tie TECHNICAL IDEA EXCHANGE

MCDONNELL DOUGLAS CORPORATION

VOL 2 • NO 3 • A BULLETIN OF ENGINEERING INFORMATION • MARCH 1971

MANAGEMENT FEATURE

Shaping Our "Leading Edges"

by A. J. VANDER WEYDEN
Director, Advance Systems and Technology Division
McDonnell Douglas Astronautics Company - West

At a time when the aerospace industry is under stress, it becomes ever more important to monitor and control the Company's "leading edges" -- its activities in advance systems and technology. The future growth of the Company is dictated to a considerable degree by the shape of its internal growth in traditional as well as new technology. Sales and employment levels in the future depend upon the effectiveness of the efforts of advance technology and systems engineers in generating new business to replace that worked off from current programs and their extensions. The generation of new business, in turn, is highly dependent upon our acuity in recognizing early (1) the systems development and production opportunities which have large business potentials, and (2) the related technology advances which can give us a competitive advantage in pursuing business opportunities not yet in the development or production phase.

We must be sensitive to major changes in the federal government environment in which we pursue both of these activities. The ability of MDAC to recognize and accommodate to these changes has been a strong factor in achieving our present stature in the aerospace industry.

One of the most significant recent changes which will shape the leading edges of advance systems and technology in MDAC is in the DOD approach to the development of military systems. In the past, the government sponsored numerous parallel analytical studies and paper experiments for new weapon systems, followed by major commitments to a total system package. Today the approach is to proceed with prototype hardware and demonstrations, before commitment to a particular system. This new approach requires that we rely more on a small integrated team to define, sell, design, and conduct prototype and demonstration projects; that we emphasize practical solutions to critical problems, and avoid "nice-to-have's" and "gold plating."

(continued on page 5, col 1)

RESEARCH FEATURE

System Design With Interactive Graphics

by K. S. YANKELEVITZ, Dept C1-253
Computing Engineer
Douglas Aircraft Company

PROBLEM To facilitate the timely completion of the DC-10 landing monitor system (i.e., the performance and failure assessment monitor) we had to devise a method to allow the system designer to work directly with a complex simulation of the aircraft automatic flight control system. The basic requirement was to give the designer a workable technique for analyzing and manipulating the performance and functional characteristics of the aircraft and its control systems throughout the various maneuvers and operating environments associated with approach and landing.

APPROACH Our approach was to use a digital simulation to provide speed, repeatability, and flexibility. The simulation was based on the sampled-data technique described in the February TIE. We selected an IBM 2250 graphics terminal to present the output to the system designer (Figure 1). A keyboard and "light pen" give him immediate and complete control of the simulation. We relied heavily on experience gained from an IRAD project to develop the interactive graphics software as a series of modular packages. Figure 2 shows the program flow chart and options available.

RESULTS The program can display tables of over 500 parameter values on the face of the CRT. Each number can be modified independently: the engineer simply types in a new value on the 2250 typewriter. For example, 35 ILS beam characteristics are stored in tables. The ILS beam is the radio navigational aid supplying information to the aircraft concerning the location of the runway. Any point in the beam tables may be modified -- i.e., the beam characteristics can be changed -- permanently or temporarily. The terrain characteristics are stored and modified in a similar manner, and wind conditions are also stored in tables; steady-state winds, wind shears (changes in wind as a function of altitude), and levels of turbulence may be stored independently.

(continued on page 5, col 1)

Shaping Our "Leading Edges" (continued)

On the technology side, with the changing emphases on the various programs in NASA, and the increased emphasis on general-purpose forces and on certain Navy programs in DOD, it is important that we recognize our strengths and deficiencies, rectify the latter, and vigorously pursue any opportunities that are presented. We must maintain a sufficiently broad yet balanced technical base to give us the flexibility to respond to the rapidly changing markets for technology. It is well recognized by our customers that MDAC is exceptionally strong in the technologies which underlie such subsystems as structural, controls, mechanical, and life support. We are less well established in the technologies supporting information handling, sensors, guidance, and communications. Therefore, our efforts are directed toward improving both our analytical and our experimental capabilities in these areas. Experimentation in the technology areas and physical, as well as computer, simulation in the system areas are becoming increasingly important in contract work as compared to extensive flight tests, to reduce the overall program costs. As our capabilities grow, it is also obviously of prime importance to have our customers recognize these expanding capabilities.

