Comparison of Radar Simulator for Air Traffic Control

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Summary

The main aim of this article is to compare different types of air traffic control simulators, which are produced by several manufacturers. These may come from various countries, such as Czech Republic, Great Britain, United States of America, Canada and France. At the beginning of this work, the simulator is defined as an aviation ground equipment, which has to prepare air traffic controllers for their work and position for real air traffic as this profession requires perfect and precise training. Simulators are characterized by technical parameters, configuration of the simulator, types of simulated events, simulation of emergency situations, construction, services which are offered by company, service and maintenance and by other facilities. The final part of the work provides a comparison of the simulators of which one is chosen as the best choice.

INTRODUCTION

To ensure the greatest readiness and reliability of air traffic controllers, it is needed to insist on maximal emphasis on their preparation and training before they come into direct contact with real flight operations. Error caused by air traffic controllers can cause huge losses of human lives, material and environment damage. That is the reason why in their training period a strong emphasis is placed on simulators training that simulates the real traffic from simplest situations to the most complex ones.

Air traffic control simulators passed through several stages of development, from the simplest to modern, well-equipped simulators which can not be recognized from real air traffic. Many producers of simulators are currently on the market. Many of them offer some other aircraft equipment too while others dedicated their development and production solely to simulators. The paper analyzes and compares several simulators from different manufacturers. This is made from the technical point of view, customer satisfaction, availability, extent of simulations, references etc. Materials for the analysis were provided by the manufacturers of the simulators, subjects using the simulators as well as the competent authorities ensuring certification simulators.

METHODOLOGY OF COMPARISON

Selection of simulators undergoing our comparison was based on cooperation of manufacturers in providing us with data and also on availability of information. Manufacturers that did not respond to our appeal for cooperation and had very few available information on their website, we could not include them in the comparison. Finally, we chose to compare products of Czech, Slovak, American, French and British producers. In the end, we conducted comparison based on the criteria that have been chosen with regard to the data. Some data are missing, since they were not available. Evaluation of the results was performed by monitoring compliance with the criteria and offering the best option for the simulator user. Based on these results we constructed a graph, which shows order of the simulators. Theoretically, the selected simulator should provide the most appropriate and best solution for the operator and comparison between different products should help them in their decision, even though the choice of a particular type is affected by many other criteria.

RADAR SIMULATOR OF AIR TRAFFIC CONTROL

Every manufacturer wants to differ from the competition on the qualitative and technical side, transferring, price, services provided together with the simulator. Their goal is to be the most demanded in the market. Described in this section are selected radar simulators of air traffic control from different manufacturers used in Slovakia, the Czech Republic, the European Union and America. Also provided are the basic information about them, parameters, references, advantages and disadvantages, scope simulations, range of users, quality, availability, similarity to real traffic and more.

SIMULATOR LETVIS

LETVIS device (ALES) is designed to simulate a wide range of civil and military ATM environments. The system fully replaces ATM real data processing and simulated air traffic situations, all radar and flight information is displayed on the desktop of the controller in training. The simulator can be used for training of civilian and military radar and procedural controllers for track or approach flights. LETVIS simulator system includes two positions:Student WP (Work Position) - composed of ATCO and ATCO assistant work position for planning and practicing . WP airspace and development - containing work position of pseudopilot, instructor and manager of exercises.

The simulator core consists of a radar data generator (SIM / GEN) and FPL data generator (SIM / FDS) . The system core allows the generation of physical and logical data fusion with the data from an actual operational resources. The positions of air traffic controllers can be run simultaneously in the operational

program enabling any situations in air traffic control, which may occur in the real traffic .

SIM / GEN - radar data generator is able to simulate situations in operation on the basis of prepared options, recordings from real air traffic and references entered by pseudopilot or instructors.

The mathematical model in the SIM / GEN is based on characteristics of aircraft specified in the EUROCONTROL BADA database for simulation behaviour of aircraft. Changes in the parameters of aircraft and adding new aircraft is carried out through a database of technical parameters and performance of aircraft. SIM / FDS - FPL Data Generator generates all planning information from prepared situations of multiradar data. LETVIS SIM / PSP - pseudo - pilot work position (PSP WP) – allows for editing and controlling flight parameters via the chain of command or the graphical interface. Number of controlled flights is limited depending on the experience and skills of the pseudopilots.

HIFI SIMU SIMULATOR

In this simulator, the manufacturer (CS Soft) tries to minimalize claim for modification of these systems, leading to a higher similarity with the real operation and higher reliability of simulator performance.

Air traffic control simulator provides the following features:

- radar function simulation;
- simulation of the flight plan, flight information including printing of flight strip;
- planning of simulation;
- integration of all simulations, practice control and online control;
- monitoring the modul of the simulator;
- raw-video simulation;
- voice recording fully synchronized with the monitor of the radar;
- cooperation with training preparations of INCA system.

