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An analysis of automation of forming exercises for air traffic control simulators with the module method.

The analysis we conducted on automation of forming exercises from compound blocks showed that the most obvious are the following three methods:

- Permutation of the compound blocks in the exercise;
- Switching the compound blocks of the exercise for compound blocks with similar parameters (within allowed deviation of parameters);
- A combination of the permutation method and switching the compound blocks.

Let's look into the first method – permuting the compound blocks of the exercise. While preparing the fifth year cadets of FA NAU in early 2014 an experiment was conducted, the aim of which was to analyze the reaction of the cadets to a number of exercises built using the block method. The only difference between the exercises was the order of the compound blocks. As far as the formal features went the exercises were identical (length of the exercise, amount of aircrafts, planned amount of potential conflict situations). The parameters of the aircraft opening and closing each compound block were set in such a way that no matter the order of the compound blocks, there were no unsolvable/unforeseeable potential conflict situations. The schematic showing the placement of the compound blocks of the exercises is shown on figure 1. Not all available options were used while compiling the exercises, only 3 out of the possible 6.

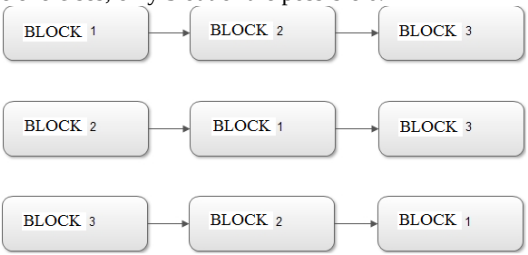

Fig. 1 Schematic showing the possibilities of compound blocks' placement during the exercises

After the cadets had completed the exercises, a survey (in the form of an interview) was conducted among them; with the aim of finding out how different the exercises were from one another. It turned out that all of the exercises were perceived as roughly the same in terms of difficulty, but not even one of the cadets could identify that the exercises consist of identical blocks, presented relatively to each other.

An irrefutable advantage of this method is its simplicity – compiling exercises using the permutation of the compound blocks does not require any special skills and knowledge. Moreover, by increasing the number of compound modules the number of possible exercises is also increased.

The drawbacks of the block permutation method can manifest in exercises with strictly set parameters of intensity, which makes changing the placement of some (and, as one of the possibilities – all) blocks impossible. In this case the strictly connected blocks can be viewed as one, and the placement can be changed while taking the connection into consideration. A different option of changing the placement of the blocks in this case is fixing the position of the key blocks with the possibility of moving the other compound blocks of the exercise around. An example of this solution is shown on figure 2, where the fixed blocks are highlighted in color.

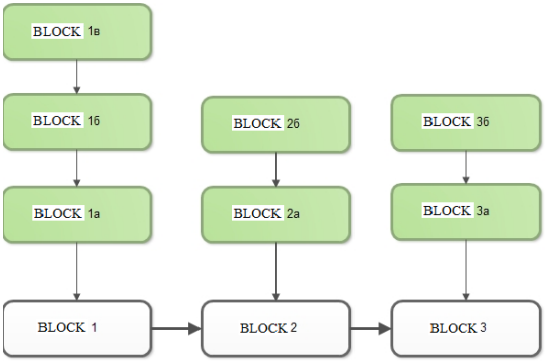

Fig. 2 Fixing the placement of key blocks in the exercise

In the provided example we have limited options of the blocks' placement because of blocks 1, 3 and 5. The placement of blocks 2 (Peak of intensity A) and 4 (Peak of intensity B) remain unchanged.

In the case when the option of moving the blocks around is undesirable, we suggest using the second method – switching the compound blocks of the exercise for compound blocks with similar parameters (within allowed deviation of the parameters). In order to make such a switch, before all else, the values of the maximum deviation of parameters (characteristics) of the blocks to be switched must be determined. After assorting the blocks suitable for switching, the number of possible exercises will be determined by multiplying all possible variants for each block. A variant of the exercise which consists of 3 blocks is shown on figure 3. 3 options for a switch are determined for the first block, 2 for the second and third each. Thus, in the provided example the number of possible exercises will be 36 (4*3*3=36).

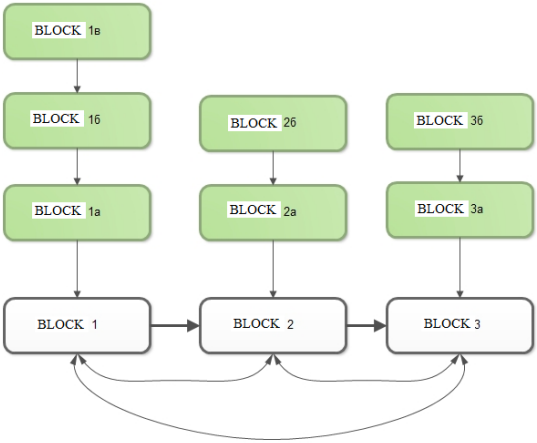

Fig. 3 Switching the compound blocks of the exercise

The advantages of this method lie in the predictability of the resulting exercise and the large number of variants of the exercises. The following can be attributed as the disadvantages:

1.A large number of blocks is required in the library;

2.As a result of point 1, a necessity to conduct prior preparation of the library of the compound blocks arises;

3.The need to determine deviations from key characteristics of the block to be switched (one of the possibilities – without deviations).

It's worth noting, that all of the disadvantages have to do with the need to fill the library of the compound blocks, and will be eliminated as time goes on.

The advantages and drawbacks of the permutation method and switching the compound blocks of the exercise repeat the advantages and drawbacks of the two parent methods.

The methods of forming exercises using the block method we suggested are easily formalized and can be used in automated or even automatic systems of forming exercises following a set template using the library of compound blocks of the exercises.