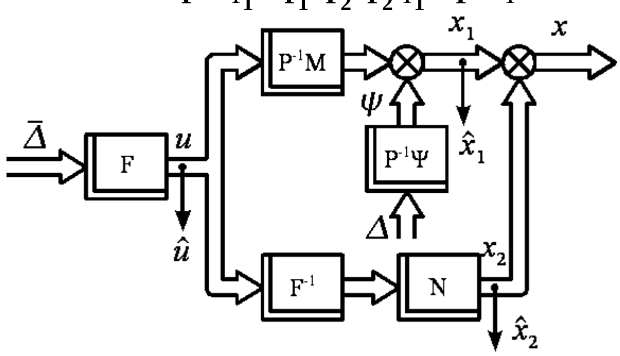


Fig. 2 The block diagram explaining to model of equivalent dynamics unstable object.

On the figure block **F** is a matrix of the transfer function's of filer, which form a vector of control signals from vector of white noise and determine from experiment result's.

So, after the number of structural transformations [2] as a result of identification it is possible to receive the equation of motion of identifiable unstable object of a kind

$$x = \mathbf{P}^{-1}\mathbf{M}u + \mathbf{P}^{-1}\Psi\Delta$$

or

$$\mathbf{P}x = \mathbf{M}u + \Psi\Delta$$

So, knowing matrixes $\mathbf{P}_1^{-1}$, $\mathbf{M}$, $\mathbf{N}$, $\mathbf{F}$ and $\mathbf{\Psi}$ as a result of experiment according to the algorithm, offered above it is possible to settle structures $\mathbf{P}^{-1}\mathbf{M}$ and $\mathbf{P}^{-1}\Psi$ of an unstable object.

A new problem and algorithms of structural identification of a steady part of object of stabilization according to its full-scale study.

Let movement of steady linear multidimensional object of the stabilization, prone to influence controllable and uncontrollable ζ, stochastic perturbation factors ψ, can be described by the set of the ordinary differential equations transformed according to Fourier, a kind

$$\mathbf{Px} = \mathbf{Mu} + \mathbf{N}\,\zeta + \phi \qquad (1)$$

Where P, M and N - unknown matrixes of dimensions, $n\times n$, $n\times m$ and $n\times l$ correspondingly, all elements of which are polynoms of argument $s = j\omega$; x-n-dimensional vector of measured signals output, u – m-dimensional vector of measured controls, ζ - l-dimensional vector of controllable indignations, ψ - n-dimensional vector of uncontrollable perturbation. It is supposed, that vectors x,u,ζ and ψ represent random, multidimensional, stationary processes, and all required non-random dynamic characteristics of vectors x,u and ζ are known due to experiment data and a stage of their primary processing; the vector ψ is beyond the reach of measurements, but its uncorrelation with a command vector u is supposed. It is also supposed that measurements of vectors x,u and ζ are made by means of special optimal observers and measurement noises are absent.

Thus, following results of the primary experiment data processing estimations of the following of spectral and mutual spectral density matrixes are received:

$$S_{xx},\ S_{uu},\ S_{\zeta\zeta},\ S_{xu},\ S_{ux},\ S_{\zeta x},\ S_{x\zeta},\ S_{u\zeta},\ S_{\zeta u} \qquad (2)$$

Using required matrixes from the series (2) by means of Wiener-Khinchin theorem [1] we shall estimate the transposed spectral and mutual spectral vectors density matrixes which are in indexes of the determined expressions.

$$\begin{aligned}\mathbf{S}'_{\mathbf{xx}} &= \mathbf{P}^{-1}\mathbf{M}\mathbf{S}'_{\mathbf{uu}}\mathbf{M}_*\mathbf{P}_*^{-1} + \mathbf{P}^{-1}\mathbf{M}\mathbf{S}'_{\zeta\mathbf{u}}\mathbf{N}_*\mathbf{P}_*^{-1} + \mathbf{P}^{-1}\mathbf{N}\mathbf{S}'_{\mathbf{u}\zeta}\mathbf{M}_*\mathbf{P}_*^{-1} + \\ &+ \mathbf{P}^{-1}\mathbf{N}\mathbf{S}'_{\zeta\zeta}\mathbf{N}_*\mathbf{P}_*^{-1} + \mathbf{P}^{-1}\mathbf{S}'_{\psi\psi}\mathbf{P}_*^{-1}\end{aligned} \qquad (3)$$

