ANNUAL REPORT

FY 1993

VERTICAL MOTION SIMULATOR

NASA-AMES

SimLab

INTRODUCTION

This is the Fiscal Year 1993 Annual Report from the NASA-Ames Simulation Laboratories (SimLab), of the Flight Systems and Simulation Research Division.

This document is intended to report to our customers and management on the SimLab events of 1993. Included is a summary of the simulation investigations conducted in the facilities during that year, plus a summary of Simulation Technology Update Projects.

The reader is referred to a corresponding document, published by SimLab and entitled "Ames Research Center, SimLab," for a description and discussion of the SimLab facilities and their capabilities for supporting aeronautical research and enhancing flight-simulation technology.

Anthony M. Cook
Assistant Chief (Operations)

Flight Systems and Simulation Research Division
NASA-Ames Research Center
Moffett Field, California 94035

1 December 1993

SIMLAB ACTIVITIES - FY93
EXECUTIVE SUMMARY

Fiscal Year 1993 was notable for several major activities:

A. Thirteen major simulation investigations on the Vertical Motion Simulator (VMS). This is an increase of three additional simulations over last year's schedule, *with the same staff*, due in part to facility improvements and capability upgrades noted below.

B. Major capability integrity/upgrade improvements were acquired and integrated in accordance with the operations/funding strategy developed in FY90.

C. The negotiation for and construction of the Evans & Sutherland ESIG-3000 Computer Generated Imagery (CGI) system for the VMS, funded by the Space Shuttle Program at $6M.

D. The last phase of a major Construction of Facilities (C of F) project to refurbish the electrical power distribution and large motor-generator set that provides D-C power for the vertical motor system of the VMS. Also the last of three phases of a major facility integrity upgrade to the heating, ventilation, and air-conditioning (HVAC) systems.

E. Recompetition of the SimLab Support Service Contract. In addition a wage and hiring freeze was placed in effect on the SYRE Support Service Contract.

F. Six papers by SimLab authors were presented at the AIAA (American Institute of Aeronautics and Astronautics) Simulation Technologies Conference, Monterey, CA, in August 1993.

A. The 13 research simulation investigations conducted in the VMS system during FY93 are shown on the following schedule. The studies ranged from rotorcraft handling qualities and performance issues, Automated NOE flight, and High Speed Civil Transport studies, to derotation, tire loads, drag chutes, and automatic landing studies for the Space Shuttle Orbiter.

PROJECT	CUSTOMER(s)
TFTA	Army
High Speed Civil Transport	Boeing
Civil Tilt Rotor	FAA/Industry
ANOE	Army
Space Shuttle (two entries)	JSC/Rockwell/Honeywell
X-Coupling	Army
THRUSTVECTOR (two entries)	Piasecki/Army
MFVT STOVL	McDonnell Douglas, Marines
E-7 STOVL	USMC, Gen. Dynamics, G.E.
MOTIVE (Simulation Technology)	NASA, Industry
Bobsled	U.S. Olympic Committee

B. SimLab management continued to comply with the FY90-developed strategy of balancing operational levels with facility integrity costs. The strategy is working effectively in that much of the obsolete equipment and subsystems have been replaced or are on a replacement schedule. Considerable scrutiny of staff size to accomplish the SimLab mission at various operational levels was performed. Non-essential positions were eliminated, while still keeping the essence of critical support intact. The SimLab support contract staff level is now 121 people (100 SYRE + 21 NSI), down from 178 four years ago, and is at the minimum for the current level of laboratory operations. In spite of this low staff level, 13 major simulations were conducted on the VMS, a 30% increase over FY92.

The VAX 9000 real-time host computer lease-to-buy was culminated with a lease buyout in FY93. An electronic video switch system was acquired and installed in the real-time network to accommodate switching between video resources and the labs and cockpits. This was an important part of the forthcoming integration of the new ESIG-3000 visual scene system, discussed below.

Two new IRIS graphics systems were acquired and integrated to support growing requirements for glass cockpit electronic displays, both head-up and head-down displays. In addition, replacement cockpit out-the-window visual scene monitors were acquired to increase productivity and accommodate the new ESIG-3000 visual system.

C. The new ESIG-3000 Computer Generated Imagery (CGI) visual system acquisition was pursued during 1993. This system, funded by the Shuttle Program, was added to a Johnson Space Center (JSC) contract acquiring multiple systems for the Shuttle simulators at JSC. Much negotiation was required to re-specify and configure the Ames VMS system to provide the broader flexibility for a general-purpose R&D capability than a purely Shuttle system. This was accomplished with a great deal of help from JSC personnel, including their in-house contractor CAE/Link, through whom the systems are being acquired. This was a good example of inter-center collaboration to minimize procurement effort, minimize costs, and maximize the benefit to NASA. Significant long-distance problems had to be overcome to make this happen, but the willingness of specific, involved people, wearing NASA “hats”, not center “hats”, made it possible. Ames’ SimLab owes a particular debt to Mr. Tom Diegelman of NASA JSC, for his pivotal role and NASA dedication to the project, and to Mr. Claude Robertson of CAE/Link, at JSC.

The system was delivered to Ames SimLab on October 4, 1993, and will be tested, checked-out, integrated, and operational for the next Shuttle approach and landing simulation in February 1994.

The end result is a simulator visual system that has significant flexibility for VMS aeronautical research and development, that also shares commonality with the JSC shuttle training simulators, and the VMS at Ames. This will provide commonality and standardization of training for shuttle astronauts for the approach and landing task for the Orbiter.

D. During a scheduled three-month maintenance period in FY93, three very important maintenance projects were completed on the VMS system. These were:

1. Major inspection, refurbishment, and preventive maintenance of the vertical motion drive 12,000 HP motor-generator set.

2. Modernization upgrade of the vertical drive electrical power distribution system.

3. The above C of F projects shutdown afforded the opportunity for additional maintenance and upgrades that were waiting in the queue for a window of opportunity. These included:

   a) Removal and resealing of the hydraulic actuators for the yaw and longitudinal motion axes.
   b) Replacement of all of the analog wiring from the cockpit, through the catenary system and into the control room and labs. The new wires are higher in quality and significantly lighter in weight.
   c) Replacement of the instrumentation systems used to measure and balance motor current for the vertical drive motors, with higher quality instruments to improve capability of torque-balancing of the motors.

Work-around scheduling, plus the lease of a portable chiller system allowed for full fixed-base simulation investigations for the twelve weeks during which the building HVAC system was down.

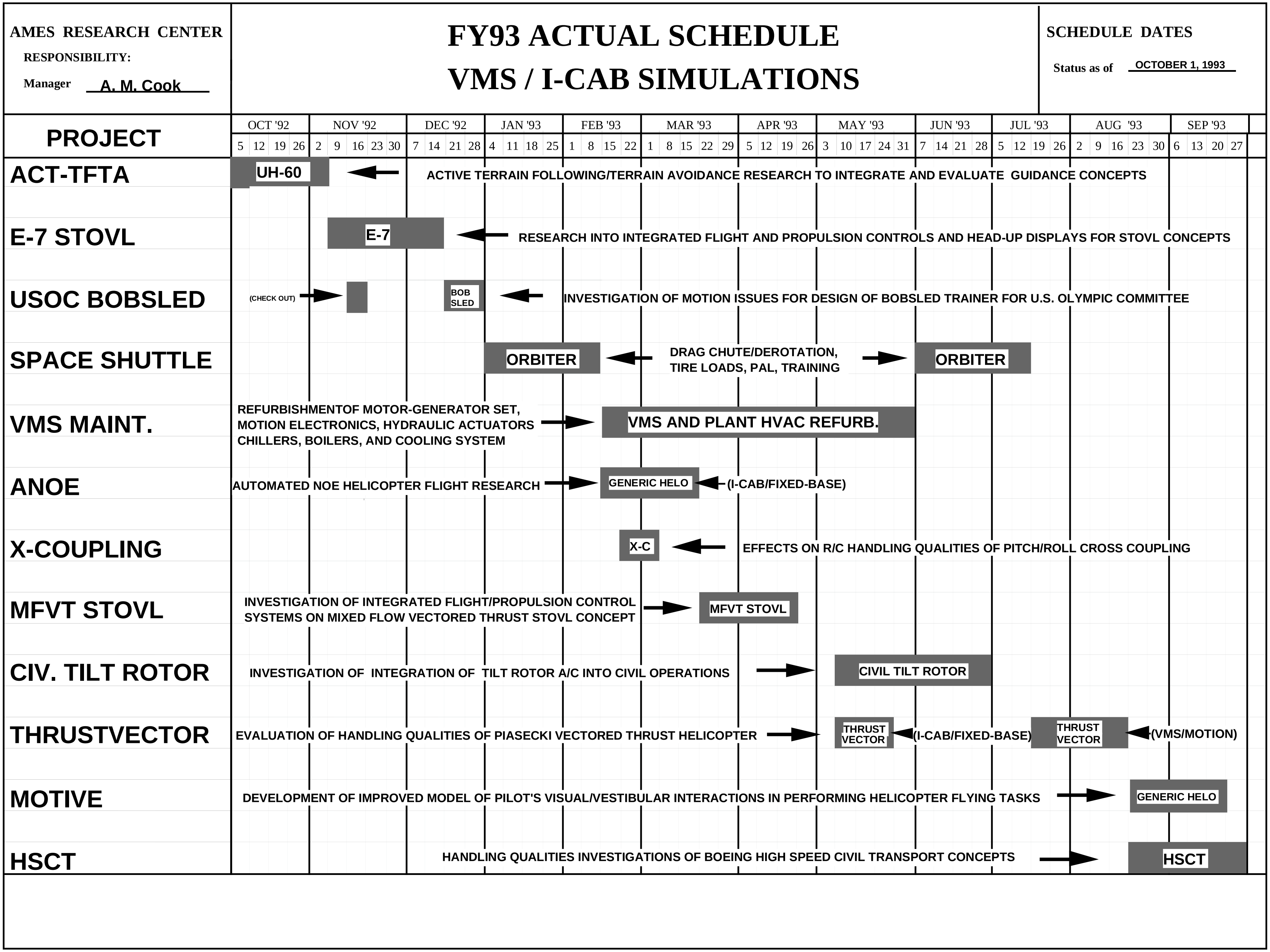
E. The recompetition for the SimLab Support Service Contract was completed in FY93. The Source Selection Statement was signed by the Center Director in July, selecting the incumbent contractor, SYRE. Negotiations were completed in September, and the new contract was signed on October 7, 1993.

