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Utilization Of Flight Simulator in Aviation

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Annotation: This article deals with the issues related to the use of flight simulator in aviation. It also discusses the scope of simulator using in flight training processes for particular aviation ratings. Furthermore, advantages and disadvantages of using flight simulators are given. In addition, the methods for using flight simulation devices in pilot training and practical training processes are presented, taking into consideration military aviation features.

Key words: flight simulator, pilot training, military aviation, scope of simulator, flight training device, aircraft.

Introduction

If you plan to be a pilot some day, a flight simulator is going to be a big part of your life. Flight simulators do what their name implies: they teach you how to fly a plane by giving you some realistic experience before you actually get in the cockpit. They are also there to teach you some very important things about flying. They are: flight training devices (FTD), simulators, other types of flight simulators.

Flight simulators are usually one of two types: a flight training device, or FTD, which doesn't move and is rated with a number instead of a letter; and a flight simulator, which moves and is rated with a series of letters. FTDs are rated from 1 to 7 with 7 being the most sophisticated. Technically, the word "simulator" only applies to those devices that move and they are classified with the letters A through D. With flight simulators, the letters refer to their level of sophistication just as the numbers do with FTDs. However, with simulators, the lower the letter is, the more sophisticated the device, so a simulator with the letter D will surpass a flight simulator with the letter A. The system used for FTDs and flight simulators can be a little on the confusing side but once you get into flight school and begin using them, they seem a lot less complicated.

Main Part

Whenever an accident happens in the air, there is a lot of pressure for the pilots. They must guarantee the safety of everyone on board and on the ground. Their actions are the only thing that prevents a regular flight becoming a disaster. Or even worse, a fatal one. That is why before you can become a full-time pilot, you have to sit in the Flight Simulator for hours and train for every situation possible – from bird strikes, engine failures to bad weather.

There are seven types of flight training devices and four types of flight simulators. Although they all perform the same basic functions, they vary according to the tasks they're able to do and they include the following types.

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Picture 1. Flight simulator cockpit

There are also some specialty flight simulators currently in existence. One of them is the Vertical Motion Simulator, or VMS, that is operated by NASA in Ames, California, which is near San Francisco. It consists of a very large-throw motion system that includes 60 feet of vertical movement. The VMS has been used in an early shuttle flight for various functions.

The Environmental Tectonics Corporation in Philadelphia, Pennsylvania, and AMST Systemtechnic GmbH in Austria manufacture a type of simulator that is used for disorientation training and has full freedom in yaw. The biggest of these simulators is found at the TNO Research Center in the Netherlands. But when you, a passenger, walk down the passenger boarding bridge you might feel anxious about the flight. You might be a bit scared. But you are very confident in the pilots that fly your plane. They undergo intense training throughout their whole career and you know that these are the most professional working people out there in the world.

This article considers the uses of flight simulation, its advantages and disadvantages, and some human factors considerations to do with the issue of flight simulator realism and effectiveness. Flight simulation involves the representation in a simulator environment of the flight and systems characteristics of an aircraft. The primary purpose of flight simulation is to train a pilot to achieve, test, and maintain proficiency in the operation of an airplane without risk to person or property and at a lower cost to training in the air.

In its simplest form, a flight simulator system usually includes:

A display, or multiple displays, to represent visually the external environment.

Control devices, such as a yoke or control stick and rudder pedals, to provide control inputs to the simulator.

An audio system to produce communications, external, aircraft, and cockpit sounds.

A computer system or systems to process control inputs, to digitally generate visual and audio representations in response to those inputs, and to record flight data for analysis

Methods And Results

Flight simulators are used as a training device because of their overall effectiveness and efficiency in training pilots. Some of the advantages of using flight simulators include the following:

Permit novice pilots to experience simulated flight without risk to him or to valuable aircraft.

Availability – that is, flight simulation is not dependent on particular environmental conditions (good weather), or availability of a real aircraft. Correspondingly, it is possible to generate particular conditions without them having to be sought out in the real world.

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Accessibility – simulation does not require a full flight progression (pre-flight, take-off, flight, landing, post-flight), but permits repeated practice of a particular stage of flight, such as an ILS approach.

Cost-effectiveness – savings in crew time, fuel, maintenance to real aircraft, revenue that would be lost using a real aircraft, and environmental impact.

Risk-free introduction of flight challenges, such as conflicting traffic, systems problems, difficult or unusual flight maneuvers, poor weather conditions, wind sheer, and wake turbulence.

When used during air crash investigations – ability to accurately replicate the environmental and flight conditions at the time of an accident to test pilot responses to those conditions.

Instructional features – recorded flight data, ability to "replay" and review a simulated flight or parts of it, allow matching of performance against criteria.

Relieves instructor from flight duties and safety considerations.

