THE SIMULATOR DATA TEST INSTRUMENTATION SYSTEM

A NEW CONCEPT IN TRAINING DEVICE FIDELITY MEASUREMENT

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ABSTRACT

The Air Force recently completed in-house development of an instrumentation system designed to measure flight simulator cue correlation, aero model fidelity, and dynamic flight handling characteristics. The Simulator Data Test Instrumentation System (SDTIS) represents a significant advance in the state of the art for flight simulation instrumentation. The SDTIS hardware is configured as a field transportable "mini-system" using composite video recording techniques to concurrently record over 180 channels of analog or digital signal data, voice audio, and television camera acquired video information. It provides immediate, in-field, automated data reduction and analysis. It permits data acquired during simulator test to be directly compared to flight test data as a measure of simulation fidelity. The Air Force intends to use SDTIS techniques as an integral part of future simulator test and specification procedures. This paper will address the SDTIS capabilities, functions, and operation in conjunction with its application to future training equipment procurements.

BACKGROUND

Military and commercial use of flight simulators for crew training has expanded rapidly in recent years in response to the rising cost of energy and new aircraft. Simulator based training systems now enable commercial airlines to transition crews from one aircraft to another (i.e., DC-9 to DC-10) with as little as one hour of actual aircraft flight time. Current trends indicate that non-revenue (training) flights may be completely eliminated by some airlines in the near future as the effectiveness of both simulator hardware and related instructional systems is improved. Military flight simulation has traditionally been more demanding of technology than its commercial counterpart. When compared to airline flight operations, military flight tasks are more difficult, involve more diverse and complex systems, and demand development of vastly more complex simulators. Future military flight crew training programs will depend on use of a "family" of training equipment, ranging from table-top part task trainers to fully integrated weapons systems trainers (WST). The most complex of these simulate not only the airframe flight dynamics, basic flight instruments and controls, but also closely duplicate the control stick "feel", cockpit motion, vibration, buffet, and the pilot's complete external visual field of view. Visual displays provide a complete 360° out-the-window view of the sky, horizon, ground terrain, airbases, ground targets, ground threats, airborne surface to air missiles, and other aircraft. Radar and electronic viewing system sensor imagery (forward looking infrared television - FLIR) is also provided, in conjunction with simulations of imagery generated by precision guided munitions and other weapons release and guidance systems. Navigation systems and electronic warfare equipment functions are also simulated. Thus, the WST represents a fully integrated trainer.

As pressure to trade-off flying hours for simulator time has intensified, military simulator users in turn have demanded simulation fidelity far beyond that which would have been acceptable in years past. This leads to consideration of simulator "cue" fidelity and "cue" correlation, which are discussed in the paragraphs which follow. Flight simulators may be viewed as closed "man in the loop" systems, wherein the simulator hardware is expected to provide accurate cues in response to pilots' control inputs. This concept has conventionally been applied to aeronautical performance parameters; however, it may likewise be applied to simulation of systems for navigation, electronic warfare, fire control, precision guided munitions control, and more. The concept in each case is the same; the simulator pilot makes inputs through his controls, and expects to perceive appropriate "cues" in response.

Proper "correlation" of the simulator cues is essential for any simulation. Human physiology allows us to sense an event time difference as small as 100 milliseconds. For example, if a man operates a switch controlling a lamp, and the lamp does not illuminate within 100 ms after the man moves the switch, he will be aware of the time delay. Thus, it is important that the simulator produce accurate cues which are properly time correlated with the control movements <u>and</u> with the other cues produced. Visual or motion simulation systems which respond to control inputs 400 or 500 milliseconds after the panel instruments react will be of little value. Moreover, it is important that the cues not only <u>start</u> at the proper time, but also that their magnitude versus time be matched to the aircraft performance. Matching of simulator cue time histories with those perceived by pilots in the aircraft thus becomes a major simulator design task. Failure to do so inevitably results in unhappy simulator pilots who report that the simulator "doesn't fly like the airplane." Quite often they can't tell you <u>why</u> it doesn't fly right; they merely perceive a difference. In most cases, that difference can be quantitatively traced to poor cue fidelity, or poor cue correlation. Of course, simulation is a cheating game; it is not technically possible to perfectly duplicate many cues. Designers must therefore be both clever and innovative in "tailoring" the cues available within the state-of-the-art such that perception of cue errors is minimized.

Development of flight simulator cue fidelity is largely a "black art." Each contractor pursues the matter a little differently. Initial success is highly dependent on the quality of aerodynamic performance data available from aircraft flight test sources. More often than not, data available falls far short of that needed for development of a high fidelity simulation. Reasons are numerous. Quality data may be unavailable due to the fact that a simulator is being developed concurrently with the aircraft, forcing use of generic aero models, wind tunnel data, iron bird characteristics, etc. Quite often, the only aero data available is based on tests of previous aircraft configurations which differ considerably from that to be simulated. As a rule, the only aircraft test data recorded and preserved is that required for airframe acceptance or performance evaluation; data characterizing the full spectrum of systems and cues perceived by the pilot is not acquired or preserved. At best, data available allows simulator designers to develop a good aerodynamic model. However, one must recognize that the aero model represents only one link in the chain of signal processing which occurs between the pilot's control input and cues produced. Flight test data is normally not acquired which can be used to support the "end to end" test concept discussed above.