To continue to advance in this period of stress, therefore, we must be sensitive to the changing customer environment, keep our tools sharp in the areas of our traditional strength, increase our capabilities in technologies which are growing in importance, and thus provide and sell a broad yet balanced capability at the leading edges of advance systems and technology.

System Design With Interactive Graphics (continued)

During a simulated approach, the values of 60 of the 500 different variables are continuously stored. At the conclusion of each run these variables can be plotted against time or against each other; they may also be superimposed on each other or upon variables plotted from previous runs. On the basis of the interpretation of these plots, the designer is able to decide what the next run should be so that the continuity of the design is maintained. This is the main advantage of the interactive graphics feature.

APPLICATIONS In its first application, the graphics package was interfaced with a simulation of the DC-10 automatic landing system so that the performance and failure assessment monitor (PAFAM) could be developed on schedule and with a high level of confidence in the integrity of the design. An added bonus was our ability to demonstrate the PAFAM concept to the airline customers in a comprehensive real-time simulation of demonstrable accuracy.

Although the aircraft/autopilot simulation discussed herein posed a unique problem, the interactive graphics portion of the simulation is extremely versatile and can greatly enhance the utility of any large-scale simulation. The software is divided into functional modules (i.e., a plotting section, gain changing, dynamic displays, etc.) which can be separated and used independently. I will be pleased to supply copies of a paper giving details about the graphics portions of the simulation; just call me at 875-33294.

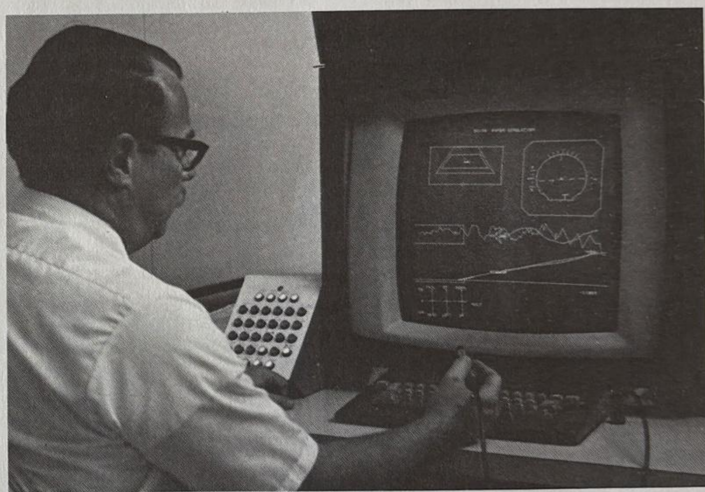
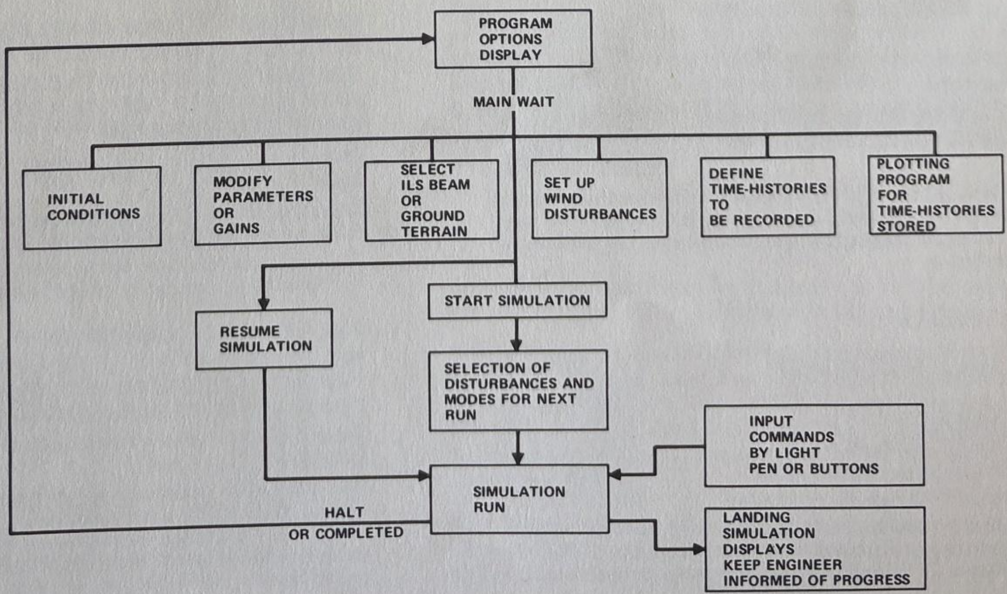


