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DEVELOPMENT OF THE APPARATUS FOR THE FORMATION OF KNOWLEDGE ABOUT THE AIR ENEMY

The article deals with methods of obtaining knowledge about an air enemy. An analysis is made of the characteristics of enemy air assets on the basis of data coming from diverse sources of information. Logical-linguistic descriptions of particular generalized characteristics of air objects are considered in more detail. Based on the obtained logical expressions of the rules for deriving generalized characteristics of air objects, a network model of the process of obtaining generalized characteristics of air objects is construcklkljkjted, which allows to visualize the entire process. A method of representing a priori knowledge is proposed.

Keywords: *formalization apparatus, generalized characteristic, network model, airborne object, radar information.*

Introduction

The basis of representing knowledge about an air enemy is understood as a set of methods, means, forms and structural models, displaying and formalization of this knowledge. Therefore, it is necessary to analyze existing sources like methods and forms of knowledge acquisition and knowledge presentation, model construction for the process of obtaining generalized characteristics (GC) of air objects (AO) which is based on the knowledge about an enemy with his special features, and development of the rules of specified characteristics. As it is known, [1] objective knowledge can be structured and characterized in a required form after a relevant analysis. As a rule, subjective knowledge is incomplete, abrupt and poorly structured [1]. For this reason subjective knowledge acquisition is considered to be the most laborious task for developer of knowledge base (cognitilogist). There are three methods of cognitologist's interaction with professional experts: protocol analysis, interview and game imitation of professional activities. Interview stage is necessary for all three methods of getting knowledge from experts. It makes the interview stage one of the most important methods of knowledge acquisition [2; 7].

Literature route. To formalize knowledge there are several models are used [4–5]. They are: logic models, frame-based models, production models, artificial neural networks, semantic networks.

Procedures of choosing knowledge model and building of formalization of knowledge are partially represented in works [4–5]. It means that in these works according to formalization of knowledge cognitologist uses one knowledge model and adapts expert's knowledge to it. Common use of models is meant by default, but the questions that deal with the exclusive formalization method is not considered.

The main purpose of the article is to state the essence of representing method of priory knowledge about the process of obtaining enemy's GC AO.

The main part

The analysis shows that there is a lack of descriptive capabilities of existing formalization method of knowledge which needs a development of new procedures and methods of its formalization. Methodological materials on the organization and conduct of operations by Air Force Command (AFC) against an air enemy were examined during the preparatory phase. As a result logical-linguistic descriptions of GC AO were obtained.

To explain the representing method of priory knowledge the logical-linguistic descriptions of GC AO should be described.

<u>Description 1.</u> If the coordinates of AO are under the responsibility of AFC and if the moving direction of this object is oriented inside this zone, AO can be characterized as a strike, in another case it is undetectable.

<u>Description 2.</u> AO can be classified as a strategic bomber if the reflected radar signal from the air object conforms to a large-sized AO:

otherwise, AO can be classified as a tactical aircraft if the reflected radar signal from the air object conforms to a medium-sized air target;

otherwise, air attack weapon can be classified as a cruise missile if the reflected radar signal from the air object conforms to a small-sized AO;

otherwise, AO can be classified as a flying command post if the reflected radar signal from the air object conforms to a large-sized AO or if the emission of on-board avionics belongs to an aerial picket aircraft and control system AWACS or Hawkeye;

otherwise, AO can be classified as an air scout if the reflected radar signal from the air object conforms to a medium-sized AO or if the emission of on-board avionics belongs to aerial spy;

otherwise, AO can be classified as an electronic warfare aircraft if the reflected radar signal from the air object conforms to a medium-sized AO or if the emission of on-board avionics belongs to a combat support aviation;

otherwise must to be considered that potential operational capabilities of AO is not identified and it should be assigned to unidentified target.

Description 3. AO should be classified as a low-altitude target if the flight level of AO is not lower than 350 meters or if the data of emission of on-board radar units corresponds to a flight service regime on low altitude. In another case this AO should be classified as a non-low altitude target.

