Adequacy of Estimation Model of Asymptotic Learning Operator – Pilot Function

Adekvatnost modela procjene operatora asimptotičkog učenja – funkcija pilota

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Summary

Aviation ergatic systems models are used in the design of concrete aviation systems and their adequacy is evaluated in the process of their design. Generally, a concrete ergatic process is realised with the help of simulation technology. Computer systems of recent and perspective flight simulators contain the architectures of hybrid information systems. Due to this, analogue as well as discrete methods of estimation of ergatic systems parametric sensitivity do not lose their practical importance.

KEY WORDS

ergatic process
asymptotic learning
estimation
successful control area
time period

Sažetak

Modeli ergativnih sustava u zrakoplovstvu koriste se prilikom dizajniranja konkretnih zrakoplovnih sustava, a njihova adekvatnost procjenjuje se tijekom dizajniranja. Općenito govoreći, konkretni ergativni proces nastaje uz pomoć simulacijske tehnologije. Računalni sustavi novijih i budućih simulatora letenja sadrže dijelove hibridnih informacijskih sustava. Zbog toga i analogne i diskretne metode procjene parametarske osjetljivosti ergativnih sustava ne gube svoj praktični značaj.

KLJUČNE RIJEČI

ergativni proces
asimptotičko učenje
procjena
područje uspješne kontrole
vremenski period

INTRODUCTION

Attention is devoted to the model of ergatic system, through the function of which the compensation process of occurred tolerance error realised by the control of aviation ergatic system AES by the operator – pilot (OP) is realised under the influence of external errors. A task aimed at the following is defined:

a) OP´s skill in compensating the influence or errors implemented into a selected circuit of simulator,
b) definition of recommendations, limits and borders of OP´s compensation skills,
c) possibilities of compensation of errors which influence AES position of flight path.

Model and modelling object mutuality is complex and technically it presents problems, which are difficult to solve. Complex demonstrations of doctrinal solution in different situations by OP are the reason of this degree of difficulty [1] The process of compensation is supposed to be realised by the principle of control according to a block scheme, which is in ergatic systems [6] called by a system of a different kind:

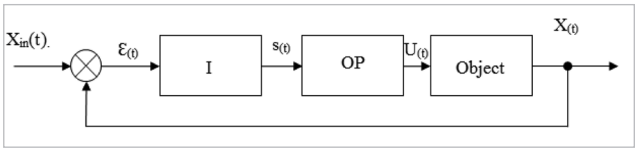

Figure 1 Scheme of compensation ergatic system

$X_{in}(t)$- input error constant; ε(t) - aberration from determined position on flight path,; I- indicator of the position of AES on flight trajectory;, S(t)- indicators of OP motivation stimuli OP; OP- operator- pilot; U(t)- AES control; Object- aviation ergatic system (aircraft).

ESTIMATION MODEL OF ASYMPTOTIC LEARNING FUNCTION

Education, learning of a human, i. e. OP requires devices that allow the above mentioned requirements of the defined task to be fulfilled. The authors own an available device, in which block

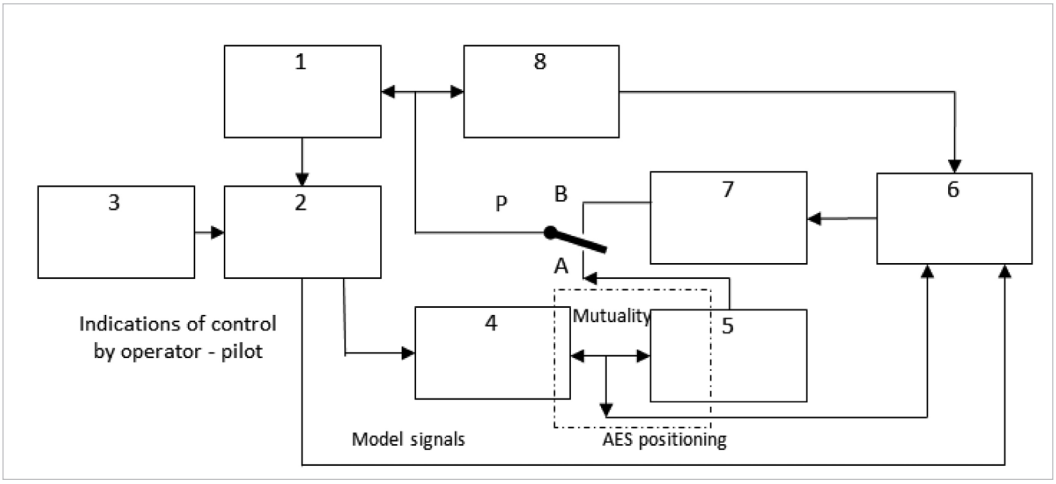

Figure 2 Compensation ergatic system scheme

1- object of control dynamics; 2- AES position on flight trajectory indicators; 3- model or errors and input entries into the system by a professional trainer; 4- OP(learner); 5-control stick of aircraft (CSA) and control unit; 6- programme device of model adjustment; 7- control model (guidance); 8- evaluation blocks of task fulfilment criteria; P- mode switch (OP performs AES control, switch in position A); B- control model performs AES control.

scheme (Fig. 1) is implemented and where complementary devices, which comply with defined requirements. Block scheme in (Fig. 2) present such a device.[2].