Permits trainee to make and learn from mistakes without risk.

Some of the disadvantages include the following:

Effect of the simulator environment on the operator. In a simulated accident situation, for example, we would not expect the simulator operator to experience the same stress levels as would be expected in anticipation of a real accident[1].

Simulator users, particularly where used as part of a currency test, may be expected to have studied and therefore anticipate certain procedures, conditions, or emergencies during the course of their simulated flight.

Shorter flight cycles do not accurately reflect pilot fatigue or boredom. In addition to the cost to build a simulator, they have ongoing operation and maintenance costs.

No flight simulator system is entirely "realistic". Flight simulator systems vary in complexity and realism, with more complex and realistic systems producing a correspondingly more realistic experience for the operator of the simulator. For example, the more advanced simulators used by commercial air transport operators usually include a motion base that responds to control inputs and digitally generated environmental factors (such as weather) to mimic the expected movements of an aircraft. This results in more realistic motion cues being felt by the operator of the simulator.

There is controversy over whether achieving realism or achieving training objectives is most important in the development of simulators. According to Hays and Singer[2], the effectiveness of a simulator depends on how its features support the total training system, and the realism of a simulator should vary according to stage of learning, type of task, and type of task analysis.

The process of testing something through model is known as simulation. For example, to test an airplane we have to make a small model of it and test its drive. The purpose of the simulation is to predict the results of something. Suppose a bank wants to test how many customers can be handled in a day. To test this, the bank will get data from previous days, such as a number of customers arriving in an hour, how many customers are waiting etc. To perform simulation we can also use the software. In simulation software, data is input and with the help of data input and diagrams, we can get appropriate results. With simulation, we can test the behavior of something without making it. We can make environment or model of the system that can behave similarly like actual system. Experiments are done on the model without disturbing the actual system. We can investigate the situation which is dangerous in real life.

We can analyze different parts of the system while testing its model. Analysis of complex system is done through simulation when we do not get results through the mathematical way.

Most of the time the result of the simulation is accurate than doing analytical or practical testing on the actual system.

While doing simulation we can note down the faults in the system. If something gives an unexpected result then we can fix it before launching the system. We can make changes in the model and check the reaction of the model.

[1] Cardullo (1994). 'Motion and force cueing', Flight simulation update-1994 (10th ed). SUNY Watson School of Engineering, Binghampton, 1994.

[2] Hays & Singer (1989).Simulation fidelity in training system design. Springer-Verlag, New York, 1989

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With simulation, engineers can see the actual product (e.g. car) without practically building it. They can change the look and feel of the product during modeling. Engineers can get inner details of the product and overall look of the product easily in the simulation.

Picture 2. "Maxvus Canadar" simulator

Teachers can do a simulation of the system by computer and explain to students. Students can get an idea of any system easily be seeing a simulation of anything. The animation and graphics can do a lot of things nowadays. You can perform a simulation of dinosaurs and wales and it looks very near to reality.

Flight training devices play a vital role in the training of air force pilots. At the beginning, in order to become a military pilot student at the Higher Military Aviation school of the Republic of Uzbekistan, a candidate for a military pilot must pass, among other tests, a test on the training device, checking his predisposition to the profession of a pilot. If he passes all the tests and examinations successfully and is admitted to school, he will also train on flight simulators during the five years of study. Simulator training includes basic training, i.e., learning and training in operating on-board equipment, learning to start up the power plant, taxi, take-off, traffic patterns, flights to the training zone and basic flight maneuvers, landing on ice, radiotelephony communication, and responses to emergency situations. In the subsequent phases, the trainee participates in advanced training, in which he also carries out flights to the training zone and intermediate flight maneuvers. During the training at the higher school, he will perform about 100 h of flying time on flight simulation devices. Some differences between the simulation training of civilian and military pilots are worth stressing. In the training of air force pilots, conducting 100 h of simulated flights does not "replace" the flying time achieved on a real aircraft; it merely complements it. This means that, if the training programme for a given type of aircraft sets a specific amount of flying time necessary for a pilot to achieve the intended level of flight training, it should be attained in a real aircraft, not simulated flight. It may be assumed that this is beneficial for the pilot, because increased training means more experience in aviation. But some drawbacks to this solution may also be noticed.

Conclusion

Taking into consideration, aircraft simulators have proven to be an essential element for flight training for individual general aviation pilots, jet figher military pilots and airline flight crew. The simulators save time, money while increasing safety. Flight simulators can be used to train flight crews in normal and emergency operating procedures, pilots are able to practice situations that are unsafe in the aircraft itself. These may include engine failures or malfunctions of aircraft systems such as electrics, hydraulics, pressurization, flight instruments etc. They are also used to implement human factors programmes such as Crew Resource Management and Threat and Error Management.

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