INFORMATION TRANSFER IN THE NATIONAL AIRSPACE SYSTEM

Human Factors Research At NASA-ARC

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Information Transfer in the NAS: An Overview of Human Factors Research at NASA-ARC

Although I had not planned on giving a formal talk on the issue, I will attempt to give an informal overview on the in-progress and planned work in the information transfer area specifically addressing the human factors issues in the current and future NAS. Information transfer is a general term which encompasses issues as to what kind of information is needed, when it is needed and in what form it should be presented to aircrews operating in today's and tomorrow's NAS. There are essentially two fundamental reasons for this effort. First, there is the mounting evidence that the existing system of transferring information concerning weather, traffic, etc. to the aircrew in an accurate and timely fashion is simply not adequate. The other reason is that plans for making changes to the existing system ought to be driven by the needs of aircrews (and controllers) and not simply by technology. This user-centered view of the implementation of elements of NASP will have to be supported by substantive data on how people will operate in this system if those of us in the human factors arena are to make a viable contribution to its design. The relevance, to the issue of windshear and other severe weather avoidance, of information transfer should be self-evident. Our focus from the human factors standpoint, in general, is long range, measured more in years than in months, so this work has a less direct relevance to these proceedings with respect to near-term regulatory implications. But Herb asked me to talk about this to give you an idea of what we are doing at Ames pertinent to windshear avoidance.

The first element of the program plan is look at the issue of information transfer in the current NAS operating environment, including problems associated with the transfer of weather information. Our chief source of information on these problems is the Aviation Safety Reporting Systems (ASRS) data base. A recent study of these problems for incidents reported during the calendar years 1985 and 1986 is due out this fall. A second study focusing strictly on weather related incidents is currently in progress.

The second are in the program deals with information transfer as it might occur in the next generation NAS, elements of which are described in the NAS plan (brown book). In this area the goal is to provide human factors guidelines for the design of the information transfer system in the NASP and to do so with as much specificity as possible. Task elements within this area include addressing the problem of managing information

so the process of delivering the needed information to the flight deck at the appropriate time can be achieved. While previously the pilot served as the msanager of information on the flight deck, it is becoming increasingly apparent that the amount of information concerning traffic, weather, etc. can overload the crew. The evolution of new technology allows a substantial increase in the amount of information available but, no increase in the ability of aircrews to select, prioritize, and integrate that information. Our task is to provide some guidance in the design of such systems with respect to meeting the needs and limitations of the humans who will operate within it.

A third task, related to future information transfer system design, address the means by which that information will be displayed on the flight deck. Included in this task are design issues with regard to the type of information displayed, its formating, whether the information should be displayed visually or aurally, and other issues. Associated with the presentation of information is the access to that information, i.e., data entry and retrieval. Those familiar with the Flight 007 know that this is a potentially nontrivial issue particularly in highly automated operating environments.

The fourth task element is to develop appropriate decision-aiding technology. In future NAS we can expect the crew to have access to far more information in real-time than is currently available. Providing a means, by which, to aid aircrew decision-making, particularly in high workload terminal area operations, will utilmately enhance safety and efficiency. With specific regard to severe weather avoidance, the provision of displayed vectoring or waypoint information which may optimize not only safety but fuel efficiency, is within current technological capabilities. The integration of such decision-aiding components into the flight deck and defining the optimal human interface remain a challenge.

Although communications engineering is not the focus of the effort a brief discussion of this area seems in order. Much of this work rests on the assumption that conventional voice/VHF transmission will not be the principal means of information transfer. Rather digital datalink transmission will likely be the chief means by which information reaches the cockpit and is sent to ground or airborne/orbiting stations. This would presumably entail both Mode S, satellite, and conventional VHF or FM station subcarriers, some of which are already in use. Basically, the problem with some of these systmes is that they are slow with regard to communications baud rate. I have numbers on the Mode S system of 200-300 bits/sec. So one of the possible research areas is to look at the tradeoffs in terms of communications rate, particularly with the regard to the transmission of weather data at least as far as its impact on crew decision-making.