Past simulator acceptance tests have been based on performance of a "family" of tests. Wherever possible, peripheral systems (such as electronic warfare hardware) are tested independently. Limited tests of the computer's aero module (which look only at the aero model, and do not consider data processing of control inputs, cue drive outputs, linkage delays, etc. which occur before and after the aero model) are performed using spare computer digital to analog outputs and strip chart recorders. Handling qualities (including control stick response) are measured statically. No multiple axis, dynamic tests are performed quantitatively. These tests are left to test pilots who evaluate the simulator performance subjectively. Thus a pilot is the first evaluator of integrated simulator performance. Government test procedures have normally required a subjective simulator evaluation by teams of experienced pilots wherein the contractor was required to make hardware and software adjustments until the dynamic simulator performance matches the pilots' memory of aircraft performance. Unfortunately, pilots became "simulator acclimated" in just a few days. All too often, simulator performance acclaimed as adequate by one team was judged inadequate by the team that followed. This subjective procedure usually resulted in an endless iteration of tests. There was no method of tracking a performance fidelity baseline. Such handling qualities tests ultimately delayed simulator deliveries at great expense to both contractor and government.

FUNCTIONAL CONCEPT

Functional concepts for the Simulator Data Test Instrumentation System were developed by Air Force engineers based on their experiences in the subjective domain discussed above. The SDTIS embodied two basic concepts. They were:

1. That it should be possible to quantify simulator handling qualities and track handling qualities changes through use of "end to end" system measurements; i.e., a comparison of cue time histories versus control input time histories, and

2. That, if given identical control inputs, the simulator and aircraft would produce "comparable" cue time histories. The first concept is now well proven; the second is still on trial.

Functional SDTIS requirements included the ability to:

a. Quantitatively measure and record the magnitude, phase, and time relationship of simulator cues produced in response to standard dynamic, multi-axis control inputs. The recording capability must include simultaneous, synchronous acquisition of analog and digital signal data, optically acquired data such as dial pointer positions and visual display positions, g-seat and g-suit forces, motion platform position and acceleration, stick position, and stick force.

b. Make measurements of cue time histories produced in response to multi-axis control inputs produced by a mechanized, automated, simulator stick (and rudder) mover. The control movers must be programmable to produce standard reference inputs (step, ramp, and sine) as well as to duplicate aircraft control movements made by test pilots flying missions from which simulator reference data was taken.

c. Automatically reduce data recorded into forms readily useable by simulator engineers. In field co-plots of time histories were required as a minimum. (Cross plots were subsequently added as a requirement.)

d. Automatically compare (through on-site, in-field plots) data recorded against that obtained from flight test and other data sources.

e. Self calibrate, automatically scale, and label all data recorded.

f. Be field portable such that the system could be easily transported (as airline luggage if necessary) to contractor facilities or Air Force field sites.

DEVELOPMENT STATUS

Development of the SDTIS was initiated in January 1978 as an in-house activity performed by the Visual and Electro-Optical Branch of the Simulator (Engineering) Division of the Aeronautical Systems Division (ASD). Program funds and support contract management were provided by the ASD Simulator System Program Office. This effort is now nearly complete. Ninety per cent of the design, and 50 per cent of the fabrication was performed as an "additional duty" responsibility by Air Force simulator engineers, technicians, and cooperative engineering students who were also required to support simulator acquisition programs. The balance was performed as sub tasks by a local