Simplification of the integration of the system - the system integrator offers API interface, system configurations and tools minimizing the time requirement to the integration of HIFI Simu system.

Technical supervision - simulator gives information about the technical supervision of the state and allows to control and configure the simulator.

Support of training - to support the training manager, HIFI SIMU provides information about the status of the training application, scenario of training, included functions, information about flights and configuration of training.

SIMULATOR X-AVION

The aim of the manufacturer (CS Soft) is that simulators show highly believable simulation and provide controller with identical environment compared to those that will be present in a real-life operation. The device is composed of several parts, linked up by Ethernet net – based on the TCP / IP protocol. These parts are: workplace of pseudopilot, workplace of controller in training (including integrated terminal) server FDP, simulation module with synchronized voice recorder. The devices integrated in the workstation of the pseudopilot can be seen from the simulator arrangement.

Workplace provides features to make the activities with air traffic control flight parameters easier and with the simulation such as stopping the simulation, return of simulation to the previous desired position, increasing or reducing the speed of the exercise.

Due to the flexibility of simulator configuration, the number of students and pseudopilots is theoretically unlimited. This arrangement means interconnection among the tasks performed during the exercise. This means that all pilots participating in the exercise do not need to attend the beginning of the exercise. This flexibility also allows them to leave their position at any time, and their controlled flights can be passed to other pseudopilots.

The flight simulator core contains a flight generator and the pseudopilot stations. In addition, the device includes a system for flight information processing, radar system, communication system etc. Simulator system was developed in the programming language C / C + + and X-Window. It currently works under Linux operating system (Unix).

SIMULATOR CASS

The training simulator CASS (ARTISYS) is designed for basic, advanced, retraining, radar, nonradar and procedural training of air traffic controllers for the area control, approach control and cross-sectoral coordination. The simulator includes air traffic control system CATT and can be

connected to any other control system or to the operational working position. The device contains an application that allows searching for specific situations in air traffic, radar and flight data and forms a training logbook. INCA - training design - is an autonomous tool for training profile that gives opportunity to choose the scenery of flight, route or trajectory definition of aircraft equipment, weather, airspace, voice and system requirements of air traffic control.

Simulation is transferred with graphic operating design in space and time. Another feature is the ability to enter data and information from the real operation and here is the possibility to connect multiple users into a single system. Tools of the data presentation - are created for designing and maintaining all data and information used in the operation of air traffic control system and simulator, such as digital maps, types and distribution of airspace, aircraft performance and procedures.

Designer of FIR maps - an application that offers various settings to aspect of maps, and also allows the creation of area and approach digital maps for work position. The application is based on a database, and is also able to import data from external database.

Flight strips designer - it's a tool for electronic or paper flight strips, which is fully supported by the system . The tool supports different types of air strips, for example arrival, departure, transit strips, or strips dealt differently , depending on the practice in the air traffic control station. You can also set the option of single or multiple air strips.

SIMULATOR BEST

Simulator BEST (MICRO NAV) is a pioneer in new software techniques and uses rapid advances in computer technology to achieve accessibility, universality and reality. It has a classic arrangement of pseudopilot and instructor work position. Positions are flexible, which means that it is possible to smoothly change from pseudopilot mode to the controller mode and also to the instructor mode. One of the advantages of this simulator is also the option of a separate training, the instructor sets the simulation forward, prepare an excercises, defines incorrect reactions, the correct reactions, sets time limits for actions and defines the reactions of simulator to these actions,

Tab. 1 Comparison of simulators based by particular criteria

Simulator / Criteria	Letvis (Ales)	Hifi-Simu (CS SOFT)	Avion-X (CS SOFT)	CASS (ARTISYS)	BEST (Micro Nav)	ATCoach (UFA)
Availability of information	good	below-average	below-average	good	excellent	good
Type of radars	PSR, SSR, PAR	n/a	n/a	PSR, SSR	PSR, SSR	n/a
Database of aircraft	BADA	n/a	n/a	n/a	n/a	BADA, UFA
Radar data format	ASTERIX, AIRCAT 500	n/a	n/a	n/a	ASTERIX	ASTERIX
Interruption of simulation	yes	yes	yes	yes	yes	yes
Record and playback	yes	yes	yes	yes	yes	yes
The lowest configuration	2	n/a	n/a	n/a	1	1
Reality	average	excellent	excellent	average	excellent	excellent
Flight strips	electronic	printed	n/a	printed	printed	printed
Adjusting the speed of simulation	n/a	n/a	yes	yes	yes	n/a
Range of sim. event	average	average	average	average	above-average	above-average
Weather options	yes	yes	yes	yes	yes	yes
Separate training	no	no	no	no	yes	yes
Speech recognition	no	no	no	no	yes	no
Programming language	n/a	n/a	C++	n/a	C++	n/a
Operational system	Solaris	n/a	X-Windows	n/a	Windows	Windows
Marketing	price, quality	technology	technology	quality	price, quality	quality
Additional Services	yes	yes	yes	yes	yes	n/a
References	4	2	4	1	21	15

while the controller may participate in the training alone.