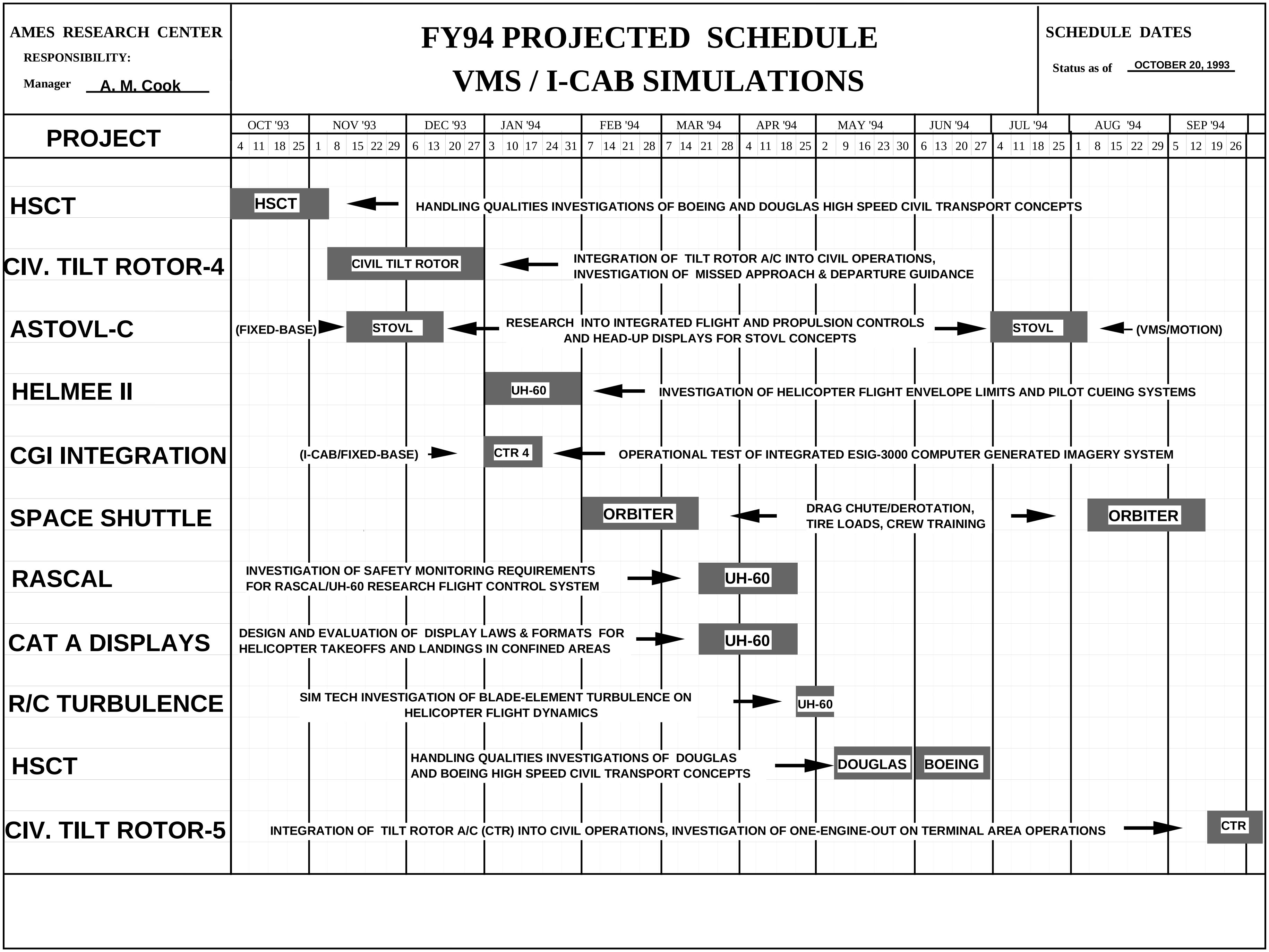
F. Members of the SimLab staff authored seven, and presented six papers at the AIAA Flight Simulation Conference, in Monterey, CA in August. This constituted 15% of the papers at the conference.

FUTURE PLANS

- Integration of the new ESIG-3000 CGI visual scene system into the real-time simulation network. First full-up checkout simulation is scheduled for the first three weeks of January 1994, and first operational simulation is the Shuttle approach and landing simulation in February.

- Continued high-quality, high-fidelity R&D simulation capability to support the NASA and national aeronautical development programs. The VMS schedule for FY94 is enclosed.


AMES RESEARCH CENTER
RESPONSIBILITY:
Manager A. M. Cook
FY93 ACTUAL SCHEDULE
VMS / I-CAB SIMULATIONS
SCHEDULE DATES
Status as of OCTOBER 1, 1993
PROJECT
OCT '92
NOV '92
DEC '92
JAN '93
FEB '93
MAR '93
APR '93
MAY '93
JUN '93
JUL '93
AUG '93
SEP '93
5 12 19 26 2 9 16 23 30 7 14 21 28 4 11 18 25 1 8 15 22 1 8 15 22 29 5 12 19 26 3 10 17 24 31 7 14 21 28 5 12 19 26 2 9 16 23 30 6 13 20 27
ACT-TFTA
UH-60
ACTIVE TERRAIN FOLLOWING/TERRAIN AVOIDANCE RESEARCH TO INTEGRATE AND EVALUATE GUIDANCE CONCEPTS
E-7 STOVL
E-7
RESEARCH INTO INTEGRATED FLIGHT AND PROPULSION CONTROLS AND HEAD-UP DISPLAYS FOR STOVL CONCEPTS
USOC BOBSLED
(CHECK OUT)
BOB SLED
INVESTIGATION OF MOTION ISSUES FOR DESIGN OF BOBSLED TRAINER FOR U.S. OLYMPIC COMMITTEE
SPACE SHUTTLE
ORBITER
DRAG CHUTE/DEROTATION, TIRE LOADS, PAL, TRAINING
ORBITER
VMS MAINT.
REFURBISHMENTOF MOTOR-GENERATOR SET, MOTION ELECTRONICS, HYDRAULIC ACTUATORS CHILLERS, BOILERS, AND COOLING SYSTEM
VMS AND PLANT HVAC REFURB.
ANOE
AUTOMATED NOE HELICOPTER FLIGHT RESEARCH
GENERIC HELO
(I-CAB/FIXED-BASE)
X-COUPLING
X-C
EFFECTS ON R/C HANDLING QUALITIES OF PITCH/ROLL CROSS COUPLING
MFVT STOVL
INVESTIGATION OF INTEGRATED FLIGHT/PROPULSION CONTROL SYSTEMS ON MIXED FLOW VECTORED THRUST STOVL CONCEPT
MFVT STOVL
CIV. TILT ROTOR
INVESTIGATION OF INTEGRATION OF TILT ROTOR A/C INTO CIVIL OPERATIONS
CIVIL TILT ROTOR
THRUSTVECTOR
EVALUATION OF HANDLING QUALITIES OF PIASECKI VECTORED THRUST HELICOPTER
THRUST VECTOR
(I-CAB/FIXED-BASE)
THRUST VECTOR
(VMS/MOTION)
MOTIVE
DEVELOPMENT OF IMPROVED MODEL OF PILOT'S VISUAL/VESTIBULAR INTERACTIONS IN PERFORMING HELICOPTER FLYING TASKS
GENERIC HELO
HSCT
HANDLING QUALITIES INVESTIGATIONS OF BOEING HIGH SPEED CIVIL TRANSPORT CONCEPTS
HSCT


AMES RESEARCH CENTER
RESPONSIBILITY:
Manager A. M. Cook
FY94 PROJECTED SCHEDULE
VMS / I-CAB SIMULATIONS
SCHEDULE DATES
Status as of OCTOBER 20, 1993
PROJECT
OCT '93 4 11 18 25
NOV '93 1 8 15 22 29
DEC '93 6 13 20 27
JAN '94 3 10 17 24 31
FEB '94 7 14 21 28
MAR '94 7 14 21 28
APR '94 4 11 18 25
MAY '94 2 9 16 23 30
JUN '94 6 13 20 27
JUL '94 4 11 18 25
AUG '94 1 8 15 22 29
SEP '94 5 12 19 26
HSCT
HSCT
HANDLING QUALITIES INVESTIGATIONS OF BOEING AND DOUGLAS HIGH SPEED CIVIL TRANSPORT CONCEPTS
CIV. TILT ROTOR-4
CIVIL TILT ROTOR
INTEGRATION OF TILT ROTOR A/C INTO CIVIL OPERATIONS, INVESTIGATION OF MISSED APPROACH & DEPARTURE GUIDANCE
ASTOVL-C
(FIXED-BASE)
STOVL
RESEARCH INTO INTEGRATED FLIGHT AND PROPULSION CONTROLS AND HEAD-UP DISPLAYS FOR STOVL CONCEPTS
STOVL
(VMS/MOTION)
HELMEE II
UH-60
INVESTIGATION OF HELICOPTER FLIGHT ENVELOPE LIMITS AND PILOT CUEING SYSTEMS
CGI INTEGRATION
(I-CAB/FIXED-BASE)
CTR 4
OPERATIONAL TEST OF INTEGRATED ESIG-3000 COMPUTER GENERATED IMAGERY SYSTEM
SPACE SHUTTLE
ORBITER
DRAG CHUTE/DEROTATION, TIRE LOADS, CREW TRAINING
ORBITER
RASCAL
INVESTIGATION OF SAFETY MONITORING REQUIREMENTS FOR RASCAL/UH-60 RESEARCH FLIGHT CONTROL SYSTEM
UH-60
CAT A DISPLAYS
DESIGN AND EVALUATION OF DISPLAY LAWS & FORMATS FOR HELICOPTER TAKEOFFS AND LANDINGS IN CONFINED AREAS
UH-60
R/C TURBULENCE
SIM TECH INVESTIGATION OF BLADE-ELEMENT TURBULENCE ON HELICOPTER FLIGHT DYNAMICS
UH-60
HSCT
HANDLING QUALITIES INVESTIGATIONS OF DOUGLAS AND BOEING HIGH SPEED CIVIL TRANSPORT CONCEPTS
DOUGLAS
BOEING
CIV. TILT ROTOR-5
INTEGRATION OF TILT ROTOR A/C (CTR) INTO CIVIL OPERATIONS, INVESTIGATION OF ONE-ENGINE-OUT ON TERMINAL AREA OPERATIONS
CTR

Simulation Projects

1. ACT-TFTA 5 OCT - 6 NOV (5 wks)
Aircraft model: UH-60 Blackhawk
Purpose: Develop a real-time simulation of the OASYS sensor. Integrate the sensor, the radar altimeter Kalman filter, and the high resolution DMA with the TFTA/STAR Dynapath algorithm.

2. E-7 STOVL 9 NOV - 18 DEC (6 wks)
Aircraft model: STOVL2C
Purpose: To verify the viability of the STOVL2C control system for a STOVL type aircraft.

3. BOBSLED 21 DEC - 31 DEC (2 wks)
Vehicle model: Olympic bobsled
Purpose: Evaluation of roll-only versus roll-lateral motion to provide motion cues in support of the U.S. Olympic Committee bobsled simulator development.