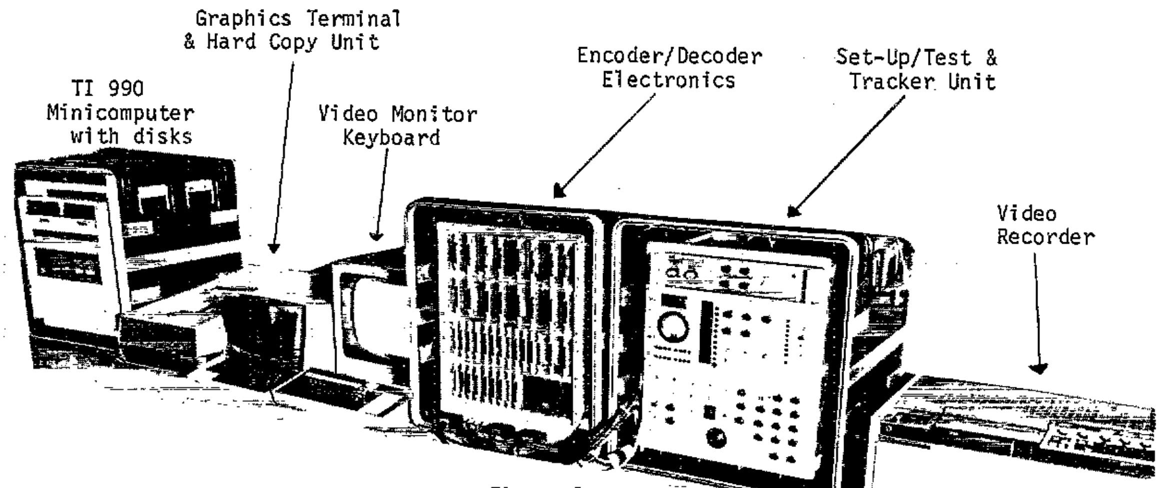

Figure 1

Simulator Data Test Instrumentation System

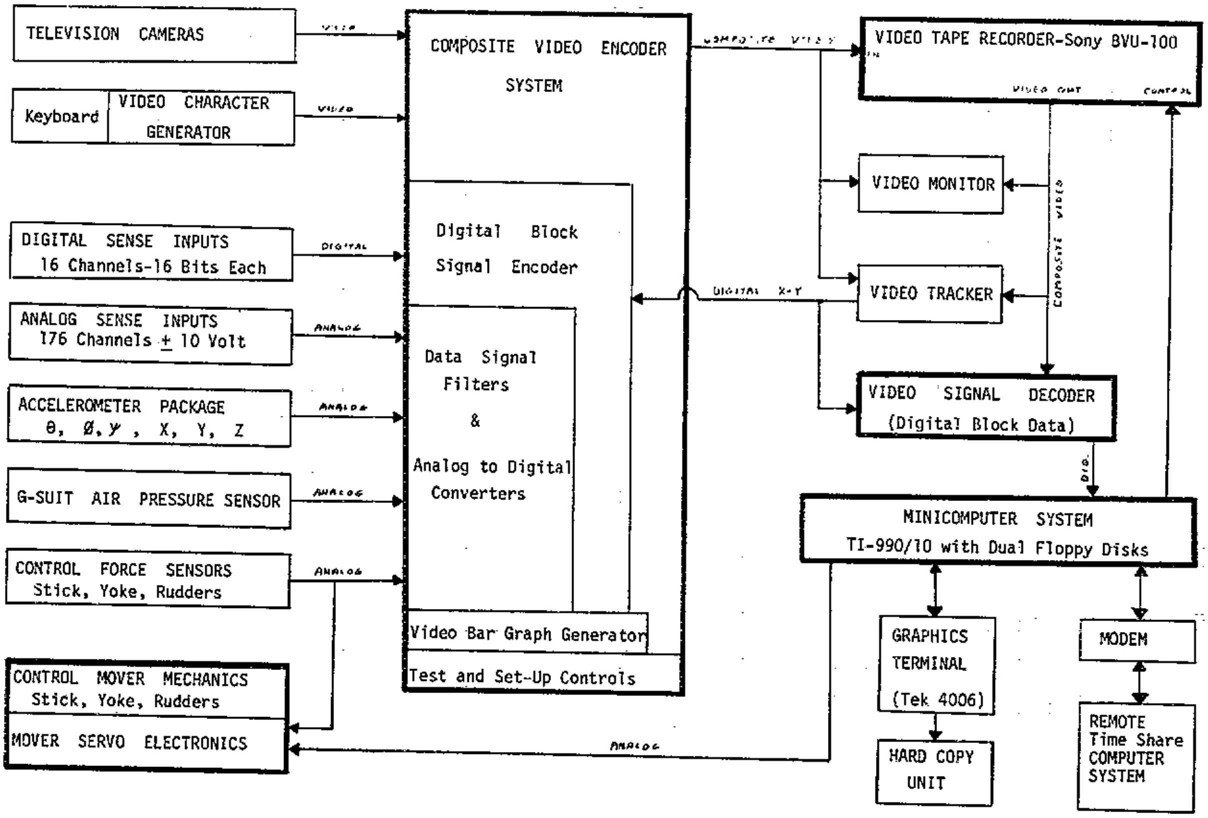

Figure 2

SDTIS Block Diagram

support contractor. All initial design objectives have been achieved; most have been expanded. Development cost to date is approximately $300K for parts and contractor support.

SYSTEM DESCRIPTION

The SDTIS system (less control movers) is shown in Figure 1, as represented by the block diagram of Figure 2. It consists of a family of sensors, video encoding and decoding electronics, a video recorder, a mini-computer, graphics terminal with hard copy unit, and a family of control movers. The functions of each subsystem will be discussed below.

Sensors

Six basic sensors have been provided for simulator instrumentation. These are:

Analog Signal Inputs - The SDTIS system has the capacity to record 176 channels of analog signal data. The signal encoding, cabling, and filtering subsystems are physically and functionally organized into blocks of sixteen channels. Analog signals (from simulator electronics, backplanes, etc.) are acquired through the use of alligator clips, J-clips, push on connectors, etc., and are connected to terminal blocks on J-boxes (or spider boxes). See Figure 3. Each J-box accommodates sixteen signals. Fifty foot lengths of multi-wire cable are then used to connect the J-boxes to the encoder electronics rack. Analog channel inputs are differential with input impedances which exceed one meg ohm (limited only by the cable capacitance). Portable, hand held, battery operated isolation electronics are used where signal loading is a problem and additional isolation is required. Simulator signals thus acquired include control force and position follow-up signals, command and follow-up signals for visual system servos, motion platform servos, panel instruments, and g-seat bellows.