Recording and measuring of the results of the simulation is present as well. This simulator software is written in C + + language using C + + Builder with Windows as an operating system. Windows XP Professional is best suited for the task as it runs on standard computers, computer networks and peripherals.

The simulator has its own integrated audio communication system, which has features such as radio, board and telephone connection, colour touch screen control panels, sound recording and backward playing too.

This simulator provides a very realistic simulation of the real environment,

navigation aid, weather settings options, procedures, and aircraft performance. BEST works with several databases. It includes the flight plan database. The data related to weather are stored in separate files. This allows for efficient and fast connection of these data, flight plans and weather, making ground for quick and easy beginning of the training.

SIMULATOR ATCOACH

Simulator ATCoach by UFA is advanced, multiple - purpose ATC simulator. It is suitable not only for basic training, but also for sustaining training already qualified ATCo.

Main core of this simulator is composed by several components:

component for data preparation, position of the ATCo, position of an instructor, position of an pseudo-pilot, record and playback of data, generating component for profile of the flight, component for generating profile of the weather.

COMPARISON OF SIMULATORS - ANALYSIS OF DIFFERENCES

Particular simulators were selected based on availability of materials and information and geographical view. We chose simulators produced by Czechoslovak, Czech, European and American manufacturers. The comparison itself would be much more accurate if we are to compare more simulators, but we were limited by range of the article.

Compared simulators: LETVIS, Hifi-Simu, Avion-X, CASS, BEST and ATCO.

CRITERIA OF COMPARISON

The comparisons were made according certain criteria, which we chose by taking into account the available data about simulators.

The particular criteria for comparison were: duration of the company at the market, the availability of information about the simulator, the type of radars during simulation, database of aircraft, radar data format, interruption and restart the simulation, recording and playback, the lowest configuration, reality of events, weather settings, dynamic utilization of job positions, the training itself, voice recognition, programming language, operating system, marketing, supplementary services and references.

The following table (Tab. 1) presents a comparison of particular criteria for selected radar simulators for air traffic control.

CRITERIA ANALYSIS

From the table (Tab.1) it is possible to determine for which simulator enabled obtaining sufficient information and materials. The largest amount of information was provided by the Micro Nav to BEST simulator company. The LETVIS, CASS and ATCoach simulators allowed for good access to information, and on the website there were sufficient materials and technical information available. Conversely, materials from simulator of Hifi Simu - and Avion- X from the CS SOFT manufacturer group were less available, despite of the employees being communicative yet only providing brief details. With regard the types of radars, from which incoming data are simulated , CASS and BEST were able to simulate PSR and SSR data. For Simu - Hifi, Avion - X and ATCoach simulator, these types of radars were not available at the leaflets supplied. Information about using aircraft database were reported only by two manufacturers for the LETVIS and ATCoach. Other producers apparently do not consider this information so important when choosing a simulator and were available only to particular customers. It is a BADA (EUROCONTROL) database or the manufacturer of the UFA also offers its own database of aircraft and their performances.

The most common form of radar data is ASTERIX (EUROCONTROL), which is used in LETVIS , BEST and ATCO. Moreover LETVIS has the format AIRCAT 500. Hifi - Simu , Avion - X and CASS this information do not declare. Function for interrupt simulation offer all selected simulators. As well as the interruption of the simulation, the recording and playback meet all devices.

LETVIS simulator allows the lowest arrangement by combining two controller positions and two pseudo - pilot positions. BEST and ATCoach allow arrangement for one position, which is associated with excercise for one controller in training. Hifi - Simu , Avion - X and CASS do not declare the smallest arrangement.

Hifi - Simu , Avion - X , BEST and ATCoach are developed to meet the requirement of high fidelity. This very feature is one of the main objectives of manufacturers. LETVIS and CASS have an average simulations fidelity, especially with regard to the environment. Simulation speed adjustment function was observed in Avion - X , CASS and BEST simulators. LETVIS this feature does not provide and in simulators HiFi - Sima and ATCoatch this information was not available.

After examining the range of simulated events offered by the compared simulators, a conclusion was made that the BEST and ATCO simulator provide a wide range of simulated events, LETVIS Avion-X, Hifi-Simu and CASS have an average range of these events. Weather in ATC simulation procedures plays an important role, because each of the simulators dispose a meteorological

conditions option.

