COMPUTER-ASSISTED INSTRUCTION
(THE SFTS AS A COMPUTER-CONTROLLED TRAINING DEVICE)

Mr. D. E. TRUNDLE
Senior Training Analyst, Training & Education
Processes Department, Silver Spring Operations
The Singer Company, Link Division

INTRODUCTION

I would like to open by giving credit to John Walsh who is now working for the General Counsel's Office of the FAA. John was primarily responsible for the conceptual development and implementation of Automated Training in the Link Synthetic Flight Training System, (SFTS).

THE SFTS AS A COMPUTER-CONTROLLED SYSTEM FOR TRAINING

Many training devices utilize computer driven equipment to provide training in tasks related to the operation of aircraft, locomotives, spacecraft or weapon systems in a total system called a simulator.

The SFTS is more than a simulator. It is a total training system which utilizes four UH-IH helicopter simulators as a part of the training system. The other parts of the system use feedback response from each of the four simulators to determine what the system should indicate to the instructor, the simulator, and the student(s).

The basic components of the system are:

- Four UH-IH cockpit simulators on motion bases
- Instructor's station controls
- Displays
- Aircraft sounds, taped messages for student exercises
- Computer complex for display system
- Computer complex for aircraft related systems and automated training.

Major functions of the total system are:

- To simulate UH-IH aircraft
- To respond to and control inputs to an instructor's station and student station
- To record information
- To control audio tape messages presenting training situations to the student
- To display student performance information
- To analyze and score student performance

This system faithfully simulates the UH-IH helicopter in terms of its associated systems, which include such things as airframe, power plant controls and indicators, and avionics equipment.

A complete instructor's station is capable of managing training in four cockpits simultaneously and of providing instructor/student communication, data displays (CRT's for student and instructor), data control, problem monitoring, training problem selection, malfunction control, closed circuit television control, flight recording control, and hardcopy device output control.

In addition to the capabilities mentioned, the device is capable of performing in two modes of operation, using different cockpits simultaneously. These modes are manual and automatic.

The manual mode need not be discussed because the automatic mode of operation is a derivation of the manual capability.

In a system that is completely controlled by a computer complex, the term AUTOMATED MODE of training, is an indication that the system is controlled by a computer and provides computer assisted instruction (CAI). This should become clear as we progress in the presentation.

COMPUTER-ASSISTED INSTRUCTION

Primarily, the function of the computer in a system such as this is to completely control all aspects of system operation. Since this is inherent to the system it implies the most important aspect of the system, that is, the COMPUTER is always aware of what is happening.

Since the computer recognizes student inputs it will react, during like training situations the same way time after time, regardless of who the student is. The computer never has a hangover from a night out.

In other words, the computer is in the system to assist instruction, because it is free from natural human weaknesses, it can anticipate actions, it will always respond in the same manner for every student for every training situation programmed into it. Actual flight situations can be duplicated and student execution monitored for comparison to established performance standards.

This brings up another important fact about COMPUTER-ASSISTED INSTRUCTION. The computer is a flexible instructor. It can be given new criteria to use, when scoring students, it can be given new methods to use in controlling the system, and it can be given partially or totally new training assignments without the need for a new device. This is accomplished by modifying existing computer programs and data (software), or developing additional software.

AUTOMATED INSTRUCTION IN THE SFTS

FUNCTIONS OF THE INSTRUCTOR'S STATION AND ASSOCIATED EQUIPMENT.

There are four functions, which the computer performs, for the SFTS while it is controlling the four cockpit simulators during automated training. These are:

1. Monitors and controls instructor station and associated equipment
2. Controls cockpit pilot training aids
3. Initiates information storage and retrieval
4. Selects and executes programs

The computer monitors the mode control switches, providing inputs to student monitoring devices at the instructor station such as: displays, selected student aircraft instruments, displays for ground tracing, altitude and vertical velocity plotting. Provisions exist for cueing and selecting appropriate devices for communications. In addition, the computer provides hardcopy printout, when the instructor requests it, for all cockpits. If the instructor wants to insert a training period or portion of a period for a student in a particular cockpit, he interrupts the actions for a selected cockpit. Through the use of a thumbwheel switch, and pushbutton switches, he can override anything that the computer is currently doing.

Malfunctions are programmed into selected problems. The instructor can prevent these from being automatically inserted by watching for displayed indications that it will be inserted and then inhibiting or removing the failure for the cockpit.

The instructor interacts with the system in the automated mode of operation. So does the student.

COCKPIT PILOT TRAINING AIDS.

The student has his normal cockpit instruments and controls. He can monitor his progress and the status of his trainer during certain phases of training by monitoring special student scoring and status indicator lamps. He can also monitor his own display unit to select training exercises, observe the map of his training area, and obtain information regarding his performance. Of course, the student can communicate with the instructor at his own discretion.

AUTOMATED TRAINING DESCRIPTION

All of these functions are going on during an automated training session. An automated training period is made up of the following:

● Briefing
● Demonstration
● Guided Practice
● Adaptive Practice
● Related Problem

A BRIEFING is automatically selected by the computer by cueing a particular selection on a tape to play through an audio system. The briefing will tell the student what to expect during the training period and tell him to start when he is ready.

During a DEMONSTRATION the cockpit is totally driven by the computer to do what the briefing has described.

When a GUIDED PRACTICE is in progress the student is permitted by the computer to operate selected control functions.

During an ADAPTIVE PRACTICE phase the student is permitted to control selected functions, but the computer inserts a selected parameter variation to increase level of difficulty in response to the student's performance. The adaptive variable is modified to make a task easier if the student has an error rate that is too great for the task being performed, or to make a task more difficult by increasing the effect of the variable if the student has a low error rate. When the computer acknowledges that the student has reached the end of an assigned task without reaching the maximum difficulty level as the result of his error rate being higher than that which is acceptable, the computer will automatically recycle the student through the task for more practice. If, however, the student reaches the minimum difficulty level when the computer is specifying further decreases in level of difficulty and the error rate is still too high, the computer will automatically stop all action so the instructor can intervene for consultation with the student. When the student has progressed to the highest level of difficulty for a task with acceptable error rates, the computer will proceed to "setup" for the next task. When a student is executing a problem during training he has complete control of the cockpit, but the computer is monitoring and scoring him throughout the problem, providing data to the system to be saved for instructor reference for critique and/or evaluation.

AUTOMATED TRAINING DATA

From the preceding statements it can be concluded that large quantities of data are being supplied to the computer to control the training program, sequencing of events and also for recording performance. The SFTS utilizes disc storage for this capability.

Automated training data is retained on the disc for use by the computer for training control. The computer also collects and organizes specific student performance data for output and later statistical analysis and review. This is accomplished simultaneously for each cockpit.

HOW THE COMPUTER ASSISTS INSTRUCTION

CONTROL FUNCTIONS.

The computer has stored in an internal memory complete sets of programs which provide:

- For monitoring and controlling all switches and lamps in the system
- For initialization of each cockpit to any one of nine training periods selectable by an instructor or student

- For information storage and retrieval
- For dispersing data to appropriate systems
- For selecting which programs should be executed and what the sequence is and when to execute.

The computer programs are controlled by a program called an EXECUTIVE. The function of the executive program is to control the WHEN and WHAT of a system of programs. When a cockpit is to be initialized, a particular program produces outputs, which set the device up, in a predetermined condition based on selected data retrieved from a particular disc file record. When this process is complete, the programs executed are those necessary for automated training. These are:

- Flight control
- Student performance measuring
- Automated demonstration
- Automated guided practice
- Automated adaptive practice
- Alert message control
- Displays control
- Automated malfunction selection
- Problem control
- Performance recording

and many more.

TRAINING FEATURES.

The features of the system, which are a result of the execution of these programs, are completely computer-controlled training periods

- Briefings, demonstration, guided practices, adaptive practice and problems
- Performance monitoring and recording
- Copilot relief
- Debriefing tapes
- Auto malfunctions and communication scripts for instructors

SUMMARY

PRESENT SYSTEM.

In brief, the SFTS system is a completely computer-controlled four cockpit training device. The instructor's role is one of interaction in the system only as an integral part of the system.

The computer has programs which are controlling a dynamic feedback response network. While the Computer programs are causing reactions to the outputs of each independent simulator, other programs are:

- Monitoring student and instructor setup requests
- Obtaining information from the disc file
- Putting data on the disc

- Monitoring student performance
- Selecting programs to be executed by the computer
- Controlling the display of information to both student and instructor
- Controlling the aural information presented to the student

It is important to remember that the computer has been programmed by humans. One must realize that the computer is merely an extension of the human brain, but it cannot learn. Its primary attributes are repeatability and programmability.

It is possible for the student to beat the system, that is, achieve a high score without performing in a prescribed manner. This is why the system has measures that are a reflection of performance criteria and do not simply correlate with them. Therefore, the computer truly assists the instructor by eliminating human subjective evaluations, when objective measures can be applied to each student, based on a prescribed set of training situations which each student must perform.

FUTURE COMPUTER ASSISTED INSTRUCTION.

The current Synthetic Flight Training System lends itself easily to future applications. In its present form, new and varied training exercises can be added to its automated training period repertoire by making adjustments and/or additions to input data. Also, as pilot requirements change or evaluation criteria change they can be readily incorporated into the existing system (programming) without the need of an entirely new device.

Automated training need not be restricted to aircraft alone, but can be used for nuclear and non-nuclear power plant operator training, ASW equipment operator training, or GCA flight controller training, just to name a very few.

Automated training techniques can be applied in any training situation that requires objective performance measurement, flexibility of criteria for evaluation, and the capability to apply new techniques to an existing device, or to a new device.