Digital Signal Inputs - The SDTIS system, as currently configured has the capacity to record sixteen 16-bit digital channels. Signal input mechanics are configured much like the analog inputs discussed above, except that the J-boxes house active electronics which:

a. provide additional isolation

b. provide for digital word latching triggered by an external signal (master clock or signal valid), and

c. accommodate digital inputs of varying thresholds, polarities, etc.

Each J-box handles one 16-bit input.

Motion Sensors - A motion sense package has been provided for motion platform acceleration measurements. The package consists of a three axis rate gyro, three linear accelerometers, and the associated electronics. (Rate gyros were chosen in lieu of angular accelerometers based on cost, availability and maintainability.) This package would normally be located at the pilot's seat; however, math exists and field operable software is under development that will permit comparison of measurements taken from anywhere on the motion platform with flight test measurements taken from anywhere on the airframe.

G-suit Air Pressure Sensor - A g-suit air pressure sensor has been provided to enable cue correlation between the g-suit, g-seat signal drives, and the motion platform.

External Position Follow-Up Sensors - Retractable string connected position sensors have been provided for measurement of control and servo movements in areas where internal simulator follow-up signals are unavailable or cannot be trusted.

Control Force Sensors - Force sensors have been acquired for stick, wheel/column and rudder control inputs.

TV Cameras - Three television cameras (one low light level intensified silicon vidicon, one Newvicon, and one silicon vidicon) have been provided for acquiring cues which are not available as electronic signals. Instrument panel dial pointer movements and visual display movements are of primary interest. Many simulator flight instruments are dc-servo replications of actual aircraft instruments - hence instrument response delays required to match aircraft instrument performance (cue correlation) are a simulator software function. Simple measurement of instrument command signals may be inadequate for cue correlation work using the "end to end" test concept. A video tracker, capable of either edge or centroid tracking, has been provided to enable dial pointer/visual horizon position tracking. The tracker functions in conjunction with electronics which "mask" instrument or display geometry which may confuse the tracker. For example, a donut shaped mask is used to track dial pointers, so that the tracker is permitted to see only video from the arc transcribed by the dial pointer tip.

Data Encoder/Decoder

The encoder/decoder shown in Figure 4 is responsible for formatting all of the sensor signals discussed above into a composite video signal suitable for recording by a standard video recorder. The composite television picture format recorded is illustrated in Figure 5. The first 15 per cent of each TV line is committed to hosting a 16-bit digital word. Thus, a "digital block" appears along the left edge of the TV picture which accommodates 240 words per TV field. All signal data is recorded in a digital format within this "digital block." The remaining TV picture area (amounting

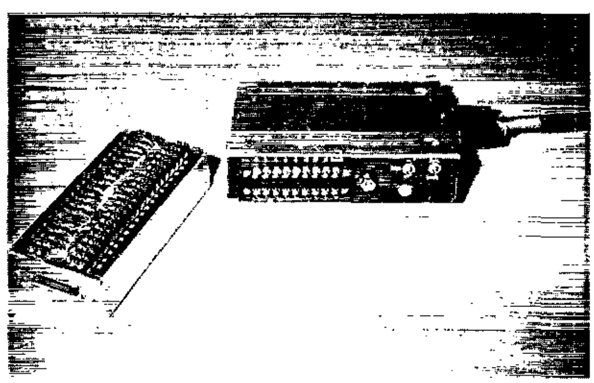

Figure 3

Analog and Digital Sense Boxes

to 85 per cent of the active TV picture) is available for recording of TV camera video and for display of labeling information. Within the digital block, 176 words are assigned to analog signal data, 16 words to digital signal data and 48 words to data labeling information. Hardware signal filtering is available for selected analog input channels with various cut-off frequencies available from 30HZ to 240HZ.

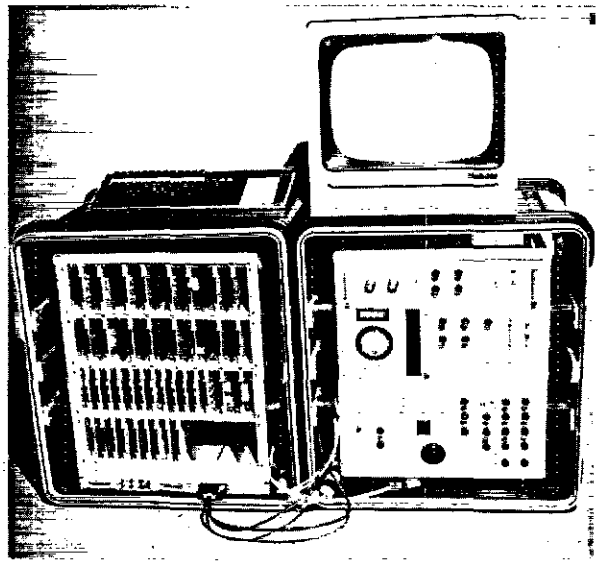

Figure 4

Encoder/Decoder Electronics with Built-In Test/Set-Up Panel and Video Tracker Controls

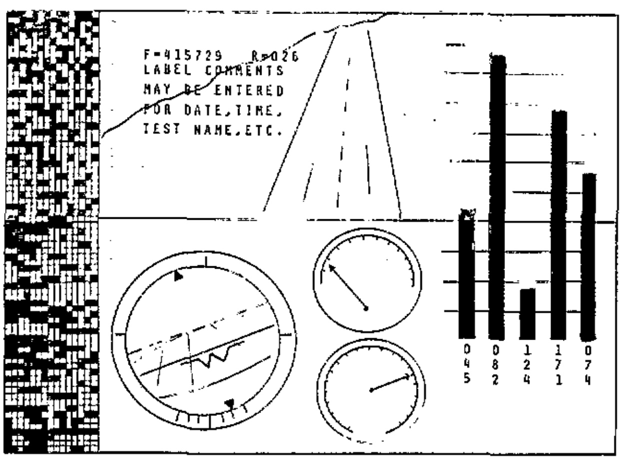

Figure 5

SDTIS Video Format

A video bar graph system has been provided as a test and set-up tool. Up to ten vertical bar graphs may be added to the composite video picture. Any of the 176 analog channel signals may be assigned to any of the 10 bar graphs, with the bar height representing signal magnitude. Bar channel assignments are displayed at the base of each bar. The encoder electronics includes a video character generator for display of "labeling" information. Labeling is performed at two levels. First, each data run is identified with a label which appears continuously in the video picture, indicating run number, the ever changing TV field number, date, time, and miscellaneous comments. Second, each signal channel is labeled with a 64 character identification used to describe the variable name, source, scaling, etc. Channel labels do not continuously appear in the video picture as characters, although they are "scrolled" through the picture at the beginning of each data run. All label information is encoded in the digital block, thus making it available to the in-field computer for proper labeling of graphs and hard copy output data. All labels, bar graph assignments and video image location assignments are controlled (entered) via a TV typewriter keyboard shown in Figure 6. Two channels of audio are concurrently recorded with the data discussed above. These are normally used to record simulator pilot intercom audio and test director comments.

Figure 6

Television Monitor and

TV Character Generator Keyboard

Video Recorder

The SDTIS design concept is based on the use of a commercial, U-matic, 3/4 inch cassette, editing type, video tape recorder as the primary data recording device. (Figure 7 - Sony BVU-200A) A video recorder was chosen because it:

1. was, in fact, a very wide bandwidth data recorder with information recording capacities which vastly exceeded those required for this effort, and
2. was available at very low cost, compared

to available instrumentation recorders of comparable capacity, and

3. allowed integrated recording of audio and video data in addition to the digitally encoded multi-channel signal data, and

4. was easily interfaced to a digital computer allowing automation of data recording and reduction tasks. The SDTIS design concept utilizes only 15 per cent of the active video field for recording the digital encoded signal data. This amounts to a 200 Killobit/second recording capability of one hour duration. If additional digital recording capability were required, the digital block could be expanded over the total active picture area to achieve a 1 megabit/second recording capability.

Figure 7

Sony BVU-200A U-Matic Video Recorder

Recording Characteristics

The above paragraphs describe a very flexible data recording system. The inherent character of the TV signal format used provides a built-in 60HZ signal sample rate for all data recorded. In effect, each data channel is digitized, and recorded sequentially within the digital block. This means that each channel is sampled, sequentially in time 63 microseconds apart. The time shift of signal sampling normally provides no problem for typical simulator measurements - as all signals are sampled within 16.3 milliseconds - a recording time accuracy which exceeds all known requirements to date. However, software can be provided which will account for the line by line signal sample time offset in plotting. The sequential sampling does provide one advantage; signal sampling rates greater than the 60HZ TV fixed rate are possible if the same signal is applied to two or more channels which are evenly spaced within the TV field. Thus, the system is capable of operating at a 120 or 240HZ sample rate, at the expense of the total number of channels available. To date, the 60HZ rate exceeds all simulator recording requirements.

Data Review

Once recorded, the video data may be reviewed by test personnel in much the same way you would review film with a film editor. Video recorder controls allow bi-directional tape playback at a variety of speeds running from field by field stop motion to twice real time. Test directors may listen to the audio and watch the movement of dials, indicators, and bar graphs representing selected signal data. As they slew through the tape, they may also note the video field numbers appearing in the run data block. When a section of data of particular interest is located, the operator then need only note the field number appearing at the start of the data of interest.