$$\mathbf{S}'_{\mathbf{ux}} = \mathbf{P}^{-1}\mathbf{M}\mathbf{S}'_{\mathbf{uu}} + \mathbf{P}^{-1}\mathbf{N}\mathbf{S}'_{\mathbf{u}\zeta} \qquad (4)$$

$$\mathbf{S}'_{\zeta\mathbf{x}} = \mathbf{P}^{-1}\mathbf{M}\mathbf{S}'_{\zeta\mathbf{u}} + \mathbf{P}^{-1}\mathbf{N}\mathbf{S}'_{\zeta\zeta} \qquad (5)$$

Where "*" - a sign of hermitian conjugate interfaces.

It is obvious, that $\mathbf{P}^{-1}\mathbf{M}$, $\mathbf{P}^{-1}\mathbf{N}$ and $\mathbf{S}'_{\psi\psi}$ in expressions (3), (4), and (5) remain unknown.

In common Solving the set of the matrix equations (4) and (5), conjointly we shall define a matrix $\mathbf{P}^{-1}\mathbf{M}$ of transfer functions of the system from controls to an output and a matrix $\mathbf{P}^{-1}\mathbf{N}$ of transfer functions of system from controllable perturbation to an output, whereupon we shall write down them in the following way.

$$\mathbf{P}^{-1}\mathbf{N} = \left[\mathbf{S}'_{\mathbf{ux}} - \mathbf{S}'_{\zeta\mathbf{x}}(\mathbf{S}'_{\zeta\zeta})^{-1}\mathbf{S}'_{\mathbf{u}\zeta}\right]\cdot\left[\mathbf{S}'_{\mathbf{uu}} - \mathbf{S}'_{\zeta\mathbf{u}}(\mathbf{S}'_{\zeta\zeta})^{-1}\mathbf{S}'_{\mathbf{u}\zeta}\right]^{-1}; \qquad (6)$$

$$\mathbf{P}^{-1}\mathbf{M} = \left[\mathbf{S}'_{\zeta\mathbf{x}} - \mathbf{S}'_{\mathbf{ux}}(\mathbf{S}'_{\mathbf{uu}})^{-1}\mathbf{S}'_{\zeta\mathbf{u}}\right]\cdot\left[\mathbf{S}'_{\zeta\zeta} - \mathbf{S}'_{\mathbf{u}\zeta}(\mathbf{S}'_{\mathbf{uu}})^{-1}\mathbf{S}'_{\zeta\mathbf{u}}\right]^{-1}. \qquad (7)$$

Substituting matrixes (6) and (7) in expression (3) and resolving it concerning a unknown matrix, we shall receive:

$$\mathbf{P}^{-1}\mathbf{S}'_{\psi\psi}\mathbf{P}_*^{-1} = \mathbf{S}'_{\mathbf{xx}} - \mathbf{P}^{-1}\mathbf{M}\mathbf{S}'_{\mathbf{uu}}\mathbf{M}_*\mathbf{P}_*^{-1} - \mathbf{P}^{-1}\mathbf{M}\mathbf{S}'_{\zeta\mathbf{u}}\mathbf{N}_*\mathbf{P}_*^{-1}\mathbf{P}^{-1}\mathbf{N}\mathbf{S}'_{\mathbf{u}\zeta}\mathbf{M}_*\mathbf{P}_*^{-1} - \mathbf{P}^{-1}\mathbf{N}\mathbf{S}'_{\zeta\zeta}\mathbf{N}_*\mathbf{P}_*^{-1} \qquad (8)$$

Supposing, that the image of a vector ψ of uncontrolled perturbations can be presented through unknown structure of the filter, which forms a vector from a vector of "white" unit noises like.