Description 4. AO can be classified as a producer of active obstacles of individual protection if AO emits active obstacles for ground-based radar aids or if on-board transmission units of active obstacles provide individual protection of AO. And also if this AO does not patrol in predetermined area:

otherwise, AO can be classified as a producer of active obstacles of collective protection if AO emits active obstacles for ground-based radar aids of reconnaissance or if on-board transmission units of active obstacles provide collective protection of AO. And also if this AO does not patrol in predetermined area;

otherwise, AO should be classified as a producer of active obstacles of group protection if AO emits active obstacles for ground-based radar aids of reconnaissance or if on-boards transmission units of active obstacles provide group protection of several AO. And also if this AO patrols in predetermined area;

otherwise, AO should be classifies as it is not a producer of active obstacles.

Description 5. AO should be classified as a target which produced before the fire effect or before the "attacking" target if AO executes heading change maneuver or if the emission data belongs to side-looking air borne radar (SLAR) of weapons control. In another case it should be classified as a "not attacking".

The analysis of the above descriptions allows to determine relations of the current data which coming from different types of information sources and priori information about an air enemy. These relations can be used to achieve the target of the process of finding out enemy's GC AO [3–4].

AO characteristics can be denoted in the following way:

the set of j characteristics of AO as an integrated generalized characteristic – $æ_j$;

characteristic which describes the role of AO in air strike as the first individual characteristic of j object – $æ_{1j}$;

characteristic of potential AO capabilities due to the dealing of fire effect as the second individual generalized characteristic of j object – $æ_{2j}$;

characteristic of using low altitudes as the third individual generalized characteristic of j object – $æ_{3j}$;

characteristic of using airborne transmitter of obstacles as the fourth individual generalized characteristic of j object – $æ_{4j}$;

characteristic of preparing to the fire effect as the fifth characteristic of individual generalized characteristic of j object – $æ_{5j}$.

Then integrated generalized characteristic of AO can be represented as a proportion:

$$\boldsymbol{æ}_j = \left\{\boldsymbol{æ}_{\rho j}\right\}; \rho \in [1,5]; j \in [1,S]. \quad (1)$$

Every fractional generalized characteristic of AO can be represented as a:

$$\begin{gathered} æ_{1j} = \{æ_{11j}, æ_{12j}\}; \\ æ_{2j} = \{æ_{21j}, æ_{22j}, æ_{23j}, æ_{24j}, æ_{25j}, æ_{26j}, æ_{26j}\}; \\ æ_{3j} = \{æ_{31j}, æ_{32j}\}; \\ æ_{4j} = \{æ_{41j}, æ_{42j}, æ_{43j}, æ_{44j}\}; \\ æ_{5j} = \{æ_{51j} \text{ and } æ_{52j}\}, \end{gathered} \quad (2)$$

which can be represented with the help of such formula as:

$$\boldsymbol{æ}_j = \left\{\boldsymbol{æ}_{\rho j}\right\}; \rho \in [1,5]; j \in [1,S], q \in \left[1, Q_\rho\right], \quad (3)$$

де Q_p={2|1,7|2,2|3,4|4,2|5}.

Therefore the process of receiving GC AO can be represented as:

$$\boldsymbol{æ}_j = \left\{\boldsymbol{æ}_{\rho j}\right\}; \rho \in [1,5]; j \in [1,S], \quad (4)$$

де $\boldsymbol{æ}_{\rho j} = \left\{\boldsymbol{æ}_{\rho qj}\right\}; q \in \left[1, Q_\rho\right]$; Q_p={2|1,7|2,2|3,4|4,2|5}.

It is known that each type of information sources forms different in composition (completeness) and accuracy of knowledge statements. Sources of radar intelligence collection (SRIC) form knowledge that contains coordinate data, characteristic data and location time. Coordinate data consists of slim axes of (X_{1j}, Y_{1j}), altitude of AO (H_{1j}) and motion variables (V_{1j}, Ψ_{1j}). Coordinate data consist of sign of AO state affiliation ($П_pГП_{1j}$), numerical composition of AO ($К_{1j}$), type of AO ($Т_{1j}$), sign of using obstacles ($П_pП_{1j}$), sign of manoeuvre of AO ($П_pМ_{1j}$) etc. Also if SRIC contains special position stations which allow to recognize the class of air targets, reports can contain the information about recognized classes of these targets (G_{1j}) according to the already known alphabet of these classes $\vec{G}_1$. Then the information about j of AO can be denoted as:

$$I^o_{1j} = \left\{\vec{K}_{1j}, \vec{П}_{1j}, G_{1j}, t_{1j}\right\}, \quad (5)$$

where $\vec{K}_{1j}, \vec{П}_{1j}$ – coordinate vector and signs of j of AO which contains such data:

$$\vec{K}_{1j} = \left\{X_{1j}, Y_{1j}, H_{1j}, V_{1j}, \Psi_{1j}\right\}; \quad (6)$$

$$\vec{П}_{1j} = \left\{П_pГП_{1j}, К_{1j}, Т_{1j}, П_pП_{1j}, П_pМ_{1j}, ...\right\}; \quad (7)$$

G_{1j} – the class of j of AO according to the stated alphabet $\vec{G}_1$;

t_{1j} – location time of j of AO with means of SRIC.