In general, our approach is looking at the area of information transfer is first, to use our existing data base (e.g., ASRS) in identifying current information transfer problems and recommending solutions. Secondly, to address human factors issues in proposed information transfer systems for the next NAS. The facilities at Ames Research Center will be employed in providing the data necessary to define guidelines for these systems. Both part systems and full mission simulators located at the Man Vehicle Systems Research Facility are being exploited in this effort.

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INFORMATION TRANSFER

o OBJECTIVES

1. IDENTIFY HUMAN FACTORS ISSUES IN EXISTING INFORMATION TRANSFER SYSTEM AND RECOMMEND SOLUTIONS

2. PROVIDE HUMAN FACTORS GUIDELINES FOR THE DESIGN OF FUTURE INFORMATION TRANSFER TECHNOLOGY

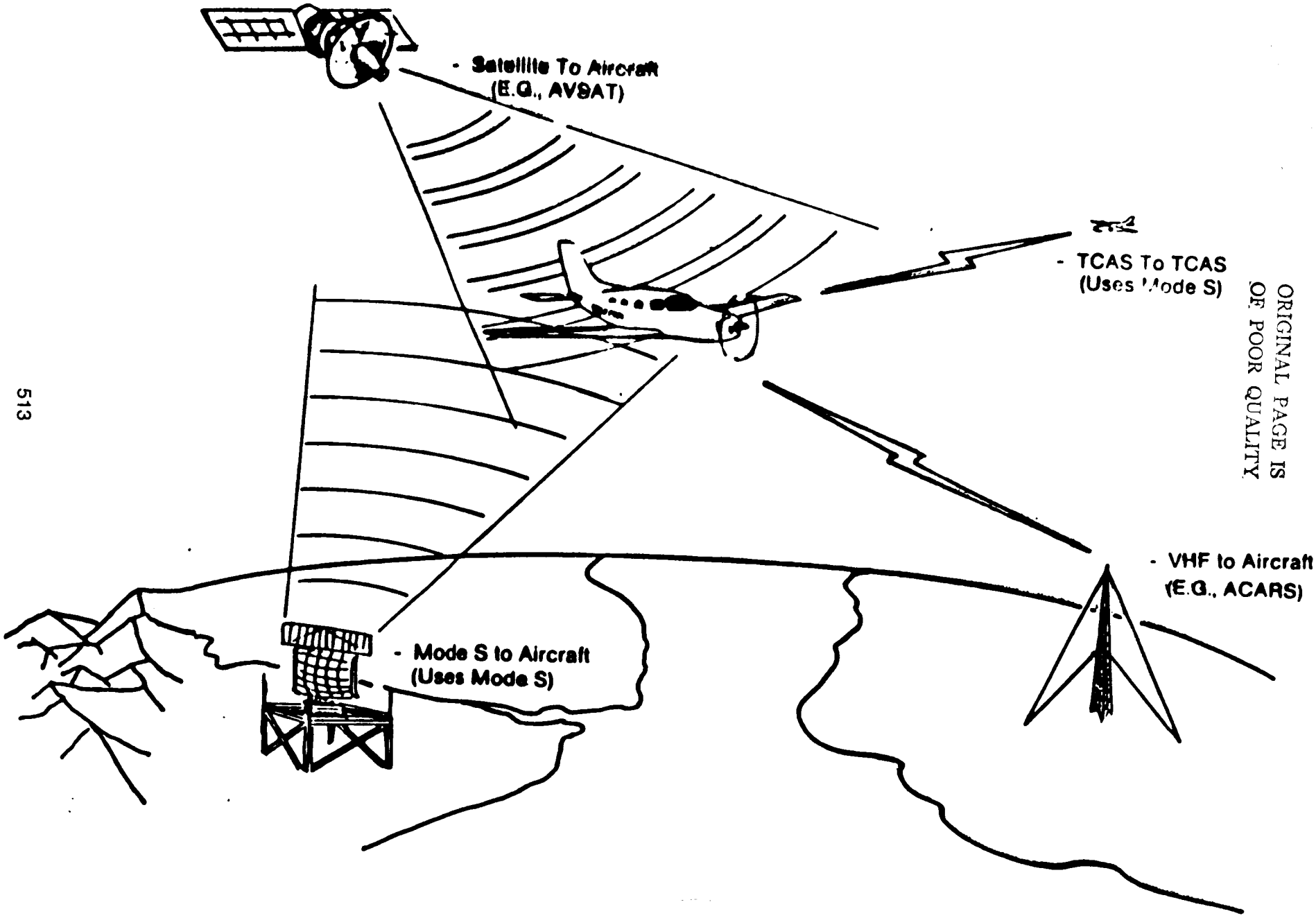
   - INFORMATION MANAGEMENT
   - INFORMATION DISPLAY
   - DATA ENTRY AND RETRIEVAL
   - DECISION-AIDING