Figure 1 INTERACTIVE GRAPHICS DISPLAY
Display shows: PAFAM instrument, ADI instrument, ILS beam centerlines, aircraft symbol (shows pitch and yaw), aircraft position traces (localizer and glideslope views), and wind indicators.

Figure 2
INTERACTIVE GRAPHICS
Landing Simulation
Program Options



TECHNICAL IDEA EXCHANGE
McDonnell Douglas Corporation
VO. 2 - NO 3 - A BULLETIN OF ENGINEERING INFORMATION - MARCH 1971

MANAGEMENT FEATURE

Shaping Our “Leading Edges”

by A. J. Vander Weyden
Director, Advance Systems and Technology Division
McDonnell Douglas Astronautics Company – West

At a time when the aerospace industry is under stress, it becomes ever more important to monitor and control the Company’s “leading edges” — its activities in advance systems and technology. The future growth of the Company is dictated to a considerable degree by the shape of its internal growth in traditional as well as new technology. Sales and employment levels in the future depend upon the effectiveness of the efforts of advance technology and systems engineers in generating new business to replace that worked off from current programs and their extensions. The generation of new business, in turn, is highly dependent upon our acuity in recognizing early (1) the systems development and production opportunities which have large business potentials, and (2) the related technology advances which can give us a competitive advantage in pursuing business opportunities not yet in the development or production phase.

We must be sensitive to major changes in the federal government environment in which we pursue both of these activities. The ability of MDAC to recognize and accommodate to these changes has been a strong factor in achieving our present stature in the aerospace industry. One of the most significant recent changes which will shape the leading edges of advance systems and technology in MDAC is in the DOD approach to the development of military systems. In the past, the government sponsored numerous parallel analytical studies and paper experiments for new weapon systems, followed by major commitments to a total system package. Today the approach is to proceed with prototype hardware and demonstrations, before commitment to a particular system. This new approach requires that we rely more on a small integrated team to define, sell, design, and conduct prototype and demonstration projects; that we emphasize practical solutions to critical problems, and avoid “nice-to-have’s” and “gold plating.” On the technology side, with the changing emphases on the various programs in NASA, and the increased emphasis on general-purpose forces and on certain Navy programs in DOD, it is important that we recognize our strengths and deficiencies, rectify the latter, and vigorously pursue any opportunities that are presented. We must maintain a sufficiently broad yet balanced technical base to give us the flexibility to respond to the rapidly changing markets for technology. It is well recognized by our customers that MDAC is exceptionally strong in the technologies which underlie such subsystems as structural, controls, mechanical, and life support. We are less well established in the technologies supporting information handling, sensors, guidance, and communications. Therefore, our efforts are directed toward improving both our analytical and our experimental capabilities in these areas. Experimentation in the technology areas and physical, as well as computer, simulation in the system areas are becoming increasingly important in contract work as compared to extensive flight tests, to reduce the overall program costs. As our capabilities grow, it is also obviously of prime importance to have our customers recognize these expanding capabilities.

To continue to advance in this period of stress, therefore, we must be sensitive to the changing customer environment, keep our tools sharp in the areas of our traditional strength, increase our capabilities in technologies which are growing in importance, and thus provide and sell a broad yet balanced capability at the leading edges of advance systems and technology.