According to the definite characteristics and data of AO it is possible to obtain the relations of logical-linguistic description.

From description 1:

a) membership relation of AO (X_{ij}, Y_{ij}) to the area of responsibility (Z_k), which can be identified as a formula

$$\left\{X_{ij}, Y_{ij}\right\} \in Z_k = \left\{X_{ij}, Y_{ij}\right\} R_1 Z_k = R_1\left(\left\{X_{ij}, Y_{ij}\right\}, Z_k\right); \quad (8)$$

b) membership relation of AO (Ψ_{ij}) to the area of responsibility (Z_k) which can be identified as a formula:

$$\Psi_{ij} \in Z_k = \Psi_{ij} R_2 Z_k = R_2\left(\Psi_{ij}, Z_k\right); \quad (9)$$

c) relation of characteristic similarity of potential operational capabilities ($æ_{2j}$) the role ($æ_{1j}$), that this AO accomplishes during the air strike:

$$\boldsymbol{æ}_{2j} \equiv \boldsymbol{æ}_{1j} = \boldsymbol{æ}_{2j} R_3 \boldsymbol{æ}_{1j} = R_3(\boldsymbol{æ}_{2j}, \boldsymbol{æ}_{1j}). \quad (10)$$

From description 2:

a) relation of classes similarity of AO (G_{1j}) which are formed with the help of sources of radar intelligence collection and characteristics of potential ($æ_{2j}$) by way of:

$$G_{1j} \equiv \boldsymbol{æ}_{2j} = G_{1j} R_4 \boldsymbol{æ}_{2j} = R_4(G_{1j}, \boldsymbol{æ}_{2j}); \quad (11)$$

b) relation of signal belonging of AO on-board emission $(f_{H2j}, \tau_{и2j}, F_{П2j})$, which are measured with the help of sources of radar intelligence collections against the one of characteristic meaning of potential capabilities of these AO, by way of:

$$(f_{H2j}, \tau_{и2j}, F_{П2j}) \in \boldsymbol{æ}_{2j} = (f_{H2j}, \tau_{и2j}, F_{П2j}) R_5 \boldsymbol{æ}_{2j} = = R_5\left(\left\{f_{H2j}, \tau_{и2j}, F_{П2j}\right\}, \boldsymbol{æ}_{2j}\right); \quad (12)$$

c) relation of signal belonging of airborne transmitter's obstacles $(\Delta S_{П2j})$, which are measured with the help of SRIC against the one of regimes of AO obstacle protection , by way of:

$$(\Delta S_{П2j}) \in \boldsymbol{æ}_{4j} = (\Delta S_{П2j}) R_6 \boldsymbol{æ}_{4j} = R_6(\Delta S_{П2j}, \boldsymbol{æ}_{4j}); \quad (13)$$

d) similarity relation of AO classes (G_{2j}), which are formed with the help of SRIC, with characteristics of their potential capabilities з ($æ_{2j}$) by way of:

$$G_{2j} \equiv \boldsymbol{æ}_{2j} = G_{2j} R_7 \boldsymbol{æ}_{2j} = R_7(G_{2j}, \boldsymbol{æ}_{2j}); \quad (14)$$

e) similarity relation of aircrafts' kinds (T_{2j}), which are formed with SRIC information against characteristics of their potential capabilities ($æ_{2j}$) by way of:

$$T_{2j} \equiv \boldsymbol{æ}_{2j} = T_{2j} R_8 \boldsymbol{æ}_{2j} = R_8(T_{2j}, \boldsymbol{æ}_{2j}); \quad (15)$$

f) similarity relation of AO (G_{3j}), which are formed with the help of intelligence source with characteristics of potential capabilities ($æ_{2j}$) by way of:

$$G_{3j} \equiv \boldsymbol{æ}_{2j} = G_{3j} R_9 \boldsymbol{æ}_{2j} = R_9(G_{3j}, \boldsymbol{æ}_{2j}). \quad (16)$$

From description 3:

a) membership relation of the present altitude of AO (H_{ij}) against the given echelon altitude ($H_{пор}$), which identifies the object as a non-low altitude, by way of:

$$H_{1j} \in H_{пор} = H_{1j} R_{10} H_{пор} = R_{10}(H_{1j}, H_{пор}); \quad (17)$$

b) membership relation of on-board emission signals of AO $(f_{H2j}, \tau_{и2j}, F_{П2j})$, which form SRIC to on-board radar station of flight support on a low altitude which identify AO as a low level, by way of:

$$(f_{H2j}, \tau_{и2j}, F_{П2j}) \in \boldsymbol{æ}_{3j} = (f_{H2j}, \tau_{и2j}, F_{П2j}) R_{11} \boldsymbol{æ}_{3j} = = R_{11}\left(\left\{f_{H2j}, \tau_{и2j}, F_{П2j}\right\}, \boldsymbol{æ}_{3j}\right). \quad (18)$$

From description 4:

a) characteristic relation which will be formed in case of active obstacles from AO to units of radar intelligence ($П_р П_{1j}$), which can be represented as a formula:

$$П_р П_{1j} \sim \boldsymbol{æ}_{4j} = \left(П_р П_{1j}\right) R_{12} \boldsymbol{æ}_{4j} = R_{12}(П_р П_{1j}, \boldsymbol{æ}_{4j}); \quad (19)$$

б) membership relation of signals of on-board obstacle transmitters to the one of regimes of enemy's AO obstacle protection, which can be described as a formula (13);

в) characteristic relation, which will be formed in case of AO shuffling in backward zone with the help of any type information sources ($П_р Б_{ij}$) and which can be represented as a formula:

$$П_р Б_{ij} \sim \boldsymbol{æ}_{4j} = \left(П_р Б_{ij}\right) R_{13} \boldsymbol{æ}_{4j} = R_{13}(П_р Б_{ij}, \boldsymbol{æ}_{4j}). \quad (20)$$

From description 5:

a) characteristic relation which characterize an about-face, AO speed or altitude of the flight, which can be formed by any type information source in the form of the sign of target maneuver ($П_р M_{ij}$),which can be represented as a formula:

$$П_р M_{ij} \sim \boldsymbol{æ}_{5j} = \left(П_р M_{ij}\right) R_{14} \boldsymbol{æ}_{5j} = R_{14}(П_р M_{ij}, \boldsymbol{æ}_{5j}); \quad (21)$$

b) characteristic relation which can be formed in case of division of clustered air target on several objects in the form of the sign of AO ungrouping ($П_р P_{ij}$), which can be represented as a formula:

$$П_р P_{ij} \sim \boldsymbol{æ}_{5j} = \left(П_р P_{ij}\right) R_{15} \boldsymbol{æ}_{5j} = R_{15}(П_р P_{ij}, \boldsymbol{æ}_{5j}); \quad (22)$$

c) membership relation of signals of on-board emission of radio-electronic equipment which can be measured with the help of communications surveillance means $(f_{H2j}, \tau_{и2j}, F_{П2j})$, by way of:

$$(f_{H2j}, \tau_{и2j}, F_{П2j}) \in \boldsymbol{æ}_{5j} = (f_{H2j}, \tau_{и2j}, F_{П2j}) R_{16} \boldsymbol{æ}_{5j} = = R_{16}\left(\left\{f_{H2j}, \tau_{и2j}, F_{П2j}\right\}, \boldsymbol{æ}_{5j}\right); \quad (23)$$

d) characteristic relation which characterizes the fact of increasing duration of impulse signals of emission of on-board radar system and can be formed as a ($П_р У_м \tau_{и2j}$),by way of:

$$(П_р У_м \tau_{и2j}) \sim \boldsymbol{æ}_{5j} = (П_р У_м \tau_{и2j}) R_{17} \boldsymbol{æ}_{5j} = = R_{17}\left(П_р У_м \tau_{и2j}\right); \quad (24)$$

e) characteristic relation which describes the loss in frequency of emission signals of on-board radar station, by a way of $(П_р У_в F_{п2j})$, which can be represented as:

$$(П_р У_в F_{п2j}) \sim \boldsymbol{æ}_{5j} = (П_р У_в F_{п2j}) R_{18} \boldsymbol{æ}_{5j} = = R_{18}(П_р У_в F_{п2j}). \quad (25)$$

The analysis of represented relations allows them to be grouped depending on data that is used for their formalization description. Relations that need only characteristic data for their formalization can be included in the first group of relations. To these relations can be included R_{12}, R_{13}, R_{14}, R_{15}, R_{17}, R_{18}.

Relations that need the attached relations of AO spatial data to spatial characteristics of area of responsibility for their formalization description we can include to the second group. These relations can be represented as R_1, R_2 і R_{10}. Herewith relations R_1, R_2 і R_{10} should be linked with priory knowledge Z_k и $H_{пор}$, which can be represented as: $Z_К^А$.

Relations that describe variables belonging of emission signals to means of particularly generalized characteristics can be included to the third group, herewith relations $æ_{2j}$, $æ_{3j}$, $æ_{4j}$ і $æ_{6j}$. To these relations belong R_5, R_6, R_{11} та R_{16}, and the priory knowledge $Z_П^А$ can be referred to the information that describes capabilities of indicated materials.

Relations of AO classes similarity which are formed with the help of different information sources and types of aircrafts with the mean of private GC AO and also relations of similarity between means of different private generalized characteristics ($æ_{2j}$ і $æ_{1j}$) we can include to the fourth group. Herewith relations R_3, R_4, R_7, R_8, R_9. In this case the priory knowledge $Z_С^А$ can be referred to the information that describes similarity possibilities.

We can receive logical formulas of the rules of taking GC AO according to received formalization descriptions of relations of current data which come from different information sources and can be characterized by their linguistic measures of credibility; necessary priory knowledge and targets of process of obtaining GC AO.

1. From description and relations (8–10) we obtained:

$$R_1\left(\left\{X_{ij},Y_{ij}\right\}\middle|W_{ki},Z_К^А\right)\wedge R_2\left(\Psi_{ij}\middle|W_{ki},Z_К^А\right)\wedge \wedge R_3\left(\boldsymbol{æ}_{2j},\boldsymbol{æ}_{1j}\right)\Rightarrow \boldsymbol{æ}_{1j}\left|W_{æ_1}\right. . \quad (26)$$

2. From description 2 and relations (11–16) we can obtain:

$$R_4\left(G_{1j}\middle|W_{\pi1},\boldsymbol{æ}_{2j}\right)\vee\left(R_5\left(\left\{f_{H2j},\tau_{и2j},F_{П2j}\right\}\middle|W_{\pi2},\boldsymbol{æ}_{2j}\right)\wedge R_6\left(\vartriangle S_{П2j}\middle|W_{\pi2},\boldsymbol{æ}_{4j}\right)\right)\vee \vee R_7\left(G_{2j}\middle|W_{\pi2},\boldsymbol{æ}_{2j}\right)\vee R_8\left(T_{2j}\middle|W_{\pi2},\boldsymbol{æ}_{2j}\right)\vee R_9\left(G_{3j}\middle|W_{\pi3},\boldsymbol{æ}_{2j}\right)\Rightarrow \boldsymbol{æ}_{2j}\left|W_{æ2}\right. . \quad (27)$$

3. From description 3 and relations (17–18) we obtained:

$$R_{10}\left(H_{1j}\middle|W_{k1},Z_К^А\right)\vee \vee R_{11}\left(\left\{f_{H2j},\tau_{и2j},F_{П2j}\right\}\middle|W_{\pi2},\boldsymbol{æ}_{2j}\right)\Rightarrow \boldsymbol{æ}_{3j}\left|W_{æ3}\right. . \quad (28)$$

4. From description 4 and relations (19; 13; 20) we obtained:

$$\left(R_{12}(П_р П_{1j}\left|W_{\pi1},\boldsymbol{æ}_{4j}\right.)\right)\vee\left(R_6\left(\vartriangle S_{П2j}\middle|W_{\pi2},\boldsymbol{æ}_{4j}\right)\right)\wedge \wedge R_{13}(П_р Б_{ij}\left|W_{\pi2},\boldsymbol{æ}_{4j}\right.)\Rightarrow \boldsymbol{æ}_{4j}\left|W_{æ4}\right. . \quad (29)$$

5. From description 5 and relations (21–25) we obtained:

$$R_{14}(П_р М_{ij}\left|W_{\pi i},\boldsymbol{æ}_{5j}\right.)\vee R_{15}\left(П_р Р_{ij}\middle|W_{\pi i},\boldsymbol{æ}_{5j}\right)\vee \vee R_{16}\left(\left\{f_{H2j},\tau_{и2j},F_{П2j}\right\}\middle|W_{\pi2},\boldsymbol{æ}_{5j}\right)\wedge \wedge R_{17}\left(П_р У_М \tau_{и2j}\middle|W_{\pi2},\boldsymbol{æ}_{5j}\right)\wedge \wedge R_{18}\left(П_р У_в F_{п2j}\middle|W_{\pi2},\boldsymbol{æ}_{5j}\right)\Rightarrow \boldsymbol{æ}_{5j}\left|W_{æ5}\right. . \quad (30)$$

In these obtained logical formulas special capabilities of uncertain GC AO were introduced, which are represented with the help of uncertain linguistic meanings: large, medium, small. And they can be identified with formulas of uncertain interactions [5]:

$$W_{æp}=\left(W_{k1}\left(W_{\pi1}\right)\vee\left(W_{k2}\left(W_{\pi2}\right)\vee(W_{k3}\left(W_{\pi3}\right))\right)\right)= =\max\left\{W_{k1}\left(W_{\pi1}\right),W_{k2}\left(W_{\pi2}\right),W_{k3}\left(W_{\pi3}\right)\right\};$$
$$W_{æp}=\left(W_{k1}\left(W_{\pi1}\right)\vee\left(W_{k2}\left(W_{\pi2}\right)\vee(W_{k3}\left(W_{\pi3}\right))\right)\right)= =\min\left\{W_{k1}\left(W_{\pi1}\right),W_{k2}\left(W_{\pi2}\right),W_{k3}\left(W_{\pi3}\right)\right\}. \quad (31)$$

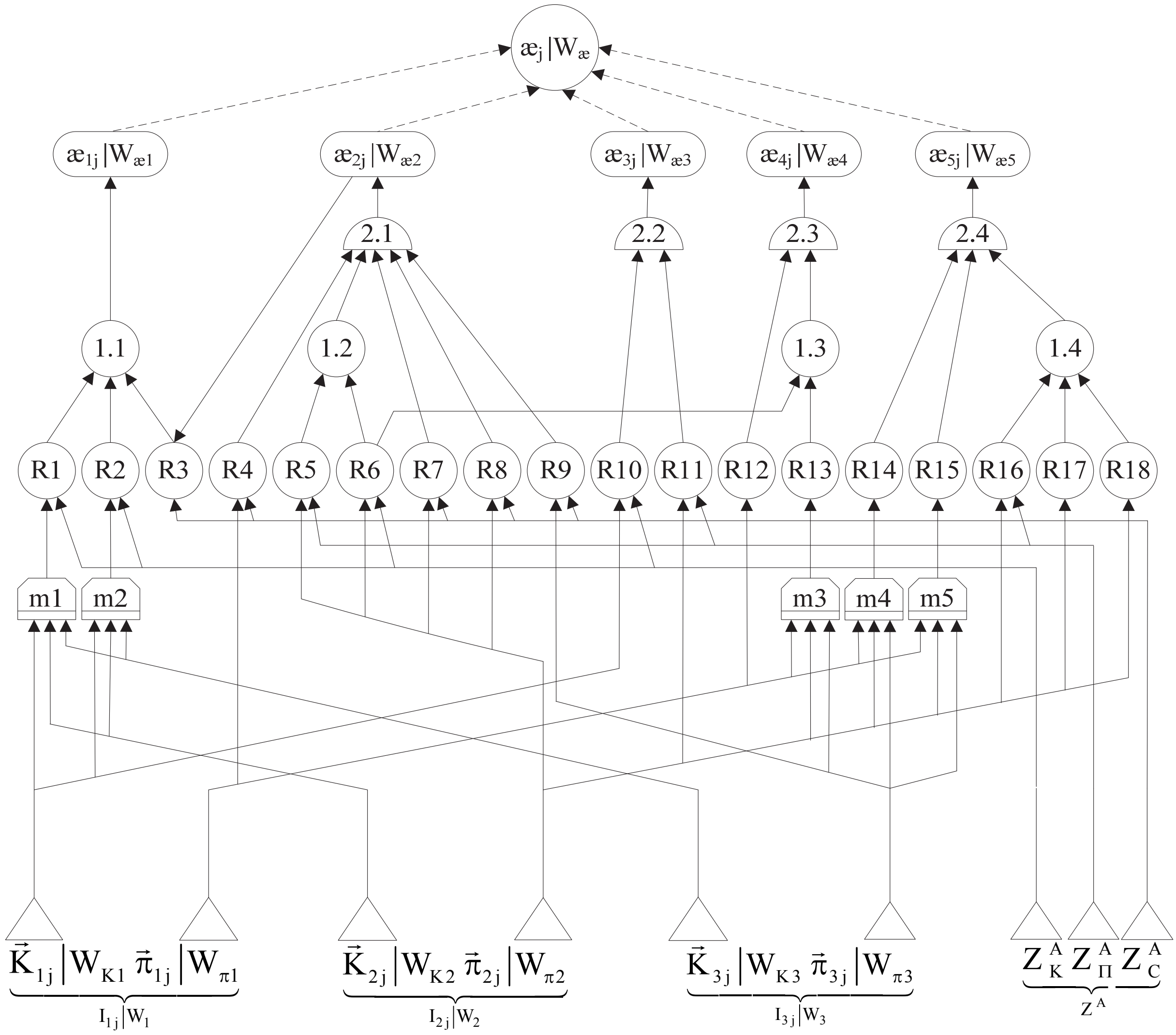
The analysis of received rules of uncertain GC AO derivation shows that they are represented as a system derived rules. Different types of priory knowledge are used in theses rules. The priory knowledge represents relations of classification, similarity and also characteristic and spatial relations and we need an assessment of authenticity for their control.

Developed formalization descriptions of target units of obtaining process GC AO are based on knowledge about enemy and description of relations between them and current data. These formalization descriptions allow us to use a network model for description of obtaining GC AO which based on knowledge about an enemy [5; 9–10].

Massages from information sources that contain the current data – I_{1j}, I_{2j}, I_{3j}, priory knowledge that is represented as $Z_К^А, Z_П^А, Z_С^А$ and the set of rules (26–30), in which the relations of different types are used can be initial conditions for obtaining GC AO and the totality of which is represented as a root vertex of network – $æ_j$.

By way of the top of the network model in solving identified targets of obtaining GC AO the components of current data, priory information about air enemy, elements of target tasks (types GC AO) and elements of action according to the realization of inference rules (production) should be used. Also tops of choosing the current data from different types of information sources to the full of meanings of linguistic credibility operations of current data which can be identified as tops of choosing of initial conditions of network: m1, ..., m5 should be implemented to the top structure.

Relations between the elements of network model can be described as relations of two types: classification (element structuring of targets) and actions that describe the sequence of rules and contain membership relations, similarity relations, spatial relations and characteristic relations. The network model diagram of process of obtaining enemy's GC AO which based on knowledge about it is represented on pic. 1. Therefore the developed model allows to imagine the whole process of obtaining enemy's GC AO which based on knowledge about it. And the realization of this process needs the development of formalization supplying of priory knowledge about an enemy [11–12].



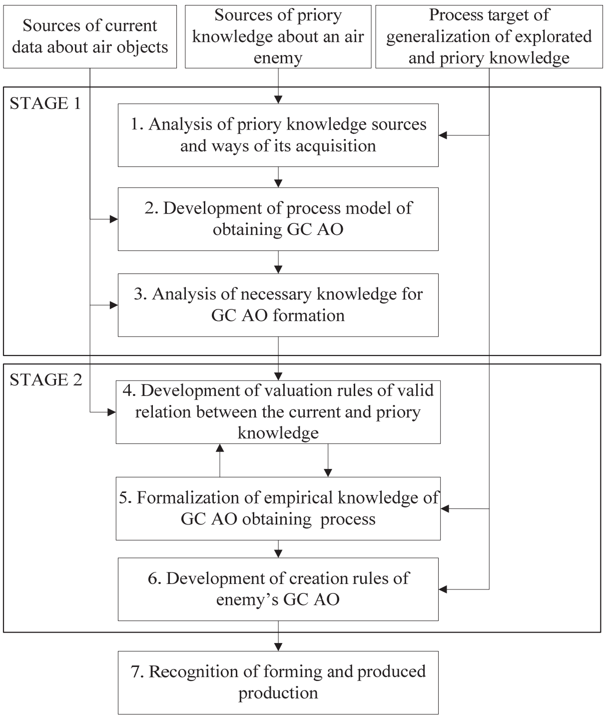
Pic. 1. The network model of process of obtaining enemy's GC AO

