14th International Research/Expert Conference
"Trends in the Development of Machinery and Associated Technology"
TMT 2010, Mediterranean Cruise, 11-18 September 2010

A GENERAL VIEW ON HARDWARE OF FULL FLIGH SIMULATOR

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ABSTRACT
A simulation is an imitation of some real thing, state of affairs, or process. To simulate something physical, you will first need to create a mathematical model which represents that physical object. Simulation of a system can be done at many different levels of fidelity so that whereas one reader will think of physics-based models and output, another may think of more abstract models which yield higher-level, less detailed output as in a network. A flight simulator is a system that tries to replicate, or simulate, the experience of flying an aircraft as closely and realistically as possible. The different types of flight simulator range from video games up to full-size cockpit replicas mounted on hydraulic (or electromechanical) actuators controlled by state of the art computer technology. Full size replica of an aircraft cockpit, including the assemblage of equipment and computer programs to represent the aircraft in ground and flight operations, a visual system providing an out-of-the-cockpit view, and a force cueing system which provides cues at least equivalent to that of a 6-DOF motion system.
Keywords: Simulation, Flight simulator, Hardware, Assembly

1. INTRODUCTION

A flight simulator is a system that tries to replicate, or simulate, the experience of flying an aircraft as closely and realistically as possible. The different types of flight simulator range from video games up to full-size cockpit replicas mounted on hydraulic (or electromechanical) actuators like HAVELSAN CN–235 Simulators, controlled by state of the art computer technology. Flight simulation can be defined as the representation of vehicle and system dynamic characteristics with varying degrees of realism for research, design, training or entertainment purposes. The "representation" is usually in the form of analytic expressions programmed on a digital computer. The Simulators mainly divided into two parts such as hardware and software. The Software controls the simulation Hardware is the structures of the simulator. In this study, general information was given about hardware of flight simulators. The shape and performance of hardware varies depending on the kind of simulator. The main pieces of the hardware associated with the simulator are: Computer, Cockpit, I/O interface ,Instructor / Operator Station.

2. COMPUTER SYSTEM

The digital computer is at the heart of the simulator and is responsible for every single event that occurs. Today, high fidelity and the complexity of the advanced training system calls for multi-processor configurations.

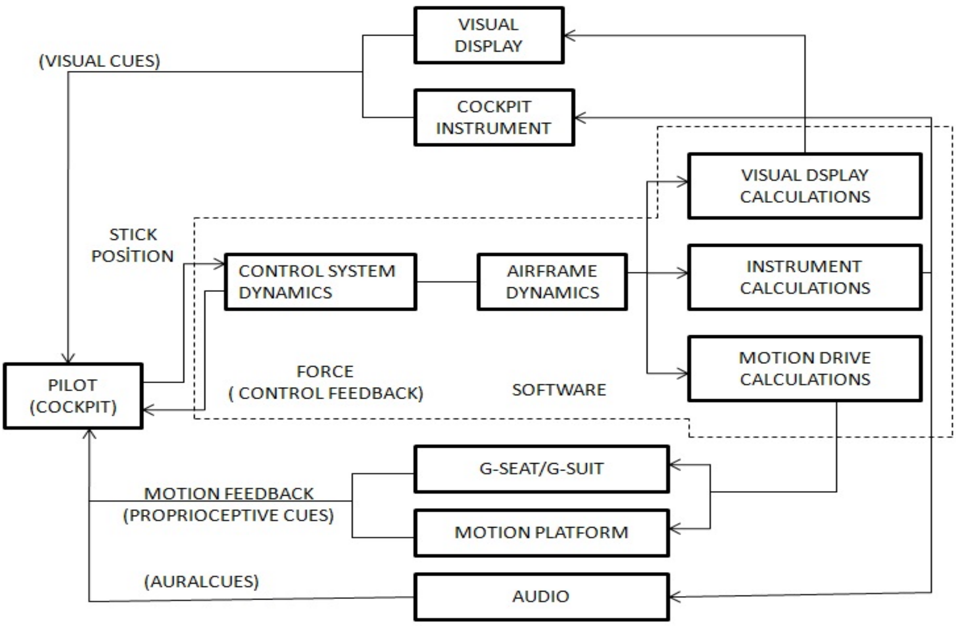

Figure 1 Flight simulation flow

3. COCKPIT (STUDENT STATION)

Student Station is the place that the trainee makes his/her training. It can be the cockpit for the training of the pilots where as can be only a part of the cockpit or special cabinet for the training of the flight operators depending on the aim of the simulation training. The decision on each component is the result of a trade-off study – make or buy from aircraft manufacturer or supplier – use real or simulated instruments – use the real cockpit or fabricate the shell of fiberglass and furnish it.

4. I/O INTERFACE

I/O interface is the real time interface between software and the hardware of the simulator. It is a two way bridge that connects them together. The interconnect panels are used to connect cockpit instrument and IO system.

5. INSTRUCTOR / OPERATOR STATION (IOS)

The purpose of the IOS is to control the training and the simulator. The instructor use the IOS to traning the trainers. IOS has a computer, monitors, control panels, and instructor needed tools**.**A simulator may have one or all of the following additional equipment:Visual System,Motion System Control Loading System ,Sound System and go on.

6. VISUAL SYSTEM

Visual Systems are used to simulate the real world. The pilot views the simulated world through a display system.The display system can be a simple monitor displaying a field of view of 40 degrees by 30 degrees to a full dome displaying a complete 360 degree of view. Visual data base designers study maps, charts and photograps of the area to be simulated, using special computer softwares.

6.1. Visual Displays

The information in almost all out-of window visual simulation systems is displayed. Real image systems display information on a surface a finite and fixed distance from the eyepoint of the observer. A projector is located behind the student or behind a screen in front of the student. In some systems, the screen is a partial or a complete dome providing a perfect surface.All visual simulation systems are limited in thier ability to portray real-world visual information. The most advanced image generation and display system may be able to display as much as fifteen to twenty percent of the information available in many real world scenes.

7. MOTION SYSTEM

Motion systems are used to provide onset and displacement cues in full mission simulators. Two types of motion system is used in simulator. Hyrauli motion system and Electric Motion system.The motion platforms which provide the more basic motions of pitch, roll and heave. Not surprisingly, the more DoF that the simulator can perform, the more complex (and expensive) the motion platform. The most sophisticated of motion based flight simulators provide six DoF.This means that the simulator can be moved in the six ways an aircraft moves. Specifically:-Vertical (also know as "Elevation" or "Heave“)-Lateral (also know as “Sway“)-Longitudinal (also know as “Surge" or “Forward“)-Pitch–Roll-Yaw. A motion system consists of a motion control computer, input/output system, hydraulic pump, hydraulic cooling system and a hydraulic actuator of each degree of freedom. Computer with I/O cards and control panel are located in the Motion Control Cabinet. Motion-based platforms add the sensation of movement to the pilot’s simulated flight. The cockpit and visual display system are mounted on the platform, which will have a number of hydraulic actuators or "legs" which do th lifting. The number of hydraulic powered legs dictates the number of degrees-of-freedom motion that can be achieved.These legs allow the platform to follow the pilot’s motions during flight. For example, if a pilot were taking off, the front of the platform would pitch so the pilot feels as if he is climbing.There are position feedback switches and limit switches on the actuators in order to get position information and prevent overshoot. There is a safety system which prevent the motion system moving in predetermined conditions like ramp is in the ingress/egress position or simulator door is open. There is also an emergency shutdown switch in the motion control cabinet.

8. CONTROL LOADING SYSTEM

This system is attached to the pilot’s control column and rudder pedals through mechanical linkages and servo mechanisms and ensures that the pilot feels the correct forces on the controls as he maneuvers the aircraft. Cockpit control feel is the resistance felt by the pilot when moving a control lever and hence aircraft response resulting from this input.Control Loading devices are classified as either passive or active. Passive control devices do not introduce energy to the system.Passive devices are used when forces to be simulated do not vary with flight conditions. This kind of devices are implemented on secondary control units such as throttles, landing gear levers, flap levers, speed brake levers. Active devices are used when the forces to be simulated vary with flight conditions.These devices are usually implemented on primary controls and some secondary controls. A typical control loading system comprise of the following basic components: Cockpit control and linkage, Loader, Electric motor (DC or AC),Transducers (Force/Torque (Load Cell), Velocity,Position) Control force (or loading) is provided by the motor. Each control axis or channel is athached via mechanical linkage to a motor. Transducers are used to avoid backlash friction and stretch.The control loading system is controlled by a computer. The control loading computer interfaces with a power amplifier (or servo driver) of each channel.The control loading computer communicates with the main simulation computer (host) via the ethernet connection.

9. SOUND SYSTEM

The sound system will reproduce sounds audible in the aircraft cockpit. The sound system will normally use either headphones or multiple speaker arrangement.The sound system consists of PC based system with A/D, D/A interface units and with DSP cards. These systems can be modelled via its own software in order to simulate the communication and environmental sounds of any aircraft or vehicle.Aural Cues are sounds initiated by an event or action in the virtual environment. For example, when a pilot in a simulator presses the trigger to fire a missile, the sound he hears as it activates and zooms away is an environmental aural cue. By the same token, when his simulated flight path brings him in range of a navigational beacon, the sound he hears in his headphones is a NavAid aural cue Simulated Radio and Communications Environment is an important issue in today's simulation environment. Achieving a realistic networked radio and communications environment requires taking into account the detailed effects involved in the transmission, propagation, and reception of a real radio signal. These effects must be duplicated reliably and with minimal latency, even under high network traffic conditions.

10. CONCLUSIONS

One of the topics that simulation world is trying to advance on is linking simulators to provide a simulated battlefield in which all the players (command and control,support and oppositon) are part of each other's environment.The simulated battlefield will be a mix of simulators (aircraft,ships,submarines,armored vehicles,command posts,etc). This approach has obvious advantages where as it has technical problems to overcome.The advantages of this approach can be summerized as :

More of the total environment can be simulated

The roles of simulators would not be limited.

The system would be very flexible.

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