RESEARCH FEATURE

System Design With Interactive Graphics

by K. S. Yankelevitz, Dept C1-253
Computing Engineer
Douglas Aircraft Company

PROBLEM

To facilitate the timely completion of the DC-10 landing monitor system (i.e., the performance and failure assessment monitor) we had to devise a method to allow the system designer to work directly with a complex simulation of the aircraft automatic flight control system. The basic requirement was to give the designer a workable technique for analyzing and manipulating the performance and functional characteristics of the aircraft and its control systems throughout the various maneuvers and operating environments associated with approach and landing.

APPROACH

Our approach was to use a digital simulation to provide speed, repeatability, and flexibility. The simulation was based on the sampled-data technique described in the February TIE. We selected an IBM 2250 graphics terminal to present the output to the system designer (Figure 1). A keyboard and “light pen” give him immediate and complete control of the simulation. We relied heavily on experience gained from an IRAD project to develop the interactive graphics software as a series of modular packages. Figure 2 shows the program flow chart and options available.

RESULTS

The program can display tables of over 500 parameter values on the face of the CRT. Each number can be modified independently: the engineer simply types in a new value on the 2250 typewriter. For example, 35 ILS beam characteristics are stored in tables. The ILS beam is the radio navigational aid supplying information to the aircraft concerning the location of the runway. Any point in the beam tables may be modified — i.e., the beam characteristics can be changed — permanently or temporarily. The terrain characteristics are stored and modified in a similar manner, and wind conditions are also stored in tables; steady-state winds, wind shears (changes in wind as a function of altitude), and levels of turbulence may be stored independently.

During a simulated approach, the values of 60 of the 500 different variables are continuously stored. At the conclusion of each run these variables can be plotted against time or against each other; they may also be superimposed on each other or upon variables plotted from previous runs. On the basis of the interpretation of these plots, the designer is able to decide what the next run should be so that the continuity of the design is maintained. This is the main advantage of the interactive graphics feature.