4. SSV-1 15 FEB - 19 MAR (5 wks)
Aircraft model: Space Shuttle Orbiter
Purpose: Continue research into drag chute handling qualities, measure pilot workload, and continue crew training.

5. ANOE-II 15 FEB - 19 MAR (5 wks)
Aircraft model: generic helicopter model
Purpose: To further develop a pilot-directed guidance interface and to assess workload reduction afforded by automated obstacle.

6. X-COUPLING 22 FEB - 19 MAR (4 wks)
Aircraft model: generic helicopter model
Purpose: To extensively test various pitch and roll coupling and roll-into-pitch coupling.

7. MFVT STOVL 22 MAR - 30 APR (6 wks)
Aircraft model: MFVT STOVL
Purpose: Validate the concept of an Integrated Flight/Propulsion Control System.

8. CTR4 10 MAY - 2 JUL (8 wks)
Aircraft model: generic tilt rotor
Purpose: To develop IFR Terminal Area procedures at urban vertiports and develop a strawman nine-degree approach glide slope.

9. SSV-2 7 JUN - 16 JUL (6 wks)
Aircraft model: Space Shuttle Orbiter
Purpose: To evaluate Pilot-Assisted Landing, study a new turbulence model, and provide crew training.

10. THRUSTVECTOR 10 MAY - 27 MAY (3 wks)
19 JUL - 20 AUG (5 wks)
Aircraft model: modified Apache helicopter
Purpose: To evaluate the handling qualities of the Piasecki Vectored Thrust Combat Agility Demonstrator helicopter concept versus the baseline Apache helicopter.

11. MOTIVE 23 AUG - 24 SEP (5 wks)
Aircraft model: Apache helicopter
Purpose: To gather data to allow development of an improved model of a pilot's visual/vestibular interactions in performing helicopter hovering tasks.

12. HSCT 23 AUG - 24 SEPT (5 wks)
Aircraft model: HSCT
Purpose: Evaluation of descent, approach, landing, and go-arounds of Boeing math model. Evaluate controls, HUD's and HDD's.

Technology Upgrade Projects

1. ESIG-3000
Purpose: To prepare the SimLab facility for the integration of the new image generation system.

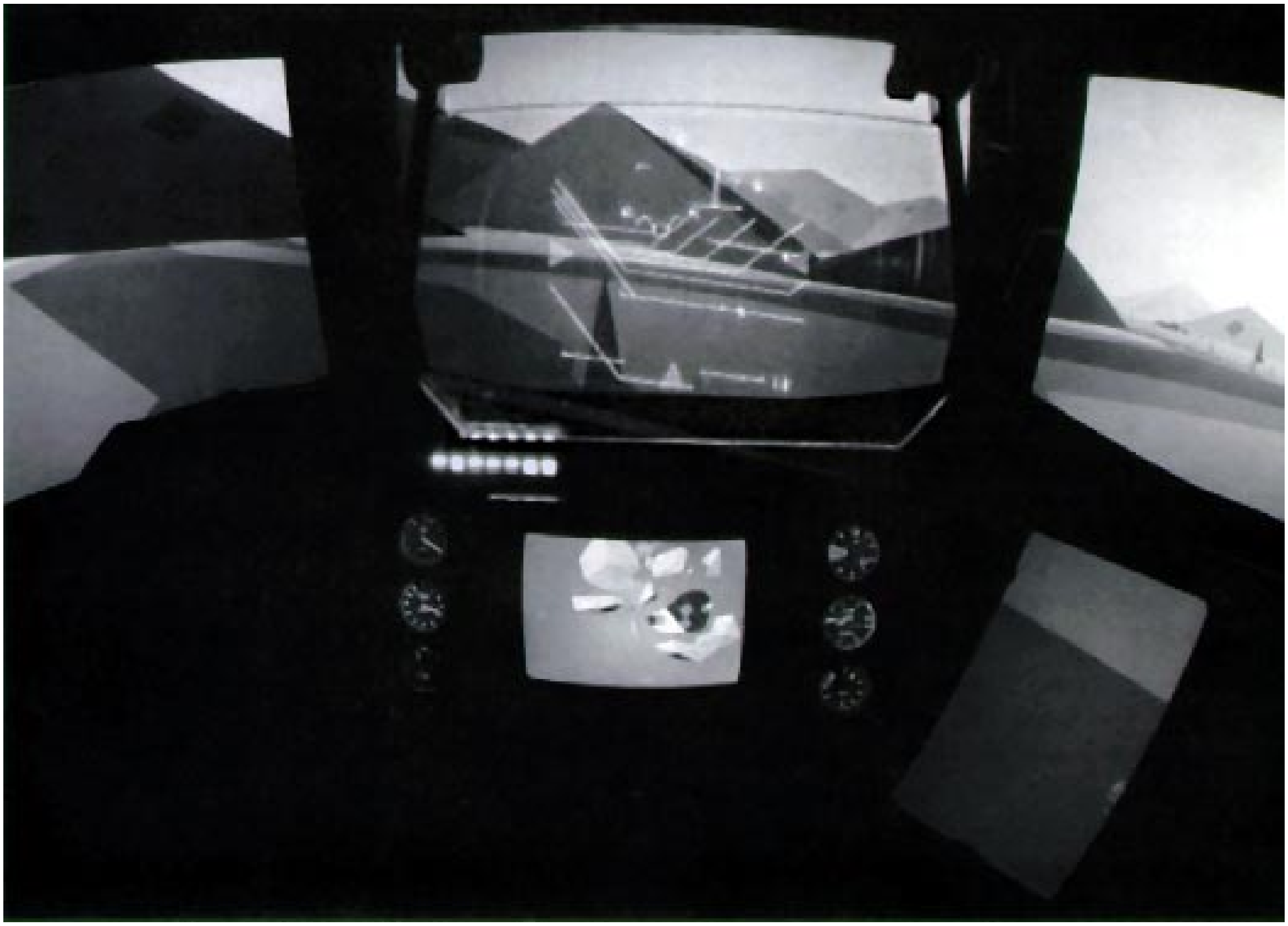
2. PICOTAU–IRIS REAL-TIME SOFTWARE
Purpose: To provide a real-time environment on the IRIS computer, to develop and run graphics applications at a consistent and deterministic update rate.

3. VAX 4000 UPGRADE
Purpose: To improve the computational speed of the VAX 4000 computer.

AIAA PAPERS

AIAA PAPERS
Purpose: A collection of papers discussing various aspects of work performed at the Flight Systems and Simulation Division, were written and presented at the AIAA Simulation Technologies Conference in August of 1993.

SIMULATION PROJECTS



ACT-TFTA

GOALS:

The primary goal of the Active-Terrain Following, Terrain Avoidance simulation was to integrate and evaluate several methods of modifying the Dynapath trajectory based on sensed mismatches between the Defense Mapping Agency (DMA) terrain map used by Dynapath and the “real” world represented by the Computer Generated Imagery (CGI). For example, the DMA map does not include trees, so Dynapath would occasionally lead the pilot through a tree. The individual goals were the following:

- develop a real-time simulation of a forward-looking sensor consistent with the prototype Army Obstacle Avoidance System (OASYS) Sensor;
- integrate the range sensor into the current Terrain Following, Terrain Avoidance/Systems Testbed for Avionics Research (TFTA/STAR) system using the Path Manager, whose function is to modify the vertical component of the Dynapath trajectory using the sensor data;
- integrate an option to use a radar altimeter based Kalman Filter

whose function is to modify the vertical component of the Dynapath trajectory based on the error between DMA determined radar altitude and sensed radar altitude;
- integrate a high resolution DMA terrain map (which includes tree heights) into Dynapath; and
- evaluate the utility of the various options in the integrated system as a function of altitude, airspeed, and pilot performance/workload.

Simulation Results:

All objectives were satisfied. A total of 184 data runs were completed over 14 test conditions.

Numerous pilot and researcher initiated experimental changes were generated and evaluated during the testing period supporting the TFTA flight test and research objectives.

The information gathered from this simulation will be used as a baseline improvement for flight test of the OASYS sensor on the UH-60 STAR helicopter. The simulation provided some working data for forward-pointed, narrow beam radar altimeter (FNR) research.

The option to use a radar altimeter based Kalman Filter, integrated on the UH-60 STAR, resulted in a reduced minimum flight level of 125 feet.

No significant difference was found during test runs between higher resolution and baseline resolution databases.

Principal Investigators:

Harry Swenson
NASA-Ames Research Center

Rick Zelenka
NASA-Ames Research Center

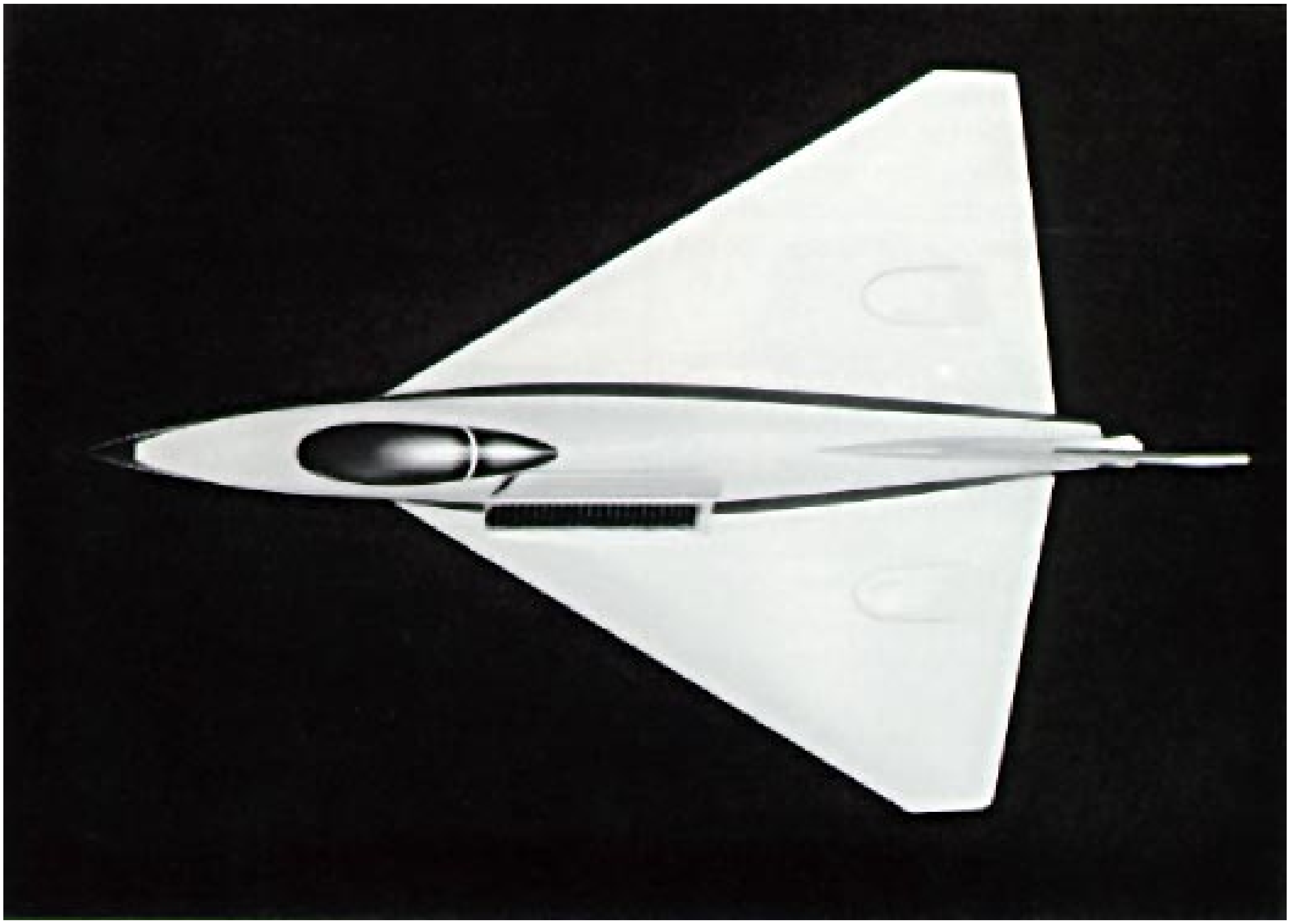
Simulation Engineers:

Frederick G. Kull Jr.
SYRE/SYSCON Corporation

Carla Ingram
SYRE/SYSCON Corporation

Technical Specifications

Lab: VMS
Host Computer: VAX 6000
Cab: R-CAB
Image Generation System: CT5A with TFTA Carlisle database
Head-Up Display: IRIS 8
Head-Down Display: IRIS 7 for moving map display



E-7 STOVL

GOALS:

This was the third of three E-7 STOVL (Short Take-Off/Vertical Landing) simulations performed at SimLab. The objectives were to:

- validate the concept of an Integrated Flight/Propulsion Control System (IFPCS);
- evaluate the IFPCS for an ejector/augmentor powered-lift aircraft and the cockpit mechanization of pilot control inceptors; and
- evaluate the performance and flying qualities of the aircraft in transitions and vertical landings, and the control power requirements for powered lift operations.

Simulation Results:

Seven pilots flew a total of 440 data runs. Pilots performed precision hovering at the vertical and horizontal targets on the hover board, and shipboard landings starting from hover near the ship. The control inceptor configuration and meteorological conditions were varied for the different runs.

Numerous deficiencies in the E-7 STOVL simulator model were found in the previous simulation. In an attempt to correct them, researchers made extensive changes to the math model specifications including modifications to the limiting logic, and new logic for control command distribution. In addition, a new version of software was provided for the component level engine model and propulsion control system.

The limit protection/redistribution logic significantly expanded the envelope of the aircraft. In hover mode, the aircraft was controllable when operating in crosswinds less than 20 knots. However, the aircraft could not operate in hover beyond a 20-knot crosswind. The aircraft was able to successfully transition from cruise to hover and back to cruise.

It was learned that in order to design a successful IFPCS, the propulsion system specifications must be sufficiently detailed that all linear and nonlinear characteristics are fully addressed over the entire flight envelope. It was also found that use of a limited-displacement force inceptor can be expected to result in unnecessarily high pilot workload while maneuvering in hover.

These studies have contributed to the technology base for integrated flight/propulsion control design.

Principal Investigator:

Walter McNeill
NASA-Ames Research Center

Simulation Engineer:

Robert Morrison
SYRE/SYSCON Corporation

Joe Ogwell
SYRE/SYSCON Corporation

Norm Bengford
SYRE/SYSCON Corporation

Technical Specifications

Lab: VMS
Host Computer: VAX 9000
Cab: F-CAB
Image Generation System: CT5A
Head-Up Display: IRIS 7
Head-Down Display: IRIS 8

BOBSLED

GOALS:

The United States Olympic Committee, the United States Bobsled Federation, and researchers from the University of California at Davis worked with NASA to design a better bobsled simulator for Olympic driver training. The bobsled simulator in use currently is a fixed-base workstation, as shown in the photo.

The objective of this simulation was to evaluate the roll-only configuration of the motion simulator versus roll and lateral motion as well as fixed-base (no motion), in order to determine the most cost-effective method for building the next generation bobsled simulator.

Simulation Results:

Approximately 230 data runs were made. The motion tests run in the Vertical Motion Simulator have provided an understanding of the trade-offs between several different motion configurations. The simulation has been crucial in helping to minimize the technical risk associated with the project and to guarantee the completion of a motion simulator in time for the February 1994 Olympic Games.

Principal Investigators:

Ken Huffman
University of California at Davis

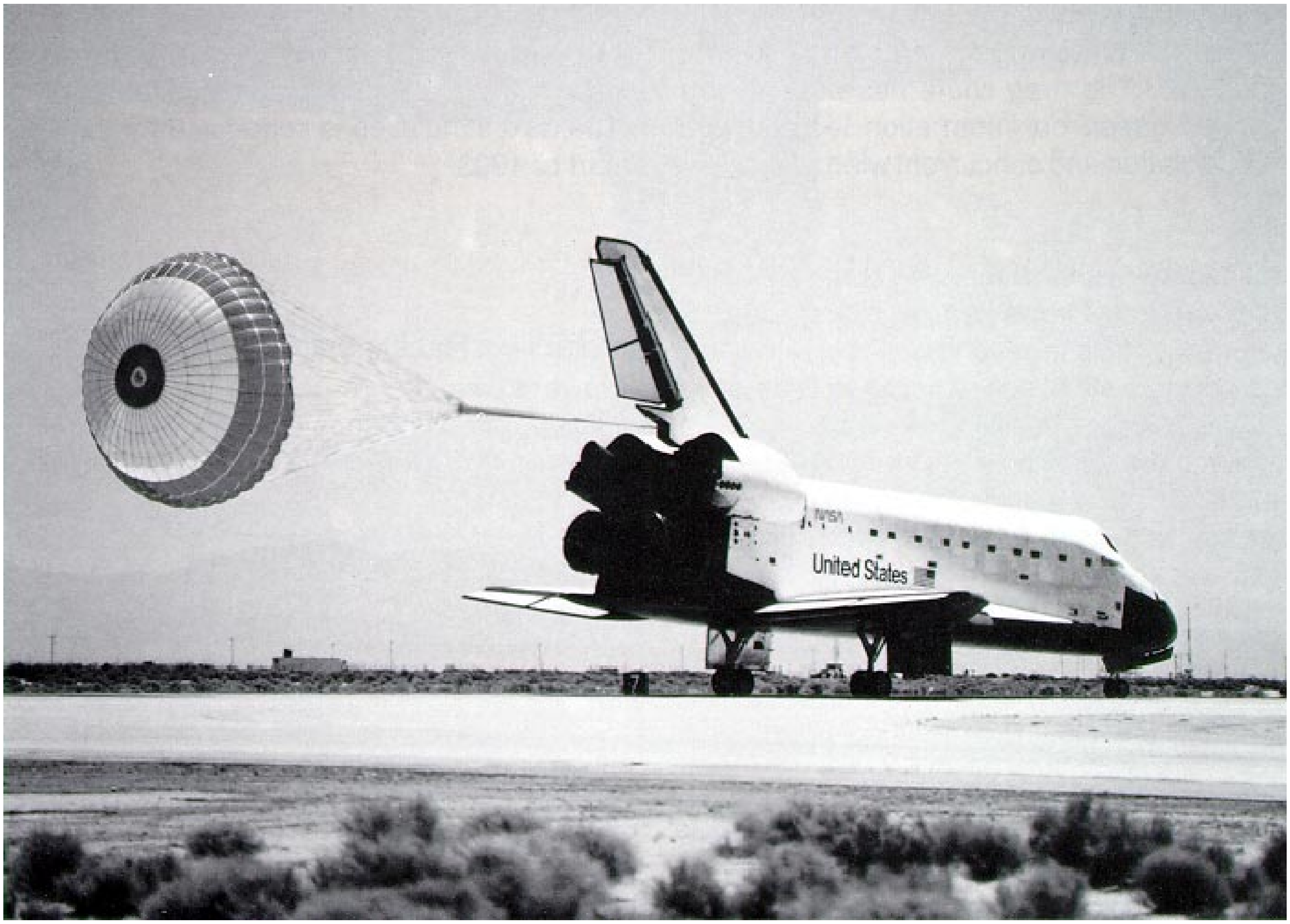
Mont Hubbard
University of California at Davis

Simulation Engineer:

Soren LaForce
SYRE/SYSCON Corporation

Technical Specifications

Lab: VMS
Host Computer: VAX 9000
Cab: N-CAB
Image Generation System: IRIS
Head-Up Display: n/a
Head-Down Display: n/a



SSV-1

GOALS:

This was the first entry for 1993 of the Space Shuttle Vehicle (SSV) simulation. The main emphasis of this shuttle simulation was the drag chute. Modifications to the drag chute were implemented to more accurately represent actual data. New wind profiles were added, in addition to the ongoing research into tire wear, braking, and derotation performance.

Additionally, a function that quantitatively evaluates pilot performance has been coded into the computers to evaluate pilot workload. System delays were included to degrade the simulation environment in this handling qualities phase.

Crew training was conducted during the latter part of the session.

Simulation Results:

A total of 1,774 approach and landings were completed. The drag chute has been slightly modified based on information learned from this simulation and concurrent wind tunnel testing.

Preliminary results of the drag chute show that the measured forces can be represented by modifying the baseline chute model with a five-degree angle offset and minor force uncertainty variables. Driving the HUD derotation cue with pitch rate proved to be a useful indicator, especially when each HUD tick mark was set at one degree per second. Using the auto pitch command as a cue proved useless as there is a tendency to try to chase the command symbol and over control. The cost function still remains to be evaluated, but preliminary indications show that there is a correlation between tracking performance and function value. The Multifunction Electronic Displays (MEDs) underwent another alteration and most reactions were positive. The wind profiles were more realistic thereby enhancing the overall simulation.

Future Plans:

Future plans include continued VMS simulation support for the Space Shuttle Orbiter program. The next simulation is scheduled for the latter part of 1993.

Principal Researchers:

Howard Law
NASA-Johnson Space Center

Viet Nguyen
Rockwell Industries, Downey

Mike Zyss
Rockwell Industries, Downey

Simulation Engineers:

M. Shirin Sheppard
SYRE/SYSCON Corporation

Frederick G. Kull Jr.
SYRE/SYSCON Corporation

Edward T. Fitzgerald
SYRE/SYSCON Corporation

Technical Specifications

Lab: VMS
Host Computer: VAX 6000
Cab: S-CAB
Image Generation System: DIG1A with shuttle 392, 492, and 592 database
Head-Up Display: IRIS 10
Head-Down Display: IRIS 4, IRIS 7, and IRIS 8

X-COUPLING

GOALS:

Under the U.S./German Memorandum of Understanding (MOU) on helicopter flight control, focus has been directed to the effects of handling qualities from pitch-due-to-roll and roll-due-to-pitch cross-coupling while flying a high bandwidth slalom course.

