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SUPPORT SYSTEMS FOR DECISION AND NEGOTIATION PROCESSES

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Editors:

Roman Kulikowski
Zbigniew Nahorski
Jan W.Owsiński
Andrzej Straszak

Systems Research Institute
Polish Academy of Sciences
Warsaw, Poland

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OPTIMIZATION OF COMPUTERIZED SUPPORT SYSTEMS

Anatoly Kolesnikov
Head of the Department of
Control Systems

Anatoly Gaiduk
Prof. of the Department of
Control Systems

Taganrog Radioengineering Institute
44 Nekrasovskiy 347915, Taganrog
USSR

Abstract: The new original approach to optimization of computerized support systems for decision making, which is based on the introduction of the special functional in the optimized criteria and the desired attractors in the state space of the design system is suggested.

Keywords: Computer, support system, optimization, decision making, criteria, functional, state space.

1. Introduction

The support system for decision making become all more widespread present day. Especially it concerns the computerized support systems. These systems are used in different spheres of the human activity: manufacturing, planing, madicine and so on.

The efficiency of the computerized support systems depends upon the structure and parameters. Therefore in each concrete case there are the best or optimal structure and parameteres values of the support systems.

One of an important problem of the decision making process is the problem to calculate value of the criteria for the considering alternatives. The problem consists in that measuring variables of the checking process are known with some deviation that leades to the indefinite. To withdraw this indefinite it is necessary exclude the influence of the prevent factors. But practically it is impossible. In reality we can obtine only the optimal estimate of the interesting for us criteria.

In report the regular analitical algorithm to determine the structure and parameteres value of the optimal computerized support system, that formes information about values of the criteria for the decision making person. Basic property of the proposed algorithm consist in that the optimal support system always obtained realizable.

2. The Main Result.

Assume the checking bargaining, economic or another process is described by differential system

$$\dot{x}(t)=Px(t)+h_1 g(t)+h_2 f(t), \qquad (1)$$

$$v(t)=c^T x(t)+b_1 g(t)+b_2 f(t), \qquad (2)$$

where x(t) - state n - vector; G - nxn - numerical matrix; h_1, h_2, c - n-numerical vectors; b_1, b_2 - scalars, g(t) - useful factor, f(t) - disturbance; v(t) - measuring variable.

Functions g(t) and f(t) in (1), (2) are the random process with the Gaussian distribution. Them mathematical models are next:

$$\dot{x}_1(t)=Gx_1(t)+h_3w(t), \tag{3}$$

$$g(t)=c_3^Tx_1(t)+b_3w_3(t), \tag{4}$$

$$\dot{x}_2(t)=Fx_2(t)+h_4w_4(t), \tag{5}$$

$$f(t)=c_4^Tx_2+b_4w_4(t), \tag{6}$$

where $w_i(t)$ - unit white noize with $E\{w_i\}=0$; G,F,h_i,c_i,b_i -numerical matrixes, vectors and scalars, $i=3,4$; $x_i(t)$-state vectors, $i=1,2$.

The unknown criteria of the checking process is determined by the differential systems (1),(2) when disturbance $f(t)\equiv0$ and some the state variables of the support system $x_{i\,o}=0$, $i\in[1,n]$. Let $\upsilon_o(t)$ is the criteria value. Since $\upsilon(t)$ is measured on $f(t)\not\equiv0$ the support system is intended to reconstract the signal $\upsilon_o(t)$ from $\upsilon(t)$. Therefore the support system in this case can be design as the optimal estimator, which minimaze the dispersion $E\{(\upsilon_o(t)-\hat{\upsilon}_o(t))^2\}$ of the difference $\upsilon_o(t)-\hat{\upsilon}_o(t)$. Here $\hat{\upsilon}_o(t)$ - the estimate of the criteria $\upsilon_o(t)$.

To design this system introduce the special functional define on the impuls responce of the designing system into the optimized criteria. This functional connect with desired attractors in the state space (Kolesnikov A.1987).

In the result the criteria is the form:

$$J = E\{(\upsilon_o(t)-\hat{\upsilon}_o(t))^2\} + \lambda^2\int_0^\infty|K^{(q)}(t)|^2dt, \tag{7}$$

where K(t) - impuls responce of the support system and $K^{(q)}(t)$- its q-th derivative.

Then consider the optimization problem to find an optimal $K_o(t)$ thach that criteria $J \rightarrow \min$ and $E\{(\upsilon_o(t) - \hat{\upsilon}_o(t))\} \rightarrow \min$.

The property of result system depend on parameters of the equations (1) - (6), order of the derivative $K^{(q)}(t)$ and value of the parameter $\lambda \geq 0$.

If $\lambda \neq 0$ and

$$q=i^{*}-1, \qquad (8)$$

where i^{*}- desired value index of the design system, then optimal system will be physically realized and it's index equales i^{*}. The optimal support system is described by equations

$$\dot{z}(t)=Dz(t)+h\upsilon(t), \quad \hat{\upsilon}_o(t)=k^{T}z(t). \qquad (9)$$

Coefficients of the matrix D, and vectors h, k are calculated by solution of the linear algebraic system (Gaiduk A. 1988)

$$M(\lambda)l = p(\lambda) \qquad (10)$$

where matrix $M(\lambda)$ and vector $p(\lambda)$ are calculated on parameters of the systems (1) - (6).

Expressions (7), (8), (10) give possibility analitically to obtain of the realizable optimal computerized support system (9) when external factors of the checking process are random process.

Example.

Let any person for make decision must know the goods cost, which fluctuates about constant value in random way. By the buying there are the addition random tipe spendings. This situation can be described by the differential system (1), (2), where $h_1 = h_2 = 0$, $b_1 = b_2 = 1$,

$$P = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & -0,395 \\ 0 & 1 & 0 \end{bmatrix}, \qquad c = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}.$$

Factors g(t) and f(t) are described by equation (3) - (6), where:
$G=[-4]$; $h_3 = c_3 = 1$; $b_3 = b_4 = 0$

$$F = \begin{bmatrix} 0 & -100 \\ 1 & 0 \end{bmatrix}, \qquad h_4 = \begin{bmatrix} 0,8 \\ 0 \end{bmatrix}, \qquad c_4 = \begin{bmatrix} 0 \\ 1 \end{bmatrix}.$$

In this case $q=3$, $\lambda_0 = 0,314$ and the system (10) has form

$$\begin{bmatrix} 39,5 & 0 & 0 & 0 & 0 & 0 \\ 0,395 & 39,5 & 4 & 0 & 0 & 0 \\ 100 & 0,395 & 1 & 4 & 0 & 0 \\ 1 & 100 & 0 & 1 & 4 & 0 \\ 0 & 1 & 0 & 0 & 1 & 4 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} l_0 \\ l_1 \\ l_2 \\ l_3 \\ l_4 \\ l_5 \end{bmatrix} = \begin{bmatrix} 100 \\ 240 \\ 288 \\ 186 \\ 33 \\ 0,314 \end{bmatrix}.$$

The solution of this system leads to the optimal state variable equation of the optimal support system:

$$\dot{z}(t)=\begin{bmatrix} 0 & 0 & 0 & 0 & -318 \\ 1 & 0 & 0 & 0 & -764 \\ 0 & 1 & 0 & 0 & -917 \\ 0 & 0 & 1 & 0 & -592 \\ 0 & 0 & 0 & 1 & -105 \end{bmatrix} z(t) + \begin{bmatrix} 318 \\ 83 \\ 809 \\ 204 \\ 2 \end{bmatrix} y(t),$$

$$\hat{\upsilon}_0(t)=[\ 0 \quad 0 \quad 0 \quad 0 \quad 1\ ]z(t).$$

This system estimates the variables υ_0 of the checking process with dispersion error 0.088.

3. References.

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