Experimental Testing of Decisional

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Abstract
The work presents the results of the scientific experimental research to design and experiment a new procedure for computer-aided testing of maritime students regarding their decision making capacity under crisis conditions. A software implemented testor is described, which is meant to the experimental testing of decisional behaviour and the experimental outcome

Keywords: computer-aided testing, decisions, crisis, merchant marine.

1. Introduction – Scope and Stages of Research

Training students in mechanical engineering is performed on real ships and under real navigation conditions. At present, testing the behaviour of maritime students under crisis conditions is performed in labs where there is no information on actions of random factors over their decision making. Under these circumstances some native peculiarities, skills or talents to conceive the most proper action and behavioural tactics are not highlighted.

The aim of this scientific research is to perform an experimental study of achieving skills and behavioural automatism under normal and crisis conditions. It is obvious that any disturbance may influence on the training process (knowledge acquiring and achieving skills and automatism concerning handling or running electromechanical machinery) To be able to assess the influences and have the possibility to divide students from the point of view of their capacity to adapt to stressful conditions, we have organized a simulated scientific experiment, meant to test the student’s behaviour when making decisions under crisis conditions.

According to Skinner, a stimulus is essential in the training process, and in computer-aided testing it becomes even more important since in tutorial training the presence and involvement of the tutor is a stimulus in itself. In examples shown by Skinner for computer-aided training as checking procedure it is proposed to request answers built by the student himself. Skinner has considered the action of building a correct answer a stimulus. That it why when the student has acquired a certain amount of knowledge, and is already studying for the following amount, it was considered necessary that he must have access to the correct answer for the previous amount (so as to be able to compare it with his own). Skinner inspired himself from his experiments with pigeons. In real life
people train themselves and acquire conditioned reflexes based on stimuli. This time the stimuli are live confirmations of reaching the target within these actions. In real cases, the possibility to achieve stimuli is at random, and when there is a possibility to achieve them, their probability is subunit. Experimental research performed at CMU has had as objective a procedure of testing the orientation capacity of seagoing students under such circumstances and to what degree can their system of conditioned reflexes adapt to allow them to take certain action and behaviour tactics so that under given crisis conditions they may continue their existence. The experiment is under development and its first outcome is shown in the present work.

The testor is a software meant to develop and assess the aptitudes to take decisions under crisis conditions and under random changes of the environment, respectively. The testor allows two consecutive stages:

- In the first stage the student is supposed to perform one of two actions A1 and A2 under different stimulus probabilities; only students who have acquired a certain assessment quota for the first stage of binary decision test, are then promoted to the second;
- In the second stage the student directs a submersible ship for the research of marine environment which has to avoid an obstacle; the crisis conditions in this case are represented by the sonar indications which are jammed at random.

2. Model to Confront the Decident and the Environment

In stage I the tested student can use two identical buttons, b1 and b2, by means of which he has to express his decision \( u = (b_1 = 1, b_2 = 0) \) or \( u = (b_1 = 0, b_2 = 1) \) pressing one of them to determine an increase of the bargraph height \( S \) of “success” by \( q \), when \( q = 1 \) is variable \( S \) becomes the content of a simple counter of successful pressings:

\[
S = S + 1,
\]

Also, the successful pressing determines a decrease by \( Q/T \) of height \( C \) of another bargraph which signifies the cost of crisis condition:

\[
C = C - Q/T,
\]

where \( T \) is the time interval from the last success.

The decident student has to decrease \( C \) as much as possible (by repeated binary decisions, pressing \( b_1 \) or \( b_2 \) intuitively) in conditions when the effect of the decision is affected by the hostile disturbing action of the environment. This is in fact the model of a game between two players: the decident student and the hostile environment. The decident transmitting +1 on one button intends through his attempts to decrease the cost of crisis condition fighting against the other player who is the hostile environment. The environment opposes trying to transmit −1 on the same button the decident is transmitting +1 by pressing it. The environment intends to maintain the cost constant to
anihilate the success in case of some of the decidents actions. Also, the decident is trying to “avoid” the button through which the environment is transmitting at the same time \( s = -1 \), so that the environment may waste “in vain” its shot by \(-1\). But, if the decident \((by +1)\) and the environment \((by -1)\) press the same button simultaneously, the result of the decident action is FAILURE (i.e. nil). The decident gains only if the environment presses by \(-1\) a different button from the one pressed by the environment.