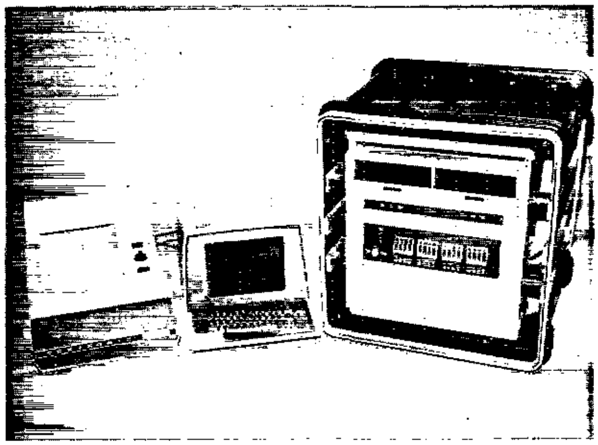

Figure 8

TI-990 Minicomputer with Dual Floppy Disk

Tektronix 4006 Graphics Terminal

Tektronix 4631 Hard Copy Unit

Data Retrieval

The data retrieval system consists of a Texas Instrument TI-990/10 Minicomputer System, a Tektronix 4006 Graphics Terminal, and a Tektronix 4631 Hard Copy Unit. (See Figure 8) The computer is a 16-bit minicomputer configured with 32K words of memory and dual floppy disk drives. Automated data retrieval is initiated using the graphics terminal keyboard to enter the beginning field number and the time duration for the data of interest. The computer will then take control of the video recorder, search for the data of interest, and transfer all digital block signal data from the video tape to the computer memory. Data is then sorted by channel and stored on a floppy disk. The operator will then be prompted to select the types of plots required. The graphics package will co-plot up to six channels of time history recordings, or will cross-plot (X-Y_1Y_2) any three channels selected. See Figures 9 and 10 for examples of time-plot and cross-plot graphics. In each case, the plot packages will also label and scale the graphs using the run and channel labeling information entered prior to recording, and carried within the digital block. The hard copy unit will

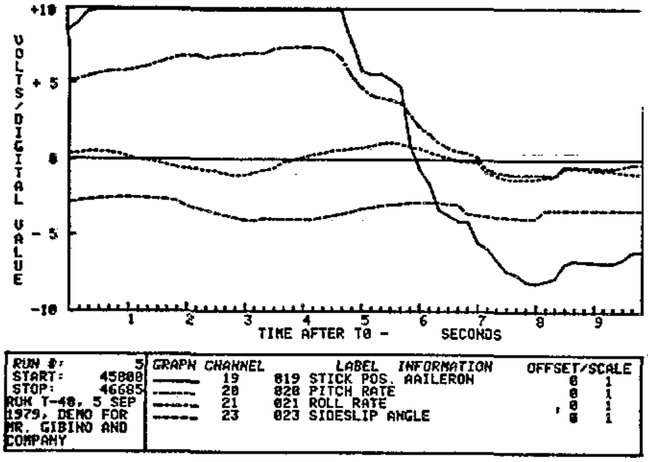

Figure 9 Time Plot

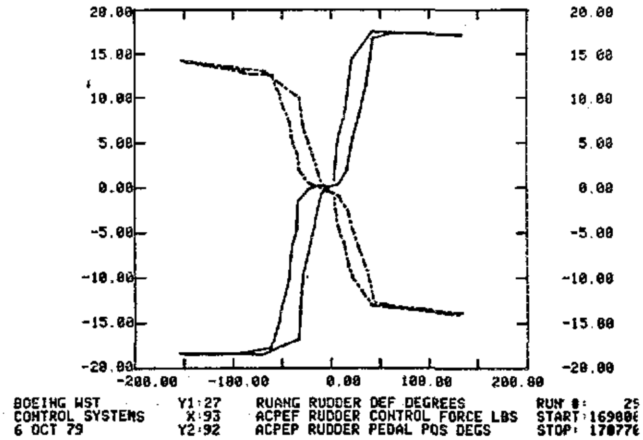

Figure 10 Cross Plot

reproduce all graphics. It is significant to note that the plotting package and retrieve software process only sixty data points (samples across time) for each of the 192 channels recorded. The plotting resolution of the graphics hardware cannot practically handle more than 60 to 100 data points. Thus, if a data retrieve of one second is desired the computer will transfer the plot values for each channel from every TV field recorded during the one second period (60). However, if a two second retrieve period/plot is required, the computer would process and plot data for all channels from every other field. A ten second retrieve would result in data being taken from every tenth field, etc. The system will retrieve and plot (on one sheet) data of any time interval from 1 second to 60 minutes using the sixty point sampling retrieve systems described above. Plotting of multiple 1 second graphs (most probably scotch taped end to end) is required in situations where <u>every</u> point recorded <u>must</u> be plotted. No simulator applications to date <u>have</u> required such plotting resolution.

Data Analysis

A very limited amount of data analysis capability has been provided as part of the SDTIS software. Four programs will be available. They are:

1. Software Filtering - A three pole butterworth filter is available and can be used to process any 60 point time history retrieved from video tape.
2. Accelerometer Translation - An accelerometer package location translation program is in development which will allow pilot seat acceleration to be taken from anywhere on the motion platform.
3. Six Post Motion Platform Conversions - Many simulators today are designed with six post synergistic motion platforms. These systems provide six degrees of freedom movement, but the axis of platform motion is usually the synergistic product of the movement of six hydraulic drives. All simulator computer software is structured to drive these six hydraulic cylinders, with signals which are easily recorded. However, review of the six post drive values tells one very little - what is desired are the resulting values of platform pitch, roll, yaw, and heave (x, y, z). Transformations have been developed for this conversion. Thus, the six post drive/follow signals can be used to produce time histories of platform motion which can be directly compared to other simulator flight performance parameters or aircraft data.
4. X-Y Position to Angle Conversion - Routines for plotting video tracker X-Y position outputs as a function of dial pointer angle.

Extensive data analysis is possible if the SDTIS is linked to a larger computer system with a modem. This will permit use of techniques such as Fast Fourier analysis which are generally beyond the capability of the SDTIS minicomputer. Software will be developed which will allow the SDTIS system to act as a data terminal to the General Electric Timeshare network. This arrangement should give simulator engineers the best of both worlds - independent data reduction to the maximum extent possible, coupled with the power of a large system when and where needed.

Control Movers

Previous sections of this paper have described the basic functions and design of the SDTIS - to sense cues, to record them, and to conveniently reproduce them as hard copy plots. However, the SDTIS (or any other instrumentation system) is incapable of fulfilling its intended "end to end" test roll without the ability to provide standard, controlled inputs for the simulator controls (stick and rudder). Comparison of cue time history data taken from run to run on the same simulator is not possible unless the control inputs (which caused the cues to be produced) were nearly identical. Even more significantly, comparison of simulator cue time histories with flight test data is not possible unless the simulator is flown under the same initial conditions, and with the same control inputs, as the flight test airplane. Such controlled, standardized inputs are not possible using human operators (pilots). Thus, we see the need for a family of control movers that are capable of:

1. Three axis dynamic control inputs
2. Making <u>standard</u> control inputs which are likely to produce known results (ramp, sine, etc.)
3. Reproducing aircraft control inputs as recorded by flight test instrumentation, and
4. Operating in either a position or force mode (force versus time or position versus time).

Figure 11 shows the yoke and rudder movers with associated controls and electronics designed for this purpose. Test and system integration of the movers is now ongoing. When fully integrated, the control movers will be driven by prerecorded control movement profiles which have been stored on floppy disks. Use of the movers will then complete our ability to perform a controlled "end to end" simulator system test. Figure 12 shows the yoke mover coupled to a control yoke. Note the force sensor located near the universal joint.

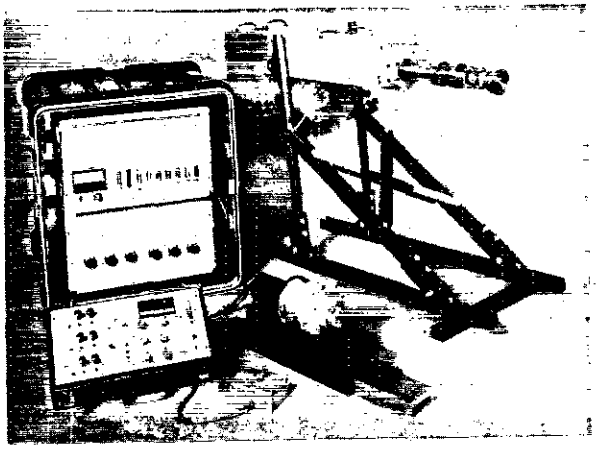

Figure 11

Control Mover Systems

(Yoke mover, Rudder mover and associated electronics)

This completes the description of the SDTIS. As illustrated in the photograph, all instrumentation hardware has been packaged such that it "could be" shipped as airline baggage by most carriers. However, the total system weight exceeds 2000 pounds. Air freight and truck are expected to be most often used.

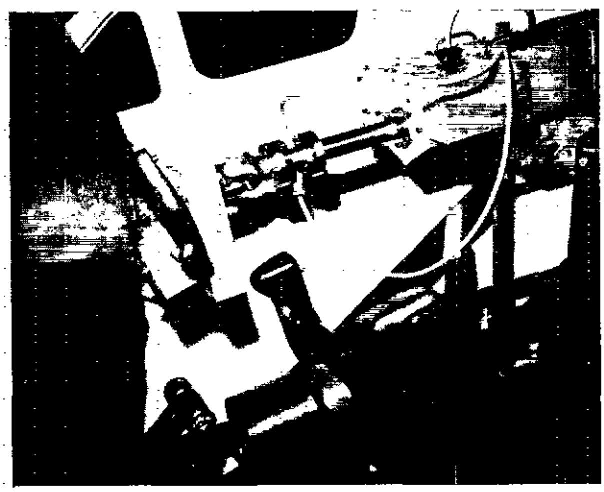

Figure 12

Yoke Mover Coupled to T-40 Simulator Yoke

FUTURE SYSTEMS-DATA BUS ARCHITECTURE

The current design concept of the SDTIS does little to consider the internal system architecture of the simulator. Of course, point to point signal tracing is possible - and was, in fact, a design objective. However, as simulator systems evolve, we expect to see the current analog interface systems replaced with architecture wherein both control inputs and cue producers (instruments and displays) are connected directly to a digital data bus. Thus, the signal tracing function will largely be replaced by a data bus monitoring function. Such is already the case with much electronic warfare (EW) simulation. The ability to eavesdrop on data bus communications is essential to system test and troubleshooting. An extension of the SDTIS to encompass data bus monitoring is now in design for the EW task. However, the basic "end to end" test concept of the SDTIS will remain unchanged. It is interesting to note too, that as aircraft systems architecture follows the data bus trend, high fidelity simulation may be even more difficult to produce. Aircraft controls and display technologists are now considering hierarchal data bus structures, wherein data is processed (by asynchronous processors) and transferred from bus to processor to bus several times. Proper simulation of cue correlation/timing for such systems may indeed by a challenge.

CONCLUSIONS

Simulator Procurement Impact

SDTIS availability is expected to significantly impact the Air Force procurement of flight simulators. Trainer handling qualities tests are expected to transition from a largely subjective activity, to a largely quantitative one, although subjective evaluation of handling qualities will probably never be eliminated completely. Use of SDTIS test procedures will be written into future procurement specifications and the specifications themselves will be written in more quantitative terms than has been possible in the past. However, the degree of simulation fidelity achievable through use of SDTIS concepts is dependent on the degree to which the flight test instrumentation community can support simulator designers with high quality data. To date, the SDTIS has been used by the Simulator SPO for evaluation of both the Boeing and Singer B-52 Weapons Systems Trainers, and by the Air Force Flight Test Center for evaluation of an F-4 Simulator at Moody AFB, Georgia.

Flight Test Impact

Use of SDTIS concepts in simulator procurement is expected to expand significantly during the 1980s. Thus there will be a demand for flight test data required to support the high fidelity integrated aircraft system simulation discussed at the beginning of this paper. This will likely impact the flight test instrumentation community in the form of requests for data from more sensors located in or near the cockpit, which are correlated with data obtained from other aircraft systems (engine, airframe, etc.). For example, accurate dynamic recording of stick and rudder position and force correlated to instrument readings, throttle setting and flight dynamics will be extremely valuable. Likewise, recordings of vibration, buffet, and g-forces experienced by the pilot and correlated to other flight dynamics will be critical to development of quality, dynamic motion simulation. The nature of flight test data processing and massage may also be impacted. Complete time histories of control force or position may be needed in areas where only peak values were required before. This is illustrated by an example of pitch trim force. During level flight, when flaps are dropped, most aircraft will naturally assume either a pitch-up or pitch-down condition. The pilot must input some amount of control stick force to pull the nose back to straight and level. Aircraft specifications are usually concerned only with the peak stick force required to resume level flight. The only data which customarily shows up in the flight test report is that number - a single value. However, development of good simulation requires a knowledge of the complete stick force time history required to trim the aircraft. Thus, we can foresee a need for not only more data (from new sensors at additional locations) but also for expansions in reporting data that is currently recorded.

Application of SDTIS to Flight Test

The current SDTIS hardware was not designed to fly (although it could probably be tested and certified for airborne use assuming an aircraft had space to hold it). However, techniques developed for the SDTIS may provide solutions to some problems of concern within the flight test community. Of particular interest should be the use of digital encoded video recording techniques. However, the SDTIS represents only one approach to exploiting a video technology that promises much capability at relatively low cost. Development of digital video sensors and recorders is now moving quickly due to the support of consumer and broadcast marketing interests. This work promises to yield future generations of advanced recording devices which may significantly surpass the capabilities of lesser developed recording technologies used conventionally for flight test instrumentation. The video techniques developed for the SDTIS should warrant serious consideration by designers of future flight test instrumentation systems.

SUMMARY

Development of the Simulator Data Test Instrumentation System is nearly complete. The instrumentation hardware and the test methodology it supports represent an extremely flexible tool which may assist both government and industry in development of training systems which exhibit the performance fidelity required in the 1980s.

ACKNOWLEDGEMENT

The SDTIS development is a product of the efforts of the engineers, technicians and co-operative engineering students within the Visual and Electro-Optical Branch at Wright-Patterson Air Force Base. The success of this system would never have been realized without their innovation and hard work. Much of the design and fabrication was accomplished through the voluntary contribution of overtime hours. I especially wish to recognize the efforts of Messrs Ronald Ewart, Steven Ingle, Edward Timko, Dana Hope, Joe Lucente, MSgts Gregory Finnie, James Loomis, William Ferrier, and 1Lt Craig Seymour. Their dedication and enthusiasm made the SDTIS possible.

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