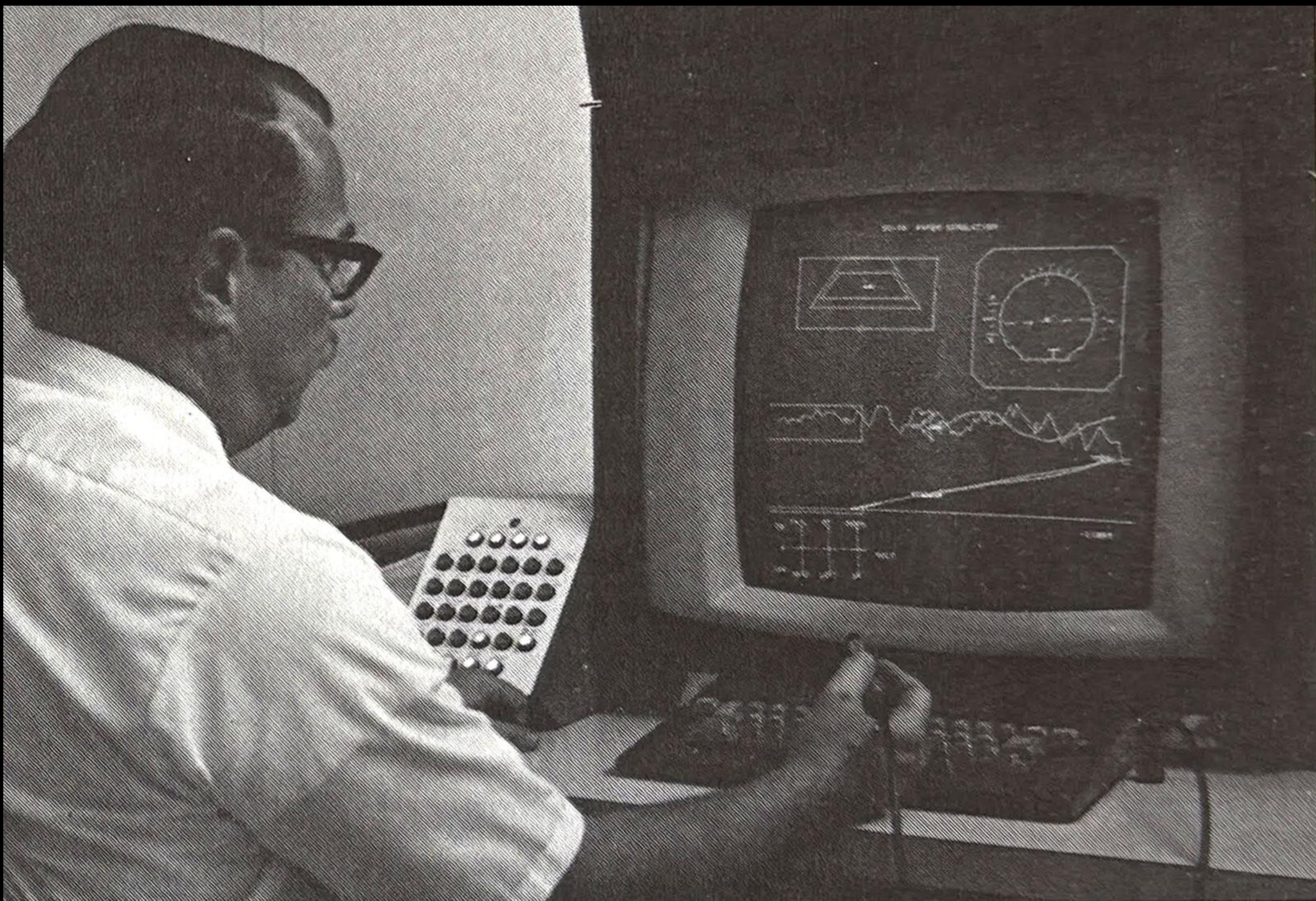
APPLICATIONS

In its first application, the graphics package was interfaced with a simulation of the DC-10 automatic landing system so that the performance and failure assessment monitor (PAFAM) could be developed on schedule and with a high level of confidence in the integrity of the design. An added bonus was our ability to demonstrate the PAFAM concept to the airline customers in a comprehensive real-time simulation of demonstrable accuracy.

Although the aircraft/autopilot simulation discussed herein posed a unique problem, the interactive graphics portion of the simulation is extremely versatile and can greatly enhance the utility of any large-scale simulation. The software is divided into functional modules (i.e., a plotting section, gain changing, dynamic displays, etc.) which can be separated and used independently. I will be pleased to supply copies of a paper giving details about the graphics portions of the simulation; just call me at 875-33294.

Figures

Figure 1 — Interactive Graphics Display



Display shows: PAFAM instrument, ADI instrument, ILS beam centerlines, aircraft symbol (shows pitch and yaw), aircraft position traces (localizer and glideslope views), and wind indicators.

Figure 2 — Interactive Graphics Landing Simulation Program Options

Program flow (simplified structure from original flowchart – not accurate):

PROGRAM OPTIONS DISPLAY
↓ MAIN WAIT
Options available:
• INITIAL CONDITIONS
• MODIFY PARAMETERS OR GAINS
• SELECT ILS BEAM OR GROUND TERRAIN
• SET UP WIND DISTURBANCES
• DEFINE TIME-HISTORIES TO BE RECORDED

• PLOTTING PROGRAM FOR TIME-HISTORIES STORED
↓
START SIMULATION → SELECTION OF DISTURBANCES AND MODES FOR NEXT RUN
↓
SIMULATION RUN
← INPUT COMMANDS BY LIGHT PEN OR BUTTONS
→ LANDING SIMULATION DISPLAYS (keep engineer informed of progress)
↓ (HALT OR COMPLETE)
RESUME SIMULATION (loop back)

Note: *This document is a transcription of the text from the March 1971 issue (Vol. 2, No. 3) of the McDonnell Douglas Technical Idea Exchange (TIE) bulletin, pages 1 and 5. Author photographs and the original interactive graphics display photograph (Figure 1) and detailed flowchart (Figure 2) appear in the source pages but are not reproduced here.*