The function of dynamic job presents flexibility of individual workstations, where the instructor can change the station for any job. BEST and CASS enable this, while ATCoach does not declare this feature. LETVIS, Avion - X, Hifi - Simu do not have this feature. Advantage of a separate training is provided only by BEST. Other simulators do not enable separate training. As an separate training and equipment for speech recognition is only the BEST. Avion - X and BEST are written in the programming language C++, other manufacturers do not publish this kind of information.

Most simulators works based on Windows. Each one of the manufacturers focuses on different features and has different goals when offering its simulator. Company Micro Nav and Ales, place great emphasis on price policy that is very accommodating to customers. They try to combine affordable price with high quality. The remaining simulators are trying to attract customers with highier technical equipment and simulator quality. Manufacturers have to adapt to competition also by expanding their services offered over the simulator life. With each simulator, except for the manufacturer the UFA, there are provided service packages related to repairs, maintenance, help, support with restoring software, etc. It is difficult to compare the Czech manufacturer with an American or British, therefore this criteria is for informational purposes only. In Table 1 we can see the amount of followers of the simulator. However, caution is to be exercised when treating the data from websites that may have not
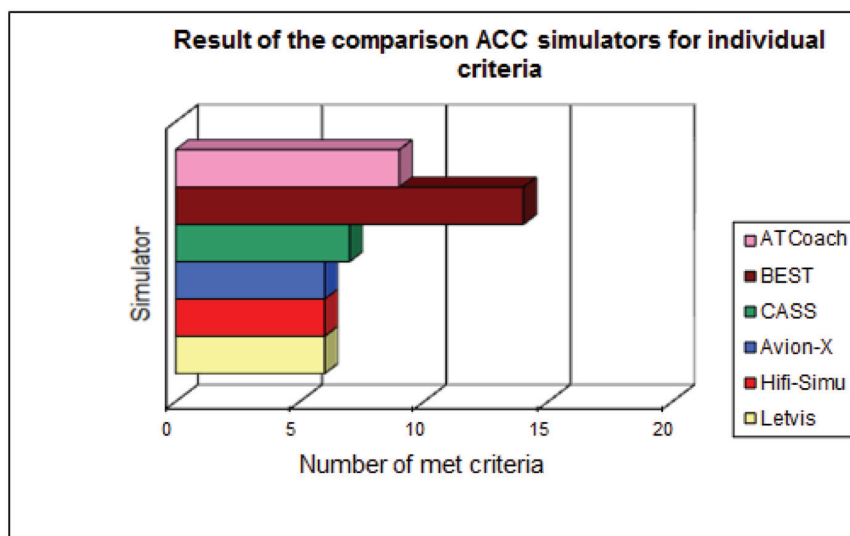

Fig. 1. Result of the comparison ACC simulators for individual criteria

been kept updated. The simulator CASS has only one reference, because of having no additional information available. The presence in the simulator market is also of great importance for asessing the manufacturer. The longest period was recorded at the UFA (established in 1985), followed by the company Micro Nav and the company CS SOFT group, which were founded in 1988. The youngest of these companies are the ALES (founded in 1992) and ARTISYS (founded in 1994).

COMPARISON RESULTS

After having them comparred according to Table. 1, we reviewed the criteria and on the basis of available data to determine the order of simulators.

At the last position is LETVIS simulator from Ales, and Hifi-Simu - and Avion-X from CS SOFT Group despite offering some benefits such as camera type, radar data format, database of aircraft, accommodating price policy, high fidelity, did not meet other criteria. Fidelity of these simulators is high, but it was not enough for simulators CASS and ATCoach. According to available information obtained, the ATCoach is a better solution than the CASS, but from a geographical point of view this is probably not (for example) for European customers.

The most appropriate solution became BEST simulator from MicroNav that offers the best solution for almost all criteria. It allows some functions that other simulators do not, such as voice recognition. In combination with the implementation price policy and the willingness of staff is the BEST best for the customer who wants to obtain an ATC simulator. For European customer is BEST easily accessible. Of course, we must take into account the results of the comparisons can be distorted by the unavailability of certain information.

CONCLUSION

Air traffic control simulators form the backbone of high quality air traffic controller training, preparing them for both standard and non-standard situations, teaching how to react and proceed. It is precisely for this reason that each operator should be well considerate in what simulator to run for training .

In this paper several simulators radar air traffic control have been chosen and compared on the basis of selected criteria. The simulator from Micro Nav Ltd manufacturer came out as the most appropriate solution for the operator. Of course, we must also take into account that the comparison was carried out on the basis of available information and materials, and only some devices could be seen live.

In future, we can expect development of newer and technically more advanced equipment that provide systems nearly identical to the reality of air traffic control. This, however, will necessitate changes in the criteria of comparison for simulators, as new features and functions may be expected. For some manufacturers whose devices were compared, we would recommend to improve market awareness and accessibility of simulators, and also the way their products are promoted.

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