$$\psi = \Psi\Delta \tag{9}$$

Having substituting on expression (9) in the structure (8) and making factorization received expression according to Davis [1] we shall define a matrix of transfer functions of object from a vector Δ to an output like

$$\mathbf{P}^{-1}\mathbf{\Psi} = \left[\mathbf{S}'_{\mathbf{xx}} - \mathbf{P}^{-1}\mathbf{M}\mathbf{S}'_{\mathbf{uu}}\mathbf{M}_*\mathbf{P}_*^{-1} - \mathbf{P}^{-1}\mathbf{M}\mathbf{S}'_{\zeta\mathbf{u}}\mathbf{N}_*\mathbf{P}_*^{-1}\mathbf{P}^{-1}\mathbf{N}\mathbf{S}'_{\mathbf{u}\zeta}\mathbf{M}_*\mathbf{P}_*^{-1} - \mathbf{P}^{-1}\mathbf{N}\mathbf{S}'_{\zeta\zeta}\mathbf{N}_*\mathbf{P}_*^{-1}\right]_+ \tag{10}$$

where a symbol "+" - a sign of expressions factorization (8).

Knowing matrixes (6), (7) and (10), it is possible to rewrite the desired equation of motion (1) in the following way

$$\mathbf{x} = \mathbf{P}^{-1}\mathbf{M}\mathbf{u} + \mathbf{P}^{-1}\mathbf{N}\zeta + \mathbf{P}^{-1}\mathbf{\Psi}\mathbf{\Delta} \tag{11}$$

Equation of motion in the form of (11) is made up unambiguously. Representing the equation (11) in the form of (1), it is possible to receive a number of "equivalent" sets of the differential equations, an investigated objects describing dynamic.

The special case of the problem is back of controlled perturbation. it is obvious, that the algorithm of structural identification in that case looks as follows:

$$\mathbf{P}^{-1}\mathbf{M} = \mathbf{S}'_{\mathbf{ux}}(\mathbf{S}'_{\mathbf{uu}})^{-1}\,; \tag{12}$$

$$\mathbf{P}^{-1}\mathbf{\Psi} = \left[\mathbf{S}'_{\mathbf{xx}} - \mathbf{S}'_{\mathbf{ux}}(\mathbf{S}'_{\mathbf{uu}})^{-1}\mathbf{S}'_{\mathbf{xu}}\right]^{+}, \tag{13}$$

And the equation of motion of a kind (11) will become:

$$\mathbf{x} = \mathbf{P}^{-1}\mathbf{M}\mathbf{u} + \mathbf{P}^{-1}\mathbf{\Psi}\mathbf{\Delta}. \tag{14}$$

Some results of experimental researches of the helicopter with the cargo suspension bracket under the hovering conditions with the purpose of structural identification of the dynamics models.

Within the limits of the report it is difficult to cover all aspects of the primary processing and (structural identification) of the navigating information received during the experimental researches of helicopter Mi-8 with a cargo suspension bracket under the hovering conditions.

In the report text just some results and conclusions, rather significant in our opinion and concern structural identification of both dynamic behavior of stochastic signals "input-output" vectors helicopter Mi-8 with a cargo suspension bracket, and models of dynamics of the helicopter with a cargo suspension bracket and the uncontrolled stochastic influences acting on it in under the hovering conditions will be presented.

The sufficient extent of actual observations and actual results of test is partially presented in presentation report materials. On the basis of the lead experimental researches and estimations of efficiency of the developed structural identification algorithms it is possible to draw following conclusions and guidance's:

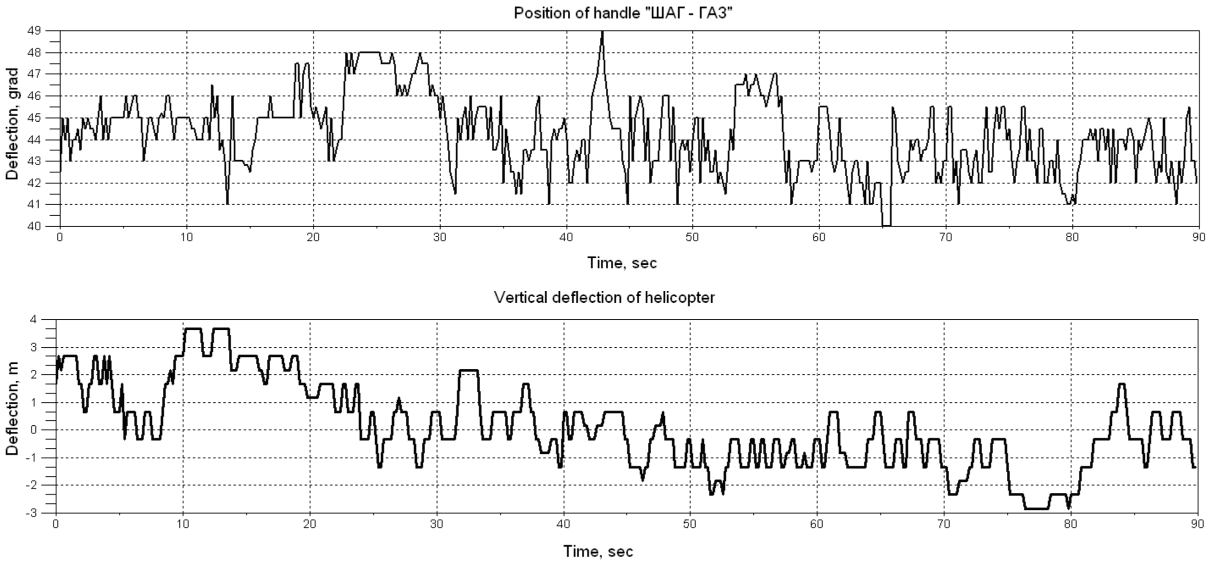
Tab.1 Analytical a designation of mutual factors correlation

$$\begin{bmatrix}
1 & \mu_{\delta_\gamma\delta_\vartheta} & \mu_{\delta_\varphi\delta_\vartheta} & \mu_{\delta_g\delta_\vartheta} & \mu_{\vartheta_g\delta_\vartheta} & \mu_{\gamma_g\delta_\vartheta} & \mu_{x\delta_\vartheta} & \mu_{y\delta_\vartheta} & \mu_{z\delta_\vartheta} & \mu_{\vartheta\delta_\vartheta} & \mu_{\gamma\delta_\vartheta} & \mu_{\varphi\delta_\vartheta} \\
\mu_{\delta_\vartheta\delta_\gamma} & 1 & \mu_{\delta_\varphi\delta_\gamma} & \mu_{\delta_g\delta_\gamma} & \mu_{\vartheta_g\delta_\gamma} & \mu_{\gamma_g\delta_\gamma} & \mu_{x\delta_\gamma} & \mu_{y\delta_\gamma} & \mu_{z\delta_\gamma} & \mu_{\vartheta\delta_\gamma} & \mu_{\gamma\delta_\gamma} & \mu_{\varphi\delta_\gamma} \\
\mu_{\delta_\vartheta\delta_\varphi} & \mu_{\delta_\gamma\delta_\varphi} & 1 & \mu_{\delta_g\delta_\varphi} & \mu_{\vartheta_g\delta_\varphi} & \mu_{\gamma_g\delta_\varphi} & \mu_{x\delta_\varphi} & \mu_{y\delta_\varphi} & \mu_{z\delta_\varphi} & \mu_{\vartheta\delta_\varphi} & \mu_{\gamma\delta_\varphi} & \mu_{\varphi\delta_\varphi} \\
\mu_{\delta_\vartheta\delta_g} & \mu_{\delta_\gamma\delta_g} & \mu_{\delta_\varphi\delta_g} & 1 & \mu_{\vartheta_g\delta_g} & \mu_{\gamma_g\delta_g} & \mu_{x\delta_g} & \mu_{y\delta_g} & \mu_{z\delta_g} & \mu_{\vartheta\delta_g} & \mu_{\gamma\delta_g} & \mu_{\varphi\delta_g} \\
\mu_{\delta_\vartheta\vartheta_g} & \mu_{\delta_\gamma\vartheta_g} & \mu_{\delta_\varphi\vartheta_g} & \mu_{\delta_g\vartheta_g} & 1 & \mu_{\vartheta_g\gamma_g} & \mu_{x\vartheta_g} & \mu_{y\vartheta_g} & \mu_{z\vartheta_g} & \mu_{\vartheta\vartheta_g} & \mu_{\gamma\vartheta_g} & \mu_{\varphi\vartheta_g} \\
\mu_{\delta_\vartheta\gamma_g} & \mu_{\delta_\gamma\gamma_g} & \mu_{\delta_\varphi\gamma_g} & \mu_{\delta_g\gamma_g} & \mu_{\gamma_g\vartheta_g} & 1 & \mu_{x\gamma_g} & \mu_{y\gamma_g} & \mu_{z\gamma_g} & \mu_{\vartheta\gamma_g} & \mu_{\gamma\gamma_g} & \mu_{\varphi\gamma_g} \\
\mu_{\delta_\vartheta x} & \mu_{\delta_\gamma x} & \mu_{\delta_\varphi x} & \mu_{\delta_g x} & \mu_{\vartheta_g x} & \mu_{\gamma_g x} & 1 & \mu_{yx} & \mu_{zx} & \mu_{\vartheta x} & \mu_{\gamma x} & \mu_{\varphi x} \\
\mu_{\delta_\vartheta y} & \mu_{\delta_\gamma y} & \mu_{\delta_\varphi y} & \mu_{\delta_g y} & \mu_{\vartheta_g y} & \mu_{\gamma_g y} & \mu_{xy} & 1 & \mu_{zy} & \mu_{\vartheta y} & \mu_{\gamma y} & \mu_{\varphi y} \\
\mu_{\delta_\vartheta z} & \mu_{\delta_\gamma z} & \mu_{\delta_\varphi z} & \mu_{\delta_g z} & \mu_{\vartheta_g z} & \mu_{\gamma_g z} & \mu_{xz} & \mu_{yz} & 1 & \mu_{\vartheta z} & \mu_{\gamma z} & \mu_{\varphi z} \\
\mu_{\delta_\vartheta\vartheta} & \mu_{\delta_\gamma\vartheta} & \mu_{\delta_\varphi\vartheta} & \mu_{\delta_g\vartheta} & \mu_{\vartheta_g\vartheta} & \mu_{\gamma_g\vartheta} & \mu_{x\vartheta} & \mu_{y\vartheta} & \mu_{z\vartheta} & 1 & \mu_{\gamma\vartheta} & \mu_{\varphi\vartheta} \\
\mu_{\delta_\vartheta\gamma} & \mu_{\delta_\gamma\gamma} & \mu_{\delta_\varphi\gamma} & \mu_{\delta_g\gamma} & \mu_{\vartheta_g\gamma} & \mu_{\gamma_g\gamma} & \mu_{x\gamma} & \mu_{y\gamma} & \mu_{z\gamma} & \mu_{\vartheta\gamma} & 1 & \mu_{\varphi\gamma} \\
\mu_{\delta_\vartheta\varphi} & \mu_{\delta_\gamma\varphi} & \mu_{\delta_\varphi\varphi} & \mu_{\delta_g\varphi} & \mu_{\vartheta_g\varphi} & \mu_{\gamma_g\varphi} & \mu_{x\varphi} & \mu_{y\varphi} & \mu_{z\varphi} & \mu_{\vartheta\varphi} & \mu_{\gamma\varphi} & 1
\end{bmatrix}$$

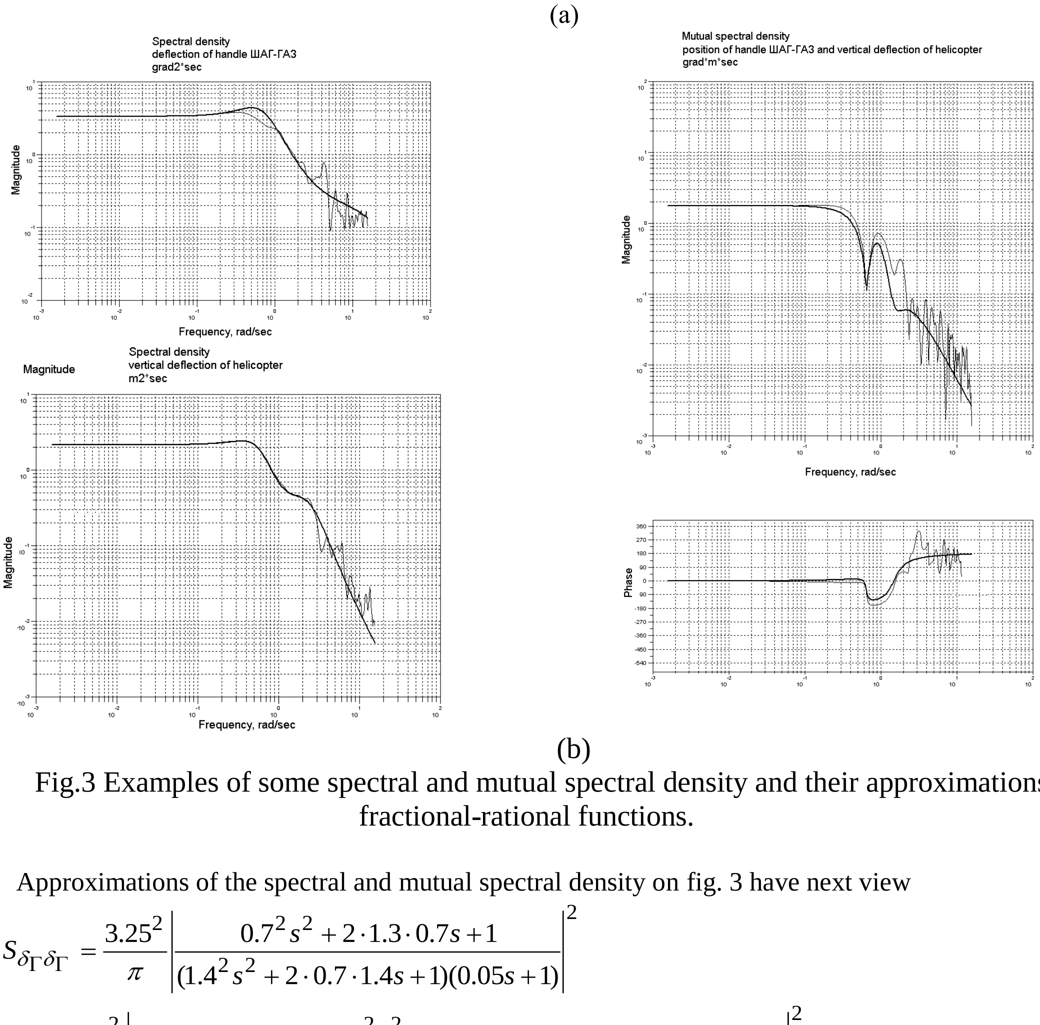
Tab.2 Value of factors of mutual correlation of the registered parameters

1.	0.078	0.316	0.74	0.444	0.265	0.568	0.359	0.486	0.203	0.234	0.172
0.078	1.	0.314	0.297	0.079	0.137	0.167	0.202	0.29	0.057	0.021	0.186
0.316	0.314	1.	0.304	0.31	0.822	0.561	0.257	0.357	0.156	0.469	0.119
0.74	0.297	0.304	1.	0.131	0.363	0.453	0.222	0.379	0.071	0.593	0.067
0.444	0.079	0.31	0.131	1.	0.494	0.045	0.217	0.1	0.555	0.378	0.387
0.265	0.137	0.822	0.363	0.494	1.	0.35	0.259	0.145	0.179	0.657	0.215
0.568	0.167	0.561	0.453	0.045	0.35	1.	0.049	0.917	0.12	0.292	0.032
0.359	0.202	0.257	0.222	0.217	0.259	0.049	1.	0.057	0.375	0.178	0.18
0.486	0.29	0.357	0.379	0.1	0.145	0.917	0.057	1.	0.043	0.092	0.02
0.203	0.057	0.156	0.071	0.555	0.179	0.12	0.375	0.043	1.	0.246	0.227
0.234	0.021	0.469	0.593	0.378	0.657	0.292	0.178	0.092	0.246	1.	0.253
0.172	0.186	0.119	0.067	0.387	0.215	0.032	0.18	0.02	0.227	0.253	1.

This results exert influence on change of classic notion upon characters of helicopter with a cargo suspension vectors "input-output" correlation.



(a)



(b)

Fig.3 Examples of some spectral and mutual spectral density and their approximations by is fractional-rational functions.

Approximations of the spectral and mutual spectral density on fig. 3 have next view

$$S_{\delta_\Gamma \delta_\Gamma} = \frac{3.25^2}{\pi} \left| \frac{0.7^2 s^2 + 2 \cdot 1.3 \cdot 0.7s + 1}{(1.4^2 s^2 + 2 \cdot 0.7 \cdot 1.4s + 1)(0.05s + 1)} \right|^2$$

$$S_{yy} = \frac{2.6^2}{\pi} \left| \frac{1.0^2 s^2 + 2 \cdot 0.7 \cdot 1.0s + 1}{(0.6^2 s^2 + 2 \cdot 0.7 \cdot 0.6s + 1)(2.5^2 s^2 + 2 \cdot 0.6 \cdot 2.5s + 1)(0.3s + 1)} \right|^2$$

$$S_{\delta_\Gamma y} = 0.66 \frac{3.25 \cdot 2.6}{\pi} \frac{(0.6^2 s^2 - 2 \cdot 0.05 \cdot 0.6s + 1)(1.4^2 s^2 + 2 \cdot 0.26 \cdot 1.4s + 1)^2}{\left| (0.9^2 s^2 + 2 \cdot 0.7 \cdot 0.9s + 1)(1.1^2 s^2 + 2 \cdot 0.5 \cdot 1.1s + 1) \right|^2}$$

The conclusion:

1. Having traditional means of stabilization of the helicopter with a cargo suspension bracket, it is impossible to secure the so-called "rigid" stabilization of the helicopter in space and in orientation. Stabilization errors have stochastic character, and their random components, which actually limit echelons of stabilization accuracy, reach significant values. Presentation materials visually illustrate foregoing.

It is obvious, that the new optimum regulating systems created on the basis of modern stochastic information processing technologies are necessary for suppression of random influences on object of stabilization, which a certainly exist.

2. In authors of the report opinion, the fact of strong mutual correlation of all synchronously fixed navigation parameters of the helicopter and a cargo (see the coefficient of parameters cross-correlation table), cleared-up during experimental researches of the helicopter is very important. This case sharply changes traditionally prevalent idea of so-called "strong" and "weak" interrelations between coordinates of the object of stabilization and certainly should tell on the principles of a partition of the general objects dynamics model under an investigated traffic conditions on partial models with the purpose of simplification of the subsequent procedures of synthesis of regulating system, which use received models.

3. At the stage of structural identification and the subsequent synthesis regulating system of optimal structure it is expedient to use all received information on investigated navigation parameters, i.e. all set of matrixes of spectral and mutual spectral planes of vectors of objects stochastic signals "input-output" for ensuring the maximum precision frontiers object stabilization. It is obvious, that this case will require essential correction of computational procedures of identification and synthesis, used at present.

4. If supposing, that mutual correlations of parameters are small, in view of that the coefficient of cross-correlation is $<0{,}25$ then the general model of dynamics of the stabilize helicopter can be dismembered on two partial: the model, corresponding to a subsystem, respondent for the control of the center there helicopter's mass only by means of control elements(the special case of the structural identification algorithm offered in the report is used); the model of a subsystem, respondent for orientation control, results of which on the influence of both displacement of control elements, and nature of a cargo oscillations(the structural identification algorithm represented in the report should be used).

5. Science-based and convenient in practical application technology of structural identification of models of dynamics of stabilized object and the stochastic perturbation acting on is offered it. This technology allows to operate effectively at the stage of structural identification of models of complex objects dynamic according to full-scale study of the prototype of object under the interesting traffic conditions.

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