This fixed-base simulation was intended to repeat the initial flight test coupling configurations from an earlier simulation, for utilization in expanding the coupling configuration matrix and to collect data and evaluations after performing the slalom tracking task.

Simulation Results:

A total of 562 data runs were flown. Preliminary results show a surprisingly good agreement in handling qualities ratings between the flight test results and the fixed-base results for the same control and rate coupling configurations. This was surprising because of the lack of acceleration cues due to the simulation being fixed-base. Hence, for these types of coupling, the fixed-base results from the new extended configurations may be used to predict trends for the flight tests. On the other hand, the fixed-base simulation results for the washed-out coupling cases did not match the flight test results for the same configurations. It is speculated that the washed-out coupling configurations were a higher frequency and lower amplitude coupling than the control and rate coupling, and hence the handling qualities ratings would be more influenced by acceleration cues or the lack of these cues. This is corroborated by the fact that the fixed-base simulation allowed higher amounts of coupling than the flight tests results allowed for the same ratings.

The fixed-base simulation provided a very useful set of data to support the U.S. Army's share of technical collaboration in the U.S./German MOU and specifically, provided the necessary database to intelligently choose configurations for the June 1993 flight tests in Germany.

Principal Investigator:

Chris Blanken
U.S. Army Aeroflightdynamics Directorate (AVSCOM)

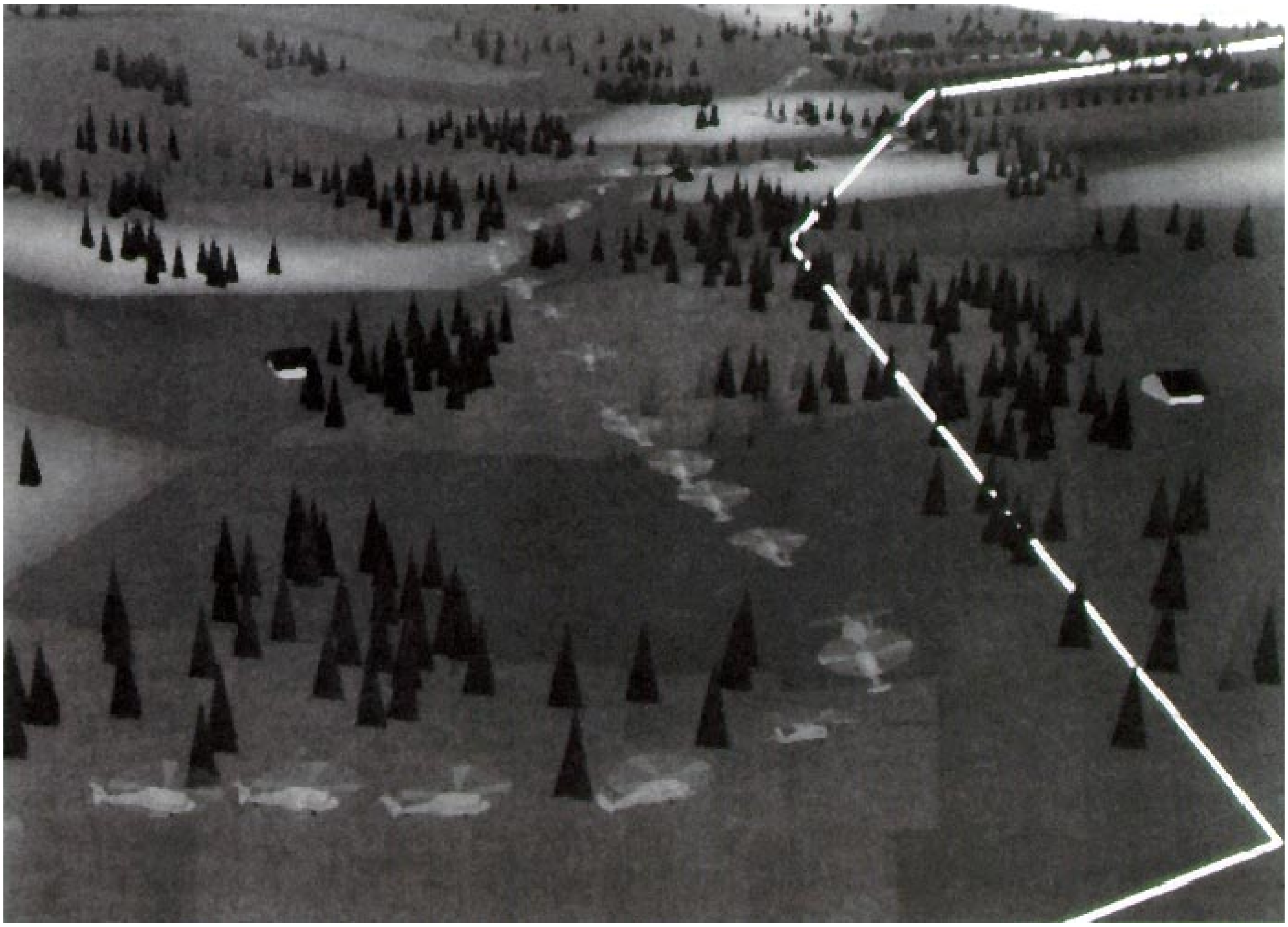
Simulation Engineers:

Carla Ingram
SYRE/SYSCON Corporation

Norm Bengford
SYRE/SYSCON Corporation

Technical Specifications

Lab: I-CAB
Host Computer: VAX 9000
Cab: R-CAB
Image Generation System: CT5A
Head-Up Display: n/a
Head-Down Display: n/a



ANOE II

GOALS:

This is the second simulation looking into Automated Nap-of-the-Earth (ANOE) helicopter flight. ANOE flight is a computer assisted mode of flight that will allow the pilot to fly low and fast during poor visibility conditions. This project had two basic modes of operation; manual mode and Pilot Directed Guidance (PDG) mode. In the manual mode, the controls function in a standard fashion. In the PDG mode, the cyclic controls the reference post location, the collective controls the set altitude clearance, and the pedals are not used. The guidance uses the reference post location and the set altitude clearance along with sensor information to calculate heading and flight path angle commands which move the helicopter around or over obstacles.

The objectives were to:

- further develop the PDG interface and associated displays based on pilot feedback;
- assess the pilot workload reduction afforded by the automated obstacle avoidance with PDG interface; and

- determine what changes need to be made to the automatic system to improve obstacle avoidance and allow smoother maneuvering.

Simulation Results:

A total of 65 data runs were flown by three pilots. The pilots learned to work with the automatic system to best plan their flights along the nominal course. The data and comments indicated that there was a workload reduction with the automatic system and that there was more time to search the area for targets with the automatic system, especially under reduced visibility conditions.

Pilot feedback on the nominal post and reference post symbology revealed a preference for the inverted wickets for the nominal posts and a triangular reference post. The size of the wickets gave the pilots an indication of distance and the shape gave an indication of the direction of the course. The posts that were occulted by trees were preferred over the strictly depth-cued posts. A spacing of five seconds between nominal posts seemed to work best for the speeds flown.

Several areas were identified as warranting further improvement:

- pilots requested a way to override the automatic system;
- when the pilot tried to force the aircraft opposite to the guidance command, the helicopter entered an uncontrollable oscillation;
- when the commanded radar altitude is set above the tree level, the sensor/guidance system should not respond to trees (the sensor/guidance continues to generate commands when it should not); and
- occasional spikes occur in the flight path command from the automatic system.

Future Plans:

Another simulation is planned for FY94 to further refine the automated obstacle avoidance system.

Principal Researchers:

Richard Coppenbarger
NASA-Ames Research Center

Victor Cheng
NASA-Ames Research Center

Simulation Engineers:

Monique Chetelat
SYRE/SYSCON Corporation

Robert Gardener
NASA-Ames Research Center

Technical Specifications

Lab: I-CAB
Host Computer: VAX 9000
Cab: R-CAB
Image Generation System: CT5A
Head-Up Display: Integrated Helmet & Display Sighting System (IHADSS) Head Tracker
Head-Down Display: moving map

MFVT STOVL

Goals:

The objectives of The Mixed Flow Vectored Thrust (MFVT) Short Take-Off and Vertical Landing (STOVL) simulation were to:

- validate the concept of an Integrated Flight/Propulsion Control System (IFPCS);
- evaluate the IFPCS for a mixed flow vectored thrust powered lift aircraft;
- evaluate the cockpit mechanization of pilot control inceptors, including switching between flight modes; and
- evaluate the performance and flying qualities for the aircraft in transitions and vertical landings, and determine control power requirements for powered lift operations.

Simulation Results:

Seven pilots flew a total of 680 data runs to evaluate the flying qualities of the aircraft in cruise, transition, and hover modes.

Five different control modes were explored during transition from cruise to hover including:

- an attitude stabilized system with manual control of thrust and thrust deflection;
- a system with vertical and longitudinal velocity command;
- a system with vertical velocity and longitudinal acceleration command/velocity hold; and
- variants of the latter two that replaced the vertical velocity command with direct control of thrust augmented at low speed with a vertical velocity damper.

During hover and vertical landing, a translational rate command system for control of longitudinal and lateral velocity was also provided. Evaluations of these systems were performed for decelerating approaches to hover under visual and instrument flight conditions and for vertical landings on a runway or aboard an LPH assault ship or DD-963 class destroyer conducted under visual conditions. In addition, short takeoffs and rolling vertical landings were also assessed. Further, several design variants in the control system were explored to assess their influence on flying qualities.

Principal Investigators:

Jack Franklin
NASA-Ames Research Center (FSD)

Paul McDowel
McDonnell Douglas

Stephen Watts
Pratt and Whitney

Simulation Engineers:

Leighton Quon
SYRE/SYSCON Corporation

Luong Nguyen
SYRE/SYSCON Corporation

Christopher Sweeney
SYRE/SYSCON Corporation

Duc Tran
NASA-Ames Research Center

Technical Specifications

Lab: I-CAB
Host Computer: VAX 6000
Cab: F-CAB
Image Generation System: CT5A (Seymour-Johnson database)
Head-Down Display: IRIS 8
Head-Up Display: FDI HUD

CTR4

GOALS:

The Civil Tilt Rotor (CTR) simulations have been developed to introduce the V-22 to the Federal Aviation Administration for civil certification. Multiple approach and landing profiles under varied weather conditions were investigated in this, the fourth project. These simulations will help assess the possible occurrence of problems, limitations of the aircraft, or constraints required in the operation of tilt-rotor aircraft for civilian use in a Terminal Control Area.