INFORMATION TRANSFER (CONT'D)

o APPROACH

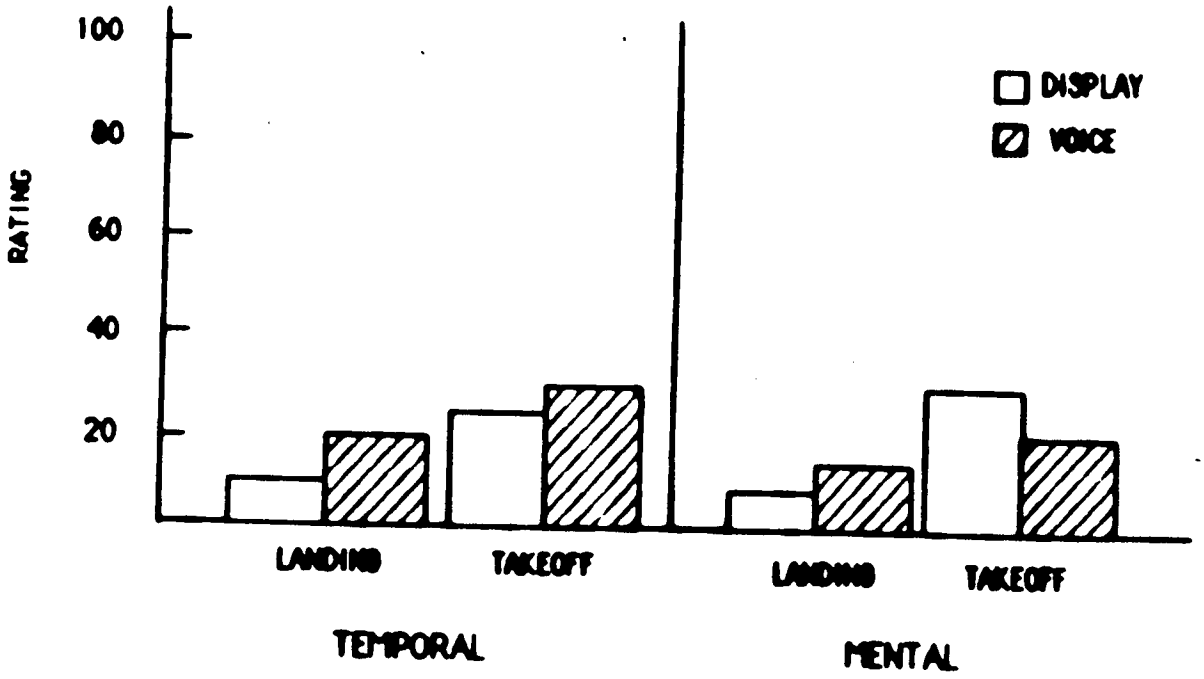
- INCIDENT, ACCIDENT DATABASE ANALYSES OF INFORMATION TRANSFER PROBLEMS
- REVIEW OF ANALOGOUS INFORMATION TRANSFER SYSTEMS
- PART SYSTEMS SIMULATION STUDIES (e.g., CDWI)
- FULL MISSION SIMULATION STUDIES