For the reasons afore presented the two buttons b1 and b2, available for the decident to press, one causes at output +1, i.e. success, with different probabilities, \( p_1 \) and \( p_2 \), respectively:

- Repeated pressing, \( N \) times of b1 brings about success only for a percentage of approximately \( F_1 \) of pressings,

\[
F_1 = N \times P_1 ,
\]

where \( F_1 \) is the frequency of success, and \( P_1 \) is the probability to be successful when pressing b1 (for \( N \) of hundred order the probability is approximated by relative frequency \( F_1/N \));

- Repeated pressing of \( N \) times of b2 brings about success only for a percentage of approximately \( F_2 \),

\[
F_2 = N \times P_2 .
\]

The difference between the two players resides in the fact that the decident is able to think and thus he may assess the characteristics of the tactics adopted by the environment in the fight between the players. This way, he can adapt his own strategy so that the percentage of success may be higher than that of failure. For example, if the decident finds out that at a certain moment he can be successful more often by pressing b1 than by pressing b2, he will press only b1 from then on because it is clear that \( p_1 > p_2 \).

3. How the Experiment Works

The tested student does not know anything about the way the experiment is organised and controlled by the computer. He only sees two buttons and expects the target to appear. His mission is that when the target comes in view he should press one of the buttons to destroy the target and make it disappear, by trying to get as many successes of this kind. Destroying a target which comes into view is a positive stimulus in searching for the solution which leads to a greater success. On the other way round, by missing the target (failure l) is a negative stimulus, a sort of penalty for the bad decision, which lead to failure. To stimulate the interest of the tested student, so as to get as good as possible results, during the entire experiment he was informed right from the beginning that he was competing against the computer and to defeat the computer-opponent he had to mobilise in order to destroy as many targets as possible. This was all the tested student had to know and this was the only information given to the tested student before the
beginning of the experiment. In the first stage concerning the test of decision making capacity in crisis conditions, the experiment was performed in two variants.

Main restrictions imposed and obeyed during the organization and performing of the experiment in the first stage concerning the testing of capacity to adopt decisions under stress conditions are shown in figure 1. The fact that the tested subject does not know details about the experiment organization makes him concentrate only on the direction of reaching the only objective, i.e. getting maximum of success.

At the end of the experiment the student has to fill in a questionnaire to explain the way he approached decision making and how he chose the tactic to counteract the actions of the computer opponent.

Figure 1. Organizational restrictions for the experiment of decision making capacity of students

As we have already shown during a testing session about N = 250 total pressings are done either on the maximum probability button or on the minimum probability button. Of the total N button pressings only Ns < N brings about success, and the rest of Ne = N – Ns lead to failures. In the first testing sessions the probability of success of a button was very high (almost 1). Under these circumstances, the subject finds out the button of maximum success after several attempts. This was considered simple in relation to the conditions when the two probabilities had close values. The characteristic of the experiments performed within the second stage consists in the fact that during the entire testing session Pmax and Pmin no longer remain attached to the same buttons during the entire testing session but from time to time they are reversed.
In the first stage the main characteristic of the experiment resides in the fact that the values \( P_{\text{max}} \) and \( P_{\text{min}} \) are maintained constant and attached to the same buttons. During a session, the subject changes the button he presses in search of a variant that would bring about maximum success. Figure 2. presents such a sequence of changes from one button to the other during a session.

4. Conclusions

In spite of achievement in the field of decisions pertaining to systems characterised by crisis, dedicated works does not comprise indications regarding attempts to broaden the results or to apply them to the field of computer-aided education. Main contributions and results in the field of computer-aided testing of maritime students are the following:

- Establishing an objective criterion to assess the capacity to adapt decisions and a normal and logical behaviour under crisis and complex conditions.
- Designing and implementing a simulator meant to computer-aided testing of maritime students to assess the decision making capacity under crisis conditions.

REFERENCES

Journal Articles


**Conference Proceedings**