The three goals of the CTR4 simulation were to:

- conduct task development and flight director development to prepare for formal Vertical Motion Simulator (VMS) evaluations in the Fall of 1993. The focus is Instrument Flight Rating (IFR) terminal procedures with emphasis on missed approaches and departures from urban vertiports;
- develop specific IFR terminal procedure for a “strawman” nine-degree approach glide slope and perform preliminary evaluation and demonstration of the procedure; and

- upgrade the real-time Generic Tilt Rotor Simulation (GTRS) program to be comparable with models employed by Bell Helicopter, Boeing Helicopter, and the Navy at NAS Patuxent River. GTRS was upgraded to account for recent aerodynamic model developments.

Simulation Results:

The objectives were successfully addressed. During the first two weeks of the simulation the basic flight procedure was developed and refined. The effort was greatly assisted through the use of the flight path vector display under development here. The flight path vector, augmented by the desired “perfect” flight path, substitutes for cues a pilot uses when operating in visual conditions near the ground. The flight path vector display was developed further throughout the simulation entry as experience and comments were received.

The newly developed strawman nine-degree approach procedure features a level flight conversion to helicopter mode, followed by glide slope capture and tracking. Arriving at a critical decision point 200 feet above the landing surface at 50 knots, the pilot commits to a landing with a final configuration change. The semi-automated configuration control developed through several CTR simulations ensured this configuration change takes place in a repeatable, controlled fashion.

The GTRS math model was evaluated and received favorable comments from test pilots.

Future Plans:

Another simulation is planned for the fall of 1993. This entry will use the Vertical Motion Simulator to further the study of Tilt-Rotor aircraft for civilian use.

Principal Investigator:

Bill Decker
NASA-Ames Research Center

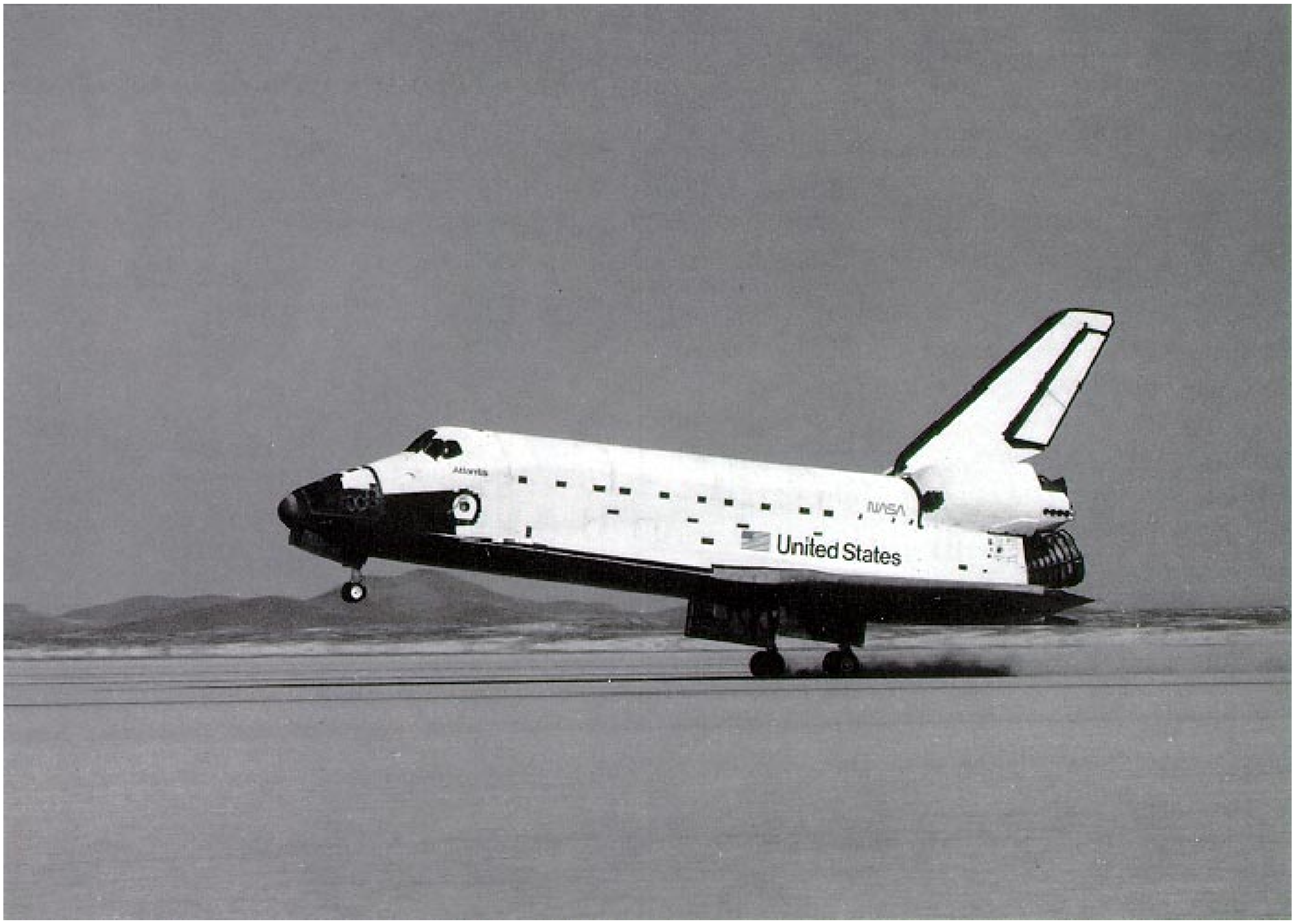
Simulation Engineers:

Carla Ingram
SYRE/SYSCON Corporation

Norm Bengford
SYRE/SYSCON Corporation

Technical Specifications

Lab: I-CAB
Host Computer: VAX 6000
Cab: R-CAB
Image Generation System: CT5A
Head-Up Display: n/a
Head-Down Display: IRIS 9



SSV-2

GOALS:

The main emphasis of the second FY93 shuttle simulation was the drag chute. The profile of the drag chute force has been modified and incorporated into the SimLab computers to further simulate the real chute. This experiment looked at the effects of drag chute deployment on handling qualities during the derotation and rollout phases. Other issues under investigation include:

- gathering Handling Qualities Ratings (HQRs) on a crosswind study to obtain a valid sample of a cross section of landing conditions;
- incorporating and evaluating the new Justus turbulence model as part of the crosswind study;
- evaluating the latest lakebed rolling friction model, based on data collected at the Edwards Air Force Base lakebed runway during this simulation;
- evaluating the new Pilot Assisted Landing (PAL), a proposed pilot performance monitor, to be used after extended duration flights;
- continuation of the Multifunction Electronic Displays (MEDs) study with several new displays under evaluation;

- evaluate a proposal to reduce the acceptable cloud ceiling for Return-To-Launch Site (RTLS) conditions; and
- crew familiarization.

Simulation Results:

The goals of the SSV-2 simulation were successfully completed. A total of 1,550 data runs and 129 PAL data runs were completed.

The relatively large amplitudes of turbulence used in the crosswind study revealed problems with both the baseline and Justus turbulence models. Further investigation is necessary to determine the source of the turbulence problem.

Engineering results from the drag chute study indicate that the maximum main gear load savings occur when the drag chute disreefs just prior to nose gear touchdown. The strongest influence on HQRs was found to be drag chute deploy time. The earlier the chute is deployed, the worse the HQRs.

The improvements in the performance of the PAL system made during the simulation made it more acceptable to the pilots. However, a few scenarios were found which confused the guidance system. Further study will be necessary to make PAL a robust system that the pilots will trust under any circumstances.

Future Plans:

Plans are to continue the twice-yearly Space Shuttle Orbiter landing simulations and to refine the landing systems of the Orbiter.

Principal Investigators:

Howard Law
NASA Johnson Space Center

Viet Nguyen
Rockwell International

Mike Zyss
Rockwell International

Simulation Engineers:

Christopher Sweeney
SYRE/SYSCON Corporation

Frederick G. Kull Jr.
SYRE/SYSCON Corporation

Robert Bardener
NASA-Ames Research Center

Technical Specifications

Lab: VMS
Host Computer: VAX 9000
Cab: S-CAB
Image Generation System: DIG1
Head-Up Display: IRIS 10
Head-Down Display: IRIS 4, IRIS 7, and IRIS 8

THRUSTVECTOR

GOALS:

The goal of the THRUSTVECTOR simulation was to evaluate the handling qualities of the Piasecki Vectored Thrust Combat Agility Demonstrator (PiAC VTCAD) helicopter concept versus the baseline Apache helicopter and to verify the claims made for the design. The flight envelope of the VTCAD was also investigated.

The proposed helicopter is a modified AH-64 Apache helicopter with an auxiliary propulsion system called the Vectored Thrust Ducted Propeller (VTDP) or "Ring-Tail". The hypothesis was that this design can be used to achieve higher speeds and, with an added wing structure may provide unloading of the rotor and high "g" capability at speed.

The claims made for the design are:

- an increase of maximum level flight speed to over 200 knots;
- a 50% increase in maximum longitudinal acceleration and deceleration in level flight;

- a 50% decrease in minimum turn and pull-up radius at forward speeds above 95 knots; and
- Handling Qualities Ratings at least as good as the baseline Apache.

The Apache and the PiAC VTCAD were evaluated against the quantitative requirements in the ADS-33C Handling Qualities Requirements for Military Rotorcraft. The qualitative handling qualities assessment used selected flight test maneuvers from the ADS-33C and other selected maneuvers.

This simulation was the second session of the THRUSTVECTOR program. The first was a three-week fixed-base session in May. During that time model checkout took place in preparation for the motion simulation.

Simulation Results:

A total of 400 data collection runs were completed out of a total of 1,400 runs. Preliminary results indicate that the VTCAD model did not meet the performance goals set by Piasecki. Both qualitative and quantitative data show that the overall VTCAD handling qualities were not a significant improvement over the handling qualities of the Apache helicopter. Early results show several problems with the VTCAD model:

- very complex control/inceptor scheduling;
- excessive bank angle in hover/low speed; and
- static sideslip instability (negative weathercock stability).

Principal Investigator:

Chris Blanken
U.S. Army Aeroflightdynamics Directorate (AVSCOM)

Hossein Mansur
U.S. Army Aeroflightdynamics Directorate

Simulation Engineer:

Charles H. Perry Jr.
SYRE/SYSCON Corporation

Joe Ogwell
SYRE/SYSCON Corporation

Technical Specifications

Lab: I-CAB
Host Computer: VAX 6000
Cab: N-CAB
Image Generation System: CT5A
Head-Up Display: IRIS 9
Head-Down Display: IRIS 7

MOTIVE

GOALS:

The goal of the Motive (MOTion and Visual Evaluation) simulation was to gather data to allow development of an improved model of a pilot's visual/vestibular interactions in performing helicopter hovering tasks. An improved model could allow for more effective development and usage of visual databases and motion systems. Emphasis was placed on the vertical and directional degrees-of-freedom.