Professional trainer – experimentalist decides about the position of switch P. Next, the method of AES control by OP in the process of AES error compensation, which evokes the change of AES position on determined path is described. Coordinates of required AES position present the successful solution area (SSA), where q=1. Time outside the successful solution area is presented by the value $\tau_q = 0$. (19-20).

Control programme, which is presented (Fig. 3) has been used in the process of position stabilisation cycle in block 7 (Fig.2).

Principle of skill measurement:

The experimentalist has activated an error by block 3 in control, which is shown in indicator 2 in unannounced time. The motivation of OP, who selected the doctrine of error compensation by switching of AES control on himself [2] in the process of ergatic operation cycle. The succession of the steps of task solution has been performed in the environment of MATLAB according to the methodology presented in the previous part of the paper [3].

LOCAL ESTIMATION OF OP QUALITY IN OBTAINING OUR AES CONTROL WITH ERROR AND WITHOUT ERROR

By SSA area, AES self-realisation space is understood

Probability of failure free obtaining SSA:
Prav{qi=1}=p,
Probability of obtaining SSA when AES failure occurs:
Prav{q=0}=1-p.
Probability of failure free obtaining SSA:
t=time of estimation of flight into SSA and time necessary for operator´s solution:
t=0:4:40;
dt-discretion interval:
dt=1;second;
t=0:4:40;tauq=0:1:10;T=40;a=1-tauq./T;T0=1./(1-a);
*yBP=1-(2.718.^-((1-a).*t./dt));*
figure(1),plot(t,yBP),grid on,hold on,
time of failure occurrence:
tvp=10;second,
Value y BP in time tvp:
yP=0.462;on Prav scale.

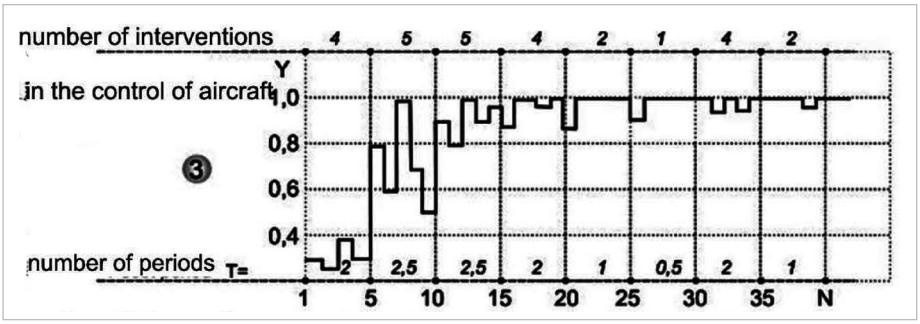

Figure 3 AES control model programme in the position of switch B

Failure changes mutuality of AES relationships. Evaluation function is determined according to OP doctrine after change to control determined by the situation – "out of control"
Let control out of control be determined by function:
yN=yP.(2.718.^-((1-a).*t-tvp./T0)./dt);*
plot(t,yN,'r'),hold on,
OP doctrine has corrected AES mutuality. Measured estimation and realisation time of the doctrine is:
tDok=(t-18)./T0;Control is function:
*yDo=1-(2.718.^-((1-a).*tDok./dt));*
plot(t,yDo,'k'),hold on,thr=(t-12)./T0;
limit value of realisation of doctrine by OP is:
thr=(t-12)./T0;Limit function is evaluation function of OP learning function.
*yhrDo=1-(2.718.^-((1-a).*thr./dt));*
figure(1),plot(t,yhrDo,'r>'),
Exceeding yhrDo, decreases the degree of OP skill in value,
title('Application local quality estimation on the reliability of analysis AES","fontsize',11),
ylabel(' probability, assessment function","fontsize',12),
xlabel('time sequences of operator","fontsize',12),
hold off, Remaining time necessary to compensate for the fault:
*yhr=(2.718.^-((1-a).*thr./dt));*
yN10=0.4567;
tpot=log(yhr+yN10)./(1-a);
The following has importance:
tpotZ=[15.1843 7.6610 5.0156 3.4889 2.3366 1.3262 0.3832];Function is:
n=3:1:9;
figure(2),ynN=plot(n,tpotZ,'m'),*
grid on,
title('The time required to compensate for fault of OP","fontsize',11),
ylabel('Necessary time to control AES by OP ,,'fontsize',11'),
xlabel(,Remainder of cycles","fontsize',11'),hold off,
There is a condition for control quality estimation:
tpot =< tpotZ;

Graphic description of OP shift in remaining cycles is shown in Fig. 4.

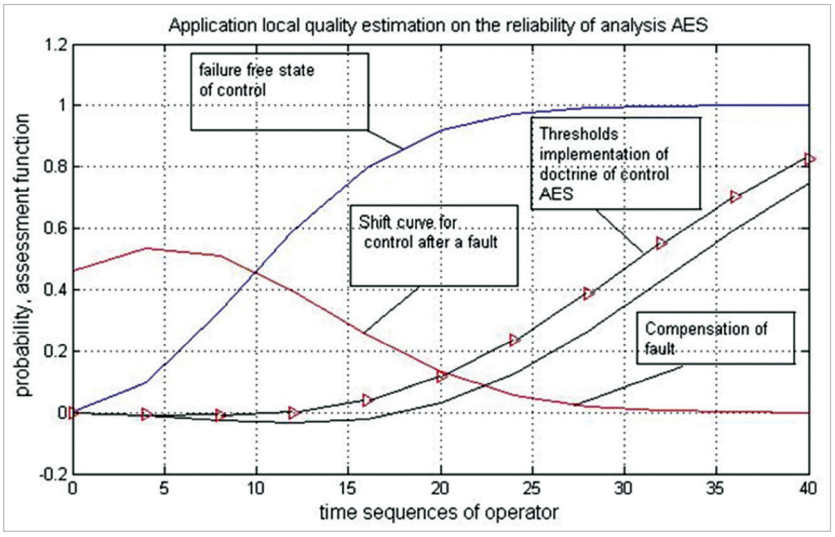

Figure 4 Local quality estimation

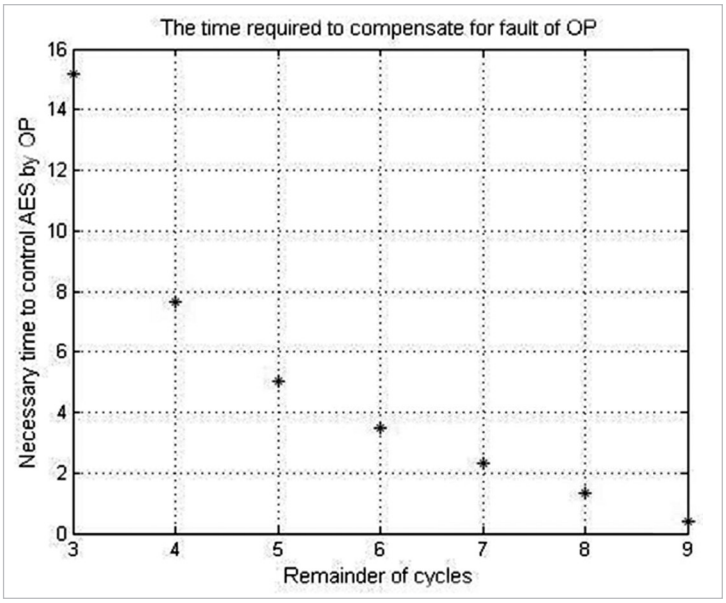

Figure 5 Graph of shift time necessary for failure compensation by OP

ADEQUACY OF LOCAL ESTIMATION IN SELECTED CLASS

Solved task belongs into the class of ergatic systems, in which OP is directly connected with the object (connection: machine – human). Local estimation of quality of such a mono-ergatic system, the effectiveness of which is evaluated by statistic methods, requires the knowledge of non-local procedures which are connected with time. Lack of time (time deficit) creates conditions for mental tension in OP´s body. Literature [1] distinguishes operational, emotional and non-specific tensions. OP´s operational tension can be seen in a different kind – tempo tension, the effect of which is unspecified aircraft control stick movement. Under the above mentioned kind of tension, a human - operator compares time period t_p necessary for failure compensation with residual period t_{pz}, which actually determines the need to perform appropriate operations until limit time value to obtain SSA. The following ratio is the measure of time deficit to perform the operation in ergatic processes [3]:

$$s = \frac{t_p}{t_{pz}} \tag{1}$$

S- tension depends only on features of the ergatic system and OP´s working conditions. Analysed kind of tension is one of the factors which influence the effectiveness of operator´s functions of all AES kinds, where it shows by its special character. The above mentioned speciality finds its reflection in emotional states of a man, which occur in time t_{pz}, which decides about obtaining SSA. That is why such procedures like the development of learning and skill to control AES are necessary to be realised in successive steps in connection with the increase of motivation of flight professionals. The required result can be obtained not by modelling but actual practice, into which education and development of skills in using a simulator lead [4], [6].

CONCLUSION

Time deficit has influence on other factors, influencing the motivation of professional OPs. Positive and negative motivations, which are accompanying phenomenon in obtaining determined aim of ergatic process, are the effect of tempo tension. Practical control of complex systems by a human – operator shows different demonstrations of emotions and has different character after crossing certain threshold. Reaching threshold value is the result of unifying decision-making educational-skill operations.[6]. Crossing the threshold value evokes the states in which the demonstrations of disorganisation and disorientation in AES control can be observed. OP´s professionalism and motivation which are marked by high level of work create a condition for minimising time in which the above mentioned effects can occur. In such a case increased threshold and rational OP´s tension can be stated.[5]

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