The analysis of sources and methods of obtaining priory knowledge about an air enemy [6; 8], the development of the process model of obtaining enemy's GC AO which based on knowledge about it, the development of the supplying of priory knowledge and formation of GC AO allow to identify the method of presenting knowledge which is represented on pic. 2.

At the first stage of procedure of supplying of priory knowledge the sources of priory knowledge and the ways of their obtaining should be analyzed (Block 1). Then it is needed to develop the model of subject area of process of obtaining GC AO using the description of current data and targets of process (Block 2). The last operation of the first stage should be the structure identification of priory knowledge which is needed for formation of GC AO (Block 3).

The second stage need to be directed to the development of valuation rules of validity relations between the current data and priory knowledge (Block 4), the formalization of empirical knowledge about process of obtaining GC AO (Block 5) and the development of creation rules GC AO (Block 6). Herewith the creation rules GC AO should be represented as a system of formed and produced production. The productional way of presenting knowledge has a number of advantages.

First of all it is close to a logical and it allows to organize the effective procedures of outputting under more visual image of knowledge. Secondly, it doesn't have hard limits and allows to change interpretation of production elements.



Pic. 2. Method of knowledge representing about an air enemy

Therefore the developed method of priory knowledge presenting is appeared to be the models of process of obtaining enemy's GC AO which contain linguistic exchangeable information of current data and indistinct intervals of credibility GC AO and the rules of changing between first and second.

Conclusion

Based on known approaches of obtaining and presenting knowledge, on analysis of possible information sources about an air enemy the method of presenting of knowledge was proposed.

At the heart of the model of process of obtaining GC AO which based on knowledge about an air enemy such components were placed:

formalization of targets of named process and presenting the current data about air objects which based on theory methods of indistinct sets.

logical-linguistic descriptions of relations between the current and priory data and also between experts' knowledge about showing specific characteristics and enemy's air objects and their actions during an airborne mission.

The listed statements formed the basis of the method of obtaining enemy's GC AO based on knowledge about it.

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РОЗРОБКА АПАРАТУ ФОРМАЛІЗАЦІЇ ЗНАНЬ ПРО ПОВІТРЯНОГО ПРОТИВНИКА

С.М. Балакірева, К.М. Кузьменко, М.О. Стахова

В статті розглядаються методи отримання знань про повітряного противника. Проводиться аналіз характеристик повітряних об'єктів противника на основі даних, які поступають від різнотипних джерел інформації. Більш детально розглядаються логіко-лінгвістичні описи часткових узагальнених характеристик повітряних об'єктів. На основі отриманих логічних виразів правил виводу узагальнених характеристик повітряних об'єктів побудована мережева модель процесу отримання узагальнених характеристик повітряних об'єктів, яка дозволяє наглядно представити весь процес. Пропонується метод представлення апріорних знань.

Ключові слова: *апарат формалізації, узагальнена характеристика, мережева модель, повітряний об'єкт, радіолокаційна інформація.*

РАЗРАБОТКА АППАРАТА ФОРМАЛИЗАЦИИ ЗНАНИЙ О ВОЗДУШНОМ ПРОТИВНИКЕ

С.М. Балакирева, Е.Н. Кузьменко, М.А. Стахова

В статье рассматриваются методы получения знаний о воздушном противнике. Проводится анализ характеристик воздушных объектов противника на основе данных, поступающих от разнотипных источников информации. Более подробно рассматриваются логико-лингвистические описания частных обобщенных характеристик воздушных объектов. На основе полученных логических выражений правил вывода обобщенных характеристик воздушных объектов построена сетевая модель процесса получения обобщенных характеристик воздушных объектов, которая позволяет наглядно представить весь процесс. Предлагается метод представления априорных знаний.

Ключевые слова: *аппарат формализации, обобщенная характеристика, сетевая модель, воздушный объект, радиолокационная информация.*