A stability derivative model of the Apache helicopter was used, but only one or two degrees-of-freedom were evaluated at a time (the vertical axis, the directional axis, or both). Several different tasks were flown:

- reposition the aircraft between specified altitudes;
- hover over a point in a disturbance environment;
- bob up (ascend) and bob down (descend) in front of a striped, vertical, visual marker (barber pole);
- bob up and down in front of barber poles that are placed on the ground in front of the aircraft (like railroad tracks);
- perform a yaw capture maneuver, in which the pilot is challenged

to quickly yaw a specified distance and align the Head-Up Display (HUD) with a marker on the barber pole; and

- bob up and down in front of the barber pole, using both the vertical and yaw degrees-of-freedom coupled together.

For each of these tasks, the motion cues provided by the Vertical Motion Simulator were varied as well.

Simulation Results:

Eight pilots flew a total of 2,020 data runs, in addition to over 100 training runs, to evaluate the motion and visual tasks. To perform their evaluations, the test plan was followed quite closely, though the amount of time to be spent on each task was not known prior to its performance. A few of the planned tasks were not performed in VMS.

A vast amount of data was collected for post experiment analysis. Results are not yet available.

Principal Investigators:

Jeff Schroeder
NASA-Ames Research Center

Walt Johnson
NASA-Ames Research Center

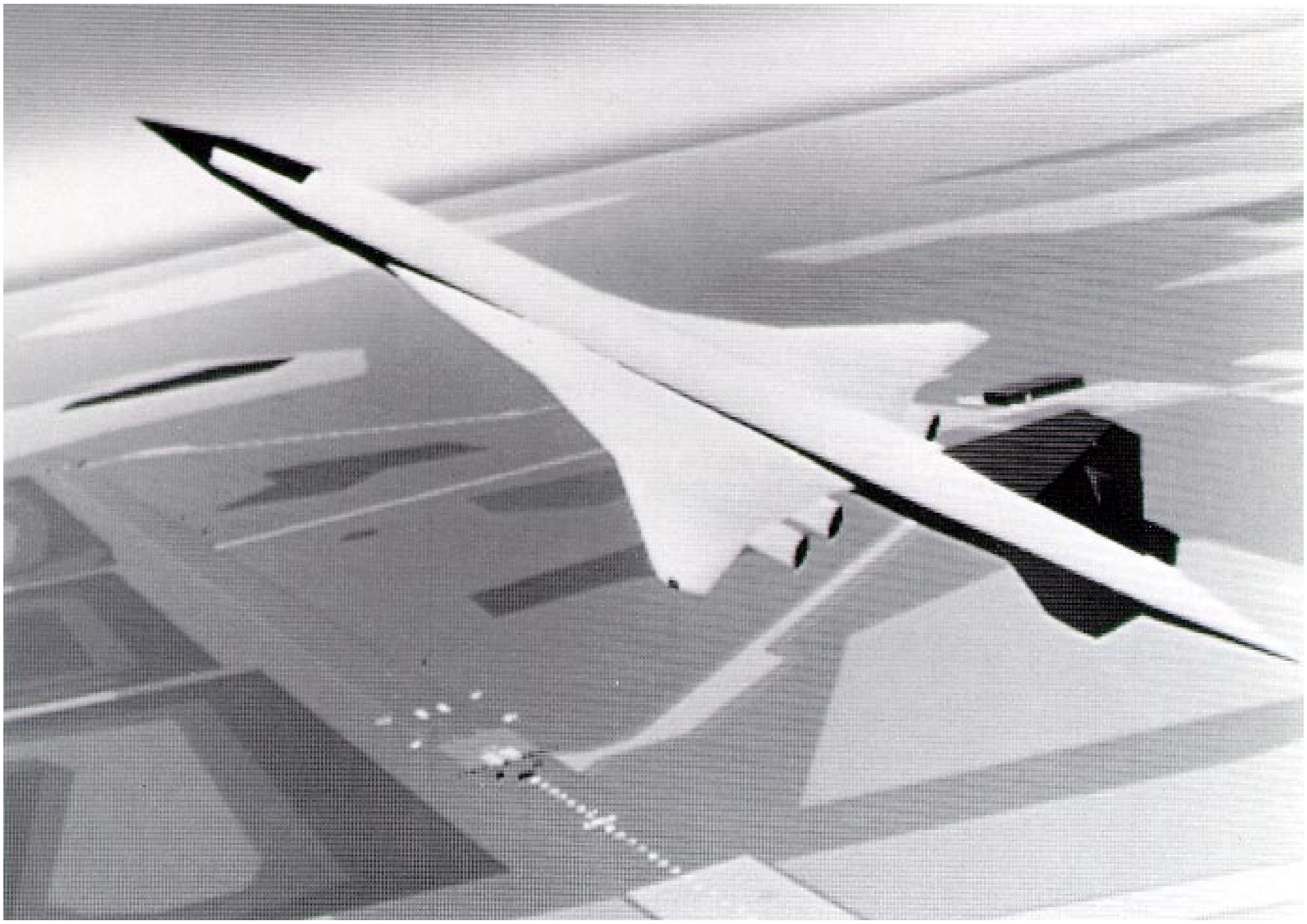
Simulation Engineers:

Duc Tran
NASA-Ames Research Center

Kenneth Duisenberg
SYRE/SYSCON Corporation

Technical Specifications

Lab: VMS
Host Computer: VAX 6000
Cab: F-CAB
Image Generation System: CT5A
Head-Up Display: IRIS 7
Head-Down Display: n/a



HSCT-B

GOALS:

The High Speed Civil Transport-Boeing (HSCT-B) simulation is part of a government/industry program to develop the next generation Super Sonic Transport (SST) aircraft for commercial use. This simulation focused on evaluations of descent, approach, landing, and go-arounds of the Boeing math model, as well as evaluations of various head-up and head-down displays, and control devices.

Simulation Results:

Early results show the simulation model performed very well in providing representative HSCT characteristics for control mode assessment. Modifications were identified that will be incorporated for the next HSCT-B simulation in the Vertical Motion Simulator. The simulation has provided NASA a capability for initiating guidance and control system and cockpit display development for HSCT as well as the basis for carrying on this technology development through to the next phase.

Future Plans:

Future plans include a one-week simulation period in the Vertical Motion Simulator at the beginning of FY94, and an additional four-week motion session later in the year.

Principal Investigators:

Sean Engelland
NASA-Ames Research Center

Jack Franklin
NASA-Ames Research Center

Simulation Engineers:

M. Shirin Sheppard
SYRE/SYSCON Corporation

Monique Chetelat
SYRE/SYSCON Corporation

Technical Specifications

Lab: I-CAB
Host Computer: VAX 9000
Cab: S-CAB
Image Generation System: DIG1
Head-Up Display: IRIS 10
Head-Down Display: IRIS 4, IRIS 7, and IRIS 8

TECHNOLOGY UPGRADE PROJECTS

ESIG-3000

GOALS:

The goal of this project was the acquisition and integration of a state-of-the-art image generation system with existing real-time flight simulation resources at SimLab. The system was acquired through an existing JSC contract, using Space Shuttle Program Funds. Integration of the ESIG-3000 image generation system will provide a current generation, state-of-the-art upgrade to the already world class visual flight simulation capabilities at SimLab. The ESIG-3000 provides six high resolution visual channels which are configurable to support options such as line-of-sight ranging, forward looking infrared and multiple viewports. The ESIG-3000 also features advanced texture capabilities for improved fidelity of visual flight cues. The Ames ESIG configuration offers both round- and flat-earth flight regimes allowing conventional and on orbit flight profiles. Other advanced features include, collision detection, height-above-terrain, laser range finder, animation sequences, transparencies, multiple illumination sources, weather, weapons, and cultural effects to name a few.

Results:

To accomplish smooth integration of the ESIG-3000 into the SimLab environment an integration team was formed. The ESIG integration project is working under joint SYRE/NASA management. SYRE is directly responsible for the integration. The project team incorporates all engineering and support disciplines provided at SimLab. These include, host hardware and software, applications, procurement, graphics and database, video, real-time, operations, maintenance, acceptance, and facilities. Each sub-team has full responsibility for planning and execution of integration tasks related to their specific areas of expertise. The ESIG integration team has provided key technical input to the specification of the Image Generator (IG), its capabilities, interface, and operational requirements as well as contract language for the statement-of-work and contract deliverables.

The ESIG-3000 and its associated database modeling system have been delivered to Ames. Stand-alone acceptance testing has been completed. The ESIG project team is currently in the process of integration and test of the IG within the SimLab environment.

Future Plans:

Integrated acceptance testing is expected to be completed by mid-December 1993. A fully integrated "operational shakedown" simulation is scheduled for January 1994, followed immediately by a full production shuttle simulation in February 1994. The entire integration schedule from receipt of the IG on October 8, 1993 to full-up production simulation in February of 1994 will have taken just under four months.

Principals:

Daniel A. Wilkins
SYRE/SYSCON Corporation

Steve Cowart
NASA-Ames Research Center

PICOTAU–IRIS REAL-TIME SOFTWARE

GOALS:

To provide a real-time environment on the IRIS computer, to develop and run graphics applications at a consistent and deterministic update rate.

IRIS graphics computers from Silicon Graphics, Inc., are used at SimLab to generate symbology for the cockpit Head-Up and Head-Down Displays (HUDs & HDDs). Prior to the development of PicoTau software, cockpit displays were updated at variable frequencies due to the conflicting timing constraints imposed by the IRIS video and simulation host input/output (I/O) rates. Hence, the PicoTau project was initiated to provide a consistent real-time environment similar to the environment (MicroTau) which exists on the host (VAX) computers.

Results:

The PicoTau executive software was developed on the IRIS computers utilizing only the system services and facilities provided by IRIX (the IRIS operating system); no special purpose device drivers were developed. PicoTau provides the operating system extensions required to configure and control real-time graphics applications for either stand-alone execution, or execution while communicating with a host computer. PicoTau provides users with the capability to control execution of a graphics application in accordance with a predefined timeline.

Cockpit displays can now be created with consistent frame times synchronized to the video frame, independent of the host I/O rate. With consistent frame times, the ability to detect missed intervals on the IRIS has been implemented in PicoTau. Consistent frame times allow for the computation of dynamic elements, like filters, within a graphics application. Extrapolation of host data to align with IRIS graphic frame boundaries is also available to accommodate the asynchronous nature of the host I/O.

Future Plans:

Currently under development are enhancements to make the PicoTau system more robust. In addition, a study will soon be conducted to determine the PicoTau configuration, targeting a Multi-CPU IRIS, necessary for obtaining optimal real-time performance. In the future, the primary enhancement to PicoTau will be the addition of a real-time debugging capability through a user interface similar to MicroTau's CASPRE. Other enhancements will include tools and utilities to facilitate development and testing of graphics applications.

