THE COMPUTER SYSTEM FOR THE ESTIMATION OF THE REALIZABILITY OF THE CREW ACTIVITY ALGORITHMS

Boris Fedunov, Denis Vidruk

Abstract. When designing specification on-board algorithm (the algorithm, realized on on-board digital computing machine, and algorithm to activity of the crew necessary to conduct the estimation their realizing. Presented computer system allows in interactive mode with user to value the temporary expenseses of the operator on processes decision making and their realizing, participations it in process of the spying.

Key words: the algorithms to activity of the crew, designing algorithm, realizing estimation.

ACM Classification Keywords: B.8.2 Performance Analysis and Design Aids; D.2.2 Computer-aided software engineering.

Introduction

During system designing of anthropocentric object onboard intelligence algorithms specifications, designers face with necessity of defined algorithms structure realization opportunity check. The algorithms of onboard intelligence intended for realization through algorithms of a crew member activity (CAA – crew activity algorithms) are estimated through their performance time interdictions. Correlation of the defined expenses with ones allowable on external conditions projected anthropocentric object will function, allows to determine the realizability of CCA designed structure. During system designing of onboard intelligence algorithms, operator activity algorithms are represented as the earl (ODE – operator decisions earl), which apexes are decisions accepted by the operator, the beginning and the end of tracking stages, and arcs – causal relation of apexes [1,2]. Computer system «GRO-otsenka» is developed for automation CAA structure estimation process. It is intended for use in designing system of anthropocentric object onboard algorithms of system-forming kernel specifications at a stage of development of their specification.

The technology onboard algorithms specifications development includes the following stages:

A) Development of naturally language technical document «crew – the onboard equipment» system logic». The text of the document is usually structured on typical situations (TS) of functioning of projected anthropocentric object and their problem subsituations. [3];

B) Onboard algorithms specifications development, including the algorithms intended for realization on onboard digital computers (ODCA), and algorithms of crew activity (CAA). The design stage is supported by computer system "Bort" [4];

C) An estimation of onboard algorithms designed specification realizability:

ODCA - by the onboard digital computing system.

CAA - by crew for set time.

The stage is provided with «GRO-otsenka» and «BTsVS - otsenka» computer systems

D) Estimation of onboard algorithms developed specification efficiency.

The stage is provided with system of computer-imitating mathematical models [5] of anthropocentric objects functioning typical situations (see for example [6,7]) and imitating mathematical model of algorithms of aim prediction operative level [1,5] in which the crew is necessarily involved.

Described computer system «GRO-otsenka» works in coordination with the mentioned above computer systems. It receives the information from computer system "Bort"in the coordinated format and prepares the initial data [8]

for designed CAA interpretation in the computer-imitating mathematical models [5] of anthropocentric objects functioning typical situations.

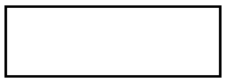
«GRO-otsenka» system represents the computer integrated environment of an estimation operators decisions earl, containing the interface of the designer, dialogue procedures for an estimation, completeness check procedures and a coordination of the data, procedures of an realizability estimation, estimation process support procedures.

Structure of the activity of operator in the technical anthropocentric object

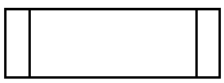
In the anthropocentric object the operator makes decisions by the operationally appearing problem, it realizes the decisions accepted and participates in different operations of tracking [9 - 13]. All decisions of operator are classified as the π-decisions (perceptive- identification), the ρ-decisions (speech-thought) and the π-ρ-decisions (heuristic) [9,13]. The class of the π-decisions is characterized only by search time, perception (quantity of operational units of perception (OUP)) and comprehension by the operator of necessary information. The process of decision making occurs instantly. Each ρ-decision with the design of the activity of operator is described through the composition of information, on the basis of which the operator must make this decision, also, through the algorithm of decision making. Each decision is described:

- by the input information: the composition of information in the information-control field of cab, on which the operator must make this decision; composition and the duration of voice communication, which is transferred to operator by cabin vocal informant and which is used with making of this decision;
- by the structure of the decision: a quantity of operational units of perception (OUP), composition and the sequence of the elementary acts of decisions working out, represented by the indicative symbolism on the personnel cabin indicators;
- by output information: by composition and by the sequence of manual operations, necessary for the realization of the accepted decision.

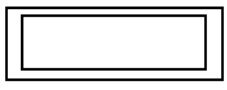
With the fulfillment of the operations of tracking it is assumed, what operator works in discretely - continuous regime, being distracted from the operation of tracking to the period of adoption and realization of the decision (decisions). After abstraction the operator again returns to the process of tracking. In this case the composition and the description of dynamic is sectional this servo system in the stage of design in question they are absent. There is only an idea about the dependence of the time of finalizing by the operator (τ-tracking) of that accumulating in the time of its abstraction (τ-otv) of following error. According to the developed requirements each apex of ODE represented for the estimation can belong to one of the established types (table 1):



Rectangles designate the algorithms of decision making with the indication of the type of decision (the π-decision, the ρ-decision, π-ρ-the decision). Each CAA-decision is always accompanied by the fragment of sequence information on the control indicators (it is possible vocal information, on which decision is chosen).



The apex with the appropriate number, designating the accepted decision algorithms of realization by the operator. Each CAA-realization is compulsorily accompanied by indication of the utilized elements of control and their arrangement or by indication of their generalized description.



Place of the replacement of the conceptual model of the operator behavior

Types of apexes are given below do not contribute time expenditures, in the general time estimation.

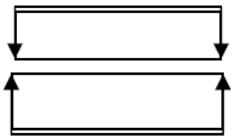
	The apex designating branching in ODE. It contains logical conditions for the actions of operator. It has two outputs: truth and lie.
	Apexes designating algorithms participations of operator in the work of tracking system, accordingly beginning and the end of the tracking.
(+)	Marker is placed on the arcs of earl in those places, where in the opinion of the developer of earl, operator can be distracted to the realization of the operation of tracking.

Table 1: Apexes types.

The apexes of earl CAA-decision and CAA-realization are characterized by time, operator spent for perception, comprehension, the production of decisions and fulfillment of manual operations. Apex, corresponding to the replacement of the conceptual model of the operator behavior, is characterized by the time of the replacement of this model. Between the apexes there are causal relationships (on the earl depicted as arcs). The beginning of the operator actions must be an operation of tracking, located in the root of earl; the activity of operator is turned from the root apex to the final (operation of tracking). The earl is represented with the treelike structure (one beginning, many ends).

The ODE "+" marker indicates the places of the possible (on semantics) distraction of operator to the process of tracking.

All apexes of the CAA type must be accompanied by information, on which with the aid of the experimental data, existing in the system «GRO-otsenka», the time of apex is determined. It is necessary to afford screen of control indicators. on the basis of which data, necessary for the description CAA will be compiled. Apex, designating the beginning of tracking, must be accompanied by table or earl of the dependence of the correction time on the distraction time

$$(\tau_{cor} = f(\tau_{dist})).$$

System Characteristic

«GRO-otsenka» system is intended for the automation of the evaluation process of the operator decisions earl realization. On the basis of data, entered manually by design engineer or exported from the system "Bort", «GRO-otsenka» system calculates ODE in the dialogue with design engineer:

- time, which operator will expend on decision making (CAA apexes), on its realization (CAA-R apexes), the replacement of the conceptual model of behavior;
- the arrangement (among the permissible points) of the points of the operator optimum switch to the tracking regime.

According to this information «GRO-otsenka» system calculates time (of each branch of the introduced operator decisions earl) spent by operator on all forms of its activity, indicated on this branch, and the mean-square deviation of this time. Such calculations are done for each branch of earl and on any selected sections inside any branch.

System automatically determines the ODE bottlenecks and exports the estimation results of the introduced earl for further processing in other programs.

Regimes of the design engineer work in the «GRO-otsenka» system.

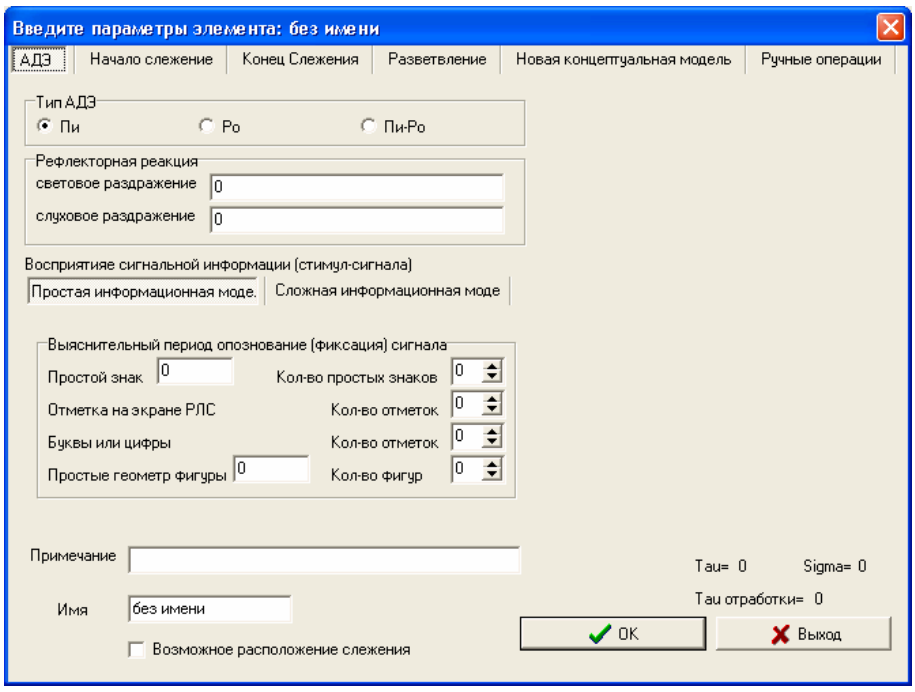
After the entering ODE into «GRO-otsenka» system the design and planning engineer fixes his attention in the concrete apex of ODE and selects the type of this apex from the following:

1. «АДЭ» – this type of apex is used for indication of the of crew activity algorithm.
2. «Начало слежения» - this type of apex is used for the indication of the beginning of the tracking operation.
3. «Конец слежения» - this type of apex is used for the indication of the ending of the tracking operation.
4. «Разветвление» - this type of apex is used for indication of branching.
5. «Новая концептуальная модель» - this type of apex is used for the indication of a conceptual model change.
6. «Ручные операции» - this type of apex is used for the indication of manual actions realization of the crew CAA-R.

Depending on the type of the selected apex, the corresponding supplementary sheet with its parameters is opened. There are parameters common for all types of earl apexes: "Имя" – name of the apex, "Примечание" - text field for any note for this apex, and the "Возможное расположение слежения" checkbox, which is placed in such a case of finalizing the deviation of the tracking parameters is possible after current of apex.

«АДЭ» apexes type.

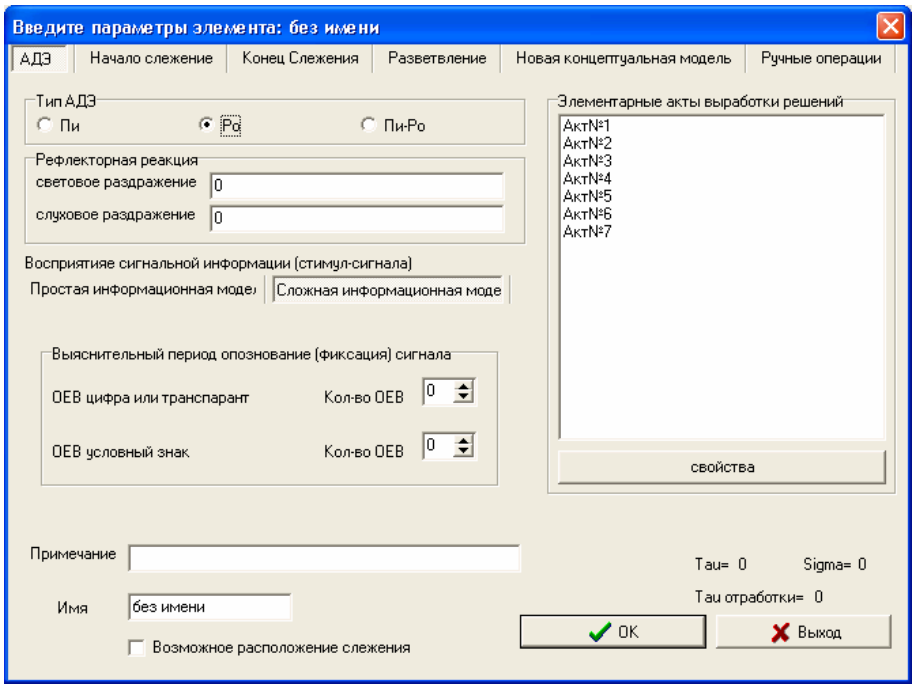
If «АДЭ» apex is selected, design engineer should select the type of the solution is used in this case. There are three accessible types: "π - decision", "ρ - decision" and " π-ρ decision" (page 1).



Page 1: Properties window of earl apexes.

When π-decision is selected, the edit fields for the data being entered according the estimation procedure of operator time expenditures [8] are available.

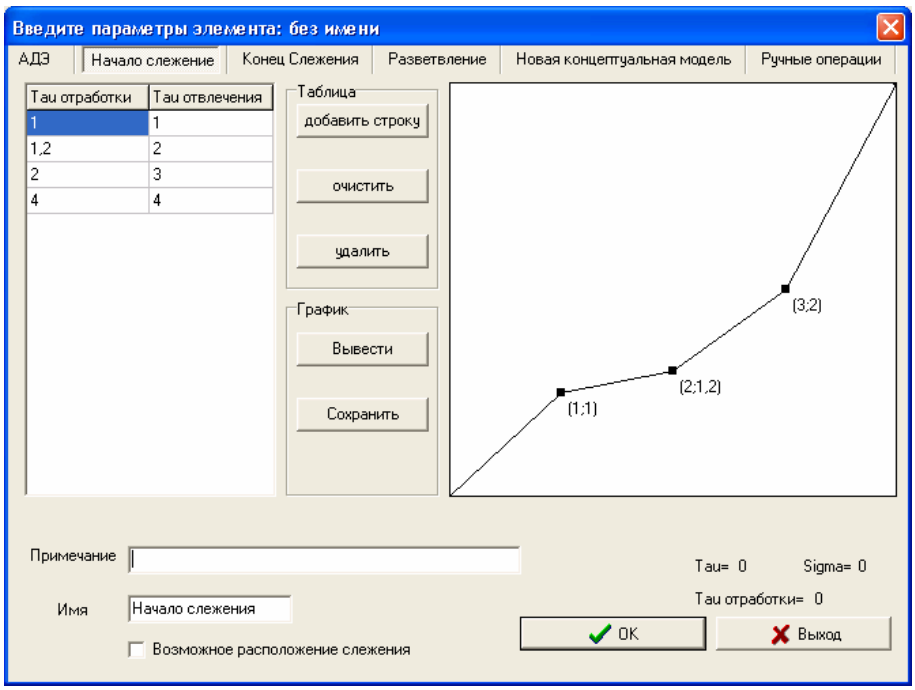
When ρ-decision is selected, the edit fields for the data being entered according the estimation procedure of operator time expenditures [8] are available (page 2).



Page 2: Estimation of CAA ρ -decision.

"Elementary reports of working out decisions" data sheet is also available.

When π-ρ-decision is selected the edit field for entering the time, spent on this decision, which is taken from the appropriate half-scale simulation.



Page 3: The beginning of the tracking operation.

«Начало слежения» apexes type.

When this type of apex is selected, the edit table for entering the dependence of the finalizing time on the time of abstraction for the tracking is available (page 3).

With the "добавить строку" button it is possible to add new line into the table. Button "удалить" makes it possible to remove line from the table. Button "очистить" removes all lines from the table.

Also there is a button "Вывести", which makes it possible to represent earl and button "сохранить" which allows to save earl as a graphic file.

«Конец слежения» apexes type.

This type of apex indicates that the tracking is finished. This type of ODE apex is logical and influences only the calculation of branches, without making changes in the results of time expenditures calculations.

«Разветвление» apexes type.

This type of apex indicates branching of the earl. This type of ODE apex is logical and influences only the calculation of branches, without making changes in the results of time expenditures calculations.

«Новая концептуальная модель» apexes type.

This type of apex indicates the change of conceptual model. This type of apex does not have parameters influencing the calculating results. The time of the change of conceptual model of operator behavior is equal of 1.2sek by default [13].

«Ручные операции» (CAA-R) apexes type.

This apex indicates realization of the accepted decision. Design engineer should manually fulfill the corresponding table (name of each manual operation and the time needed for it).

«Новая операция» button adds a new operation string into the table. «Удалить» button deletes selected operation string. «Очистить» button clears all the table.

Calculation of the earl parameters.

It is necessary to be convinced that the earl is built correctly. This checking is produced by looking through entered ODE with visual monitoring of the following positions:

1. The first apex of earl must have a type "Новое слежение".
2. All apexes with the type "Новое слежение" must have the filled table of tracking.
3. The last apex of earl must have a type "Конец слежения".
4. Cycles are not admitted in the earl - they must be opened to corresponding branches.
5. If the apex of graph is branching off and does not have the «Разветвление» type all apexes on the branch "no" they would not be considered in the calculations.
6. If the apex of graph has the «Разветвление» type and does not have the appropriate branches only existing branches ODE would be considered in the calculations.

If some of requirements for the earl are not fulfilled the system will give out the corresponding warning. For calculating of the earl parameters the «Пересчитать ветки» button should be pressed. ODE branches will be calculated with the time needed for their fulfillment (including the time spent on finalizing of tracking) and its mean-square deviation. Parameters of branch can be examined after selecting it in the menu of the «Параметры ветки» division. System also provides the verification of the assigned time limitations in the section of ODE branch.

Conclusion

The "GRO-otsenka" computer system allows to solve the problems of the realizability evaluating of designed ODE in the early stage of the onboard algorithms design. It significantly facilitates the task of ODE realizability evaluating, it makes it possible to obtain the result of estimation and the corresponding information immediately. The "GRO-otsenka" system has comfortable interface and sufficient execution speed (for the solution of the problems of this level). It is oriented as to manual input of initial data, so to obtaining of them directly from the "Bort" system.

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