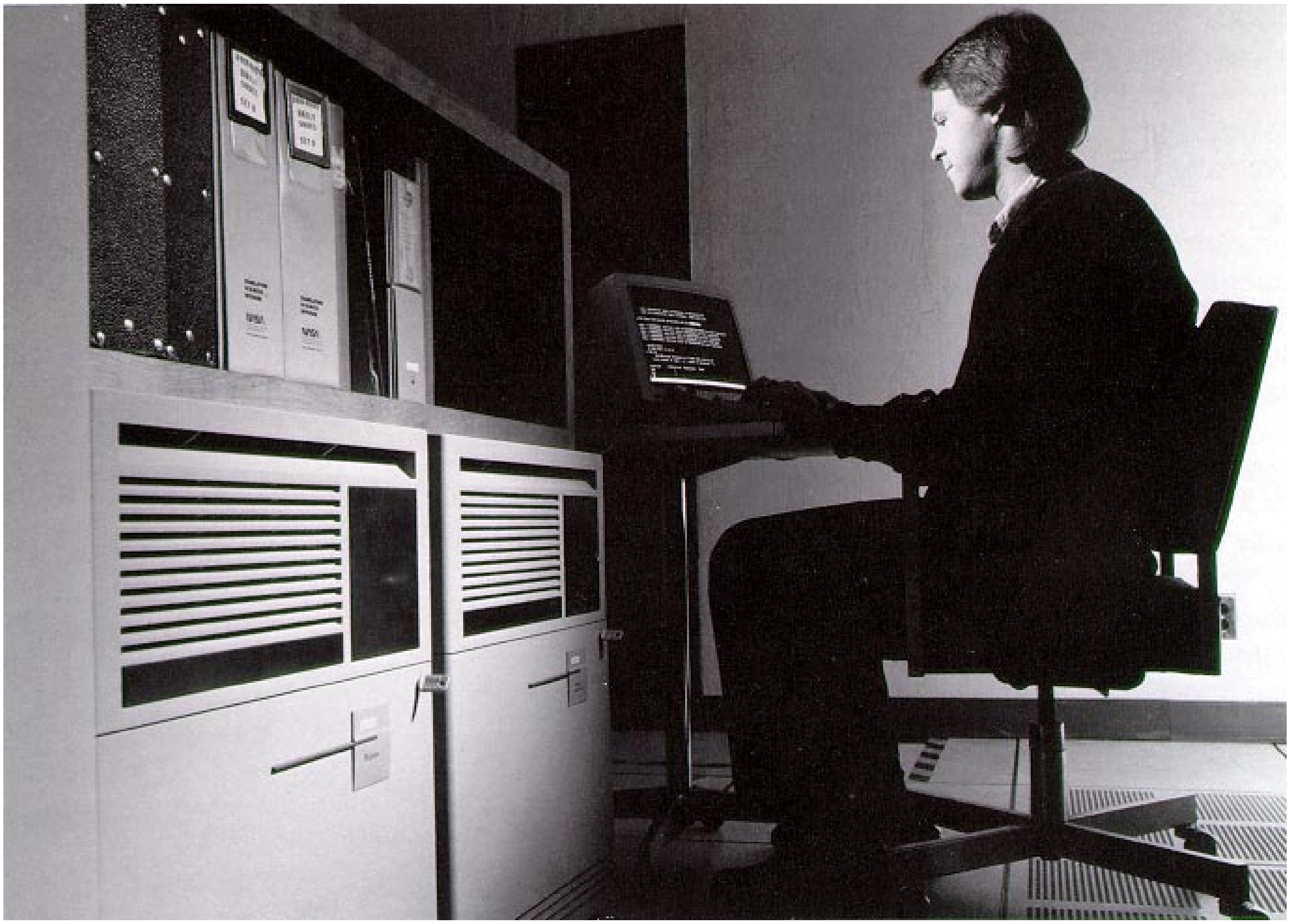
Project Principals:

G. David Sherrill
SYRE/SYSCON Corporation

William Cleveland
NASA-Ames Research Center

TECHNICAL SPECIFICATIONS:

Silicon Graphics, Inc.
IRIS Model 4D 310 VGXT



VAX 4000 UPGRADE

GOALS:

The goal of this project was to improve the computational speed of the VAX 4000 computer. SimLab uses a VAX 4000 to support simulation and system development for the VMS simulator. The VAX 4000-300 could be upgraded with the same CPU chip-set as the VAX 6000. This upgrade would provide SimLab with an additional host with comparable speed to the VAX 6000 and the VAX 9000.

Results:

It was determined that a CPU with the speed of the VAX 4000-600 would greatly increase the flexibility and capabilities at SimLab. Before a simulation can be assigned to a dedicated operations facility, time must be made available for substantial debugging of simulations. The computer must be able to run a complete simulation. A computer with the power of a VAX 4000-600 greatly improves the capabilities to handle these requirements.

The performance improvement for the new VAX 4000-600 is substantial. It now has essentially the same performance as the VAX 6000. For the $47,000 invested to purchase this upgrade kit this improvement has proven to be a tremendous value.

Future Plans:

The VAX 4000-600 is now fully operational and is currently dedicated to the integration of the ESIG-3000. The VAX 4000-600 will then be made available as a general purpose host computer and integrated into the simulation schedule along with the VAX 6000 and VAX 9000.

Principal:

T. Martin Pethtel
SYRE/SYSCON Services Corporation

AIAA PAPERS

AIAA PAPERS

Several technical papers from engineers in the Flight Systems and Simulation Reserach Division were written, describing various topics of interest to users of the Vertical Motion Simulation facility at the NASA-Ames Research Center. All but one of these papers were presented at the American Institute of Aeronautics and Astronautics (AIAA) international conference held in Monterey, California, August 9 - 13. The following is a brief description of each paper:

Development and Operation of a Real-Time Simulation at the NASA-Ames Vertical Motion Simulator

Written by:
Christopher Sweeney (presenter), SYRE/SYSCON Corporation
Shirin Sheppard, SYRE/SYSCON Corporation
Monique Chetelat, SYRE/SYSCON Corporation

This paper describes the SimLab facility and the software tools necessary for an operating simulation. It also describes the process that a simulation undergoes from development to operation; including acceptance of the model, validation, integration, and production phases. The point is made that due to the diverse nature of the aircraft simulated and the number of simulations conducted annually, the challenge for the simulation engineer is to develop an accurate real-time simulation within time constraints.

Lessons Learned from a Historical Review of Piloted Aircraft Simulators at NASA-Ames Research Center

Written by:
Seth B. Anderson (presenter), NASA-Ames Research Center
Robert H. Morrison, SYRE/SYSCON Corporation

This paper traces the conception and development of piloted aircraft simulators at NASA-Ames Research Center, starting with the first fixed-based simulator in 1955 and continuing to the early 1990’s. Problems with their development and operation and how limitations were handled are recounted. Advances needed in simulator equipment to improve performance and fidelity to gain pilot acceptance are discussed. The uses of these simulators in various aircraft research and development programs and their importance to aircraft design and flight testing are reviewed. Lessons learned include a better understanding of the trade-off between motion cues and visual cues, the importance of simulation sophistication when examining aircraft with marginal handling qualities characteristics, and the continuing need for upgrading simulation technology as more complex problems are encountered.

Line-of-Sight Determination in Real-Time Simulations

Written by:
Frederick G. Kull Jr., SYRE/SYSCON Corporation
Donald E. Fought, Ph.D. (presenter), SYRE/SYSCON Corporation

This paper describes the selection of a method for determining line-of-sight in real-time simulations for the NASA-Ames Vertical Motion Simulator (VMS) facility. Five different combinations of terrain representation and line-of-sight determination algorithms were tested. A gridpost terrain format, in conjunction with a Digital Differential Analyzer algorithm, was found to best meet the simulation criteria of high speed, low storage requirements, and accuracy.

A Radar Altitude and Line-of-Sight Attachment

Written by:
Russell Sansom, SYRE/SYSCON Corporation
David Darling (presenter), SYRE/SYSCON Corporation

This paper describes a method of overcoming much of the computational expense of finding radar altitude and determining lines-of-sight in flight simulations over databases built from polygons. Methods are described for quantizing polygonal databases and for searching through them quickly. Various tuning parameters are explained and run-time performance figures are offered.

A High Fidelity Video Delivery System for Real-Time Flight Simulation Research

Written by:
Daniel A. Wilkins (presenter), SYRE/SYSCON Corporation
Carl C. Roach, SYRE/SYSCON Corporation

The Flight Systems and Simulation Research Laboratory (SimLab) at the NASA-Ames Research Center, utilizes an extensive network of video image generation, delivery, processing, and display systems coupled with a large amplitude Vertical Motion Simulator (VMS) to provide a high fidelity visual environment for flight simulation research.

This paper explores the capabilities of the current SimLab video distribution system architecture with a view toward technical solutions implemented to resolve a variety of video interface, switching, and distribution issues common to many simulation facilities. Technical discussions include a modular approach to a video switching and distribution system capable of supporting both coax and fiber optic video signal transmission, video scan conversion and processing techniques for lab observation and recording, adaptation of image generation and display system video interfaces to industry standards, and an all-raster solution for “glass cockpit” configurations encompassing Head-Up, Head-Down, and Out-the-Window display systems.

Pseudo Aircraft Systems: A Multi-Aircraft Simulation System for Air Traffic Control Research

Written by:
Reid A. Weske (presenter), SYRE/SYSCON Corporation
George L. Danek, ATC Field Systems Office, NASA-Ames Research Center

Pseudo Aircraft Systems (PAS) is a computerized flight dynamics and piloting system designed to provide a high fidelity multi-aircraft real-time simulation environment to support Air Traffic Control (ATC) research. PAS is composed of three major software components that run on a network of computer workstations. Functionality is distributed among these components to allow the system to execute fast enough to support real-time operation. PAS workstations are linked by an Ethernet Local Area Network, and standard UNIX socket protocol is used for data transfer. Each component of PAS is controlled and operated using a custom designed Graphical User Interface. Each of these is composed of multiple windows, and many of the windows and sub-windows are used in several of the components. Aircraft models and piloting logic are sophisticated and realistic and provide complex maneuvering and navigational capabilities. PAS will continually be enhanced with new features and improved capabilities to support ongoing and future Air Traffic Control system development.

Enhancing Real-Time Flight Simulation Execution by Intercepting Run-Time Library Calls

Written by:
Namejs Reinbachs, SYRE/SYSCON Corporation

Standard operating system input-output (I/O) procedures impose a large time penalty on real-time program execution. These procedures are generally invoked by way of Run-Time Library (RTL) calls. To reduce the time penalty, as well as add flexibility, a technique has been developed to dynamically intercept these calls. The design and implementation of this technique, as applied to FORTRAN WRITE statements, are described. Measured performance gains using this RTL intercept technique are on the order of 1,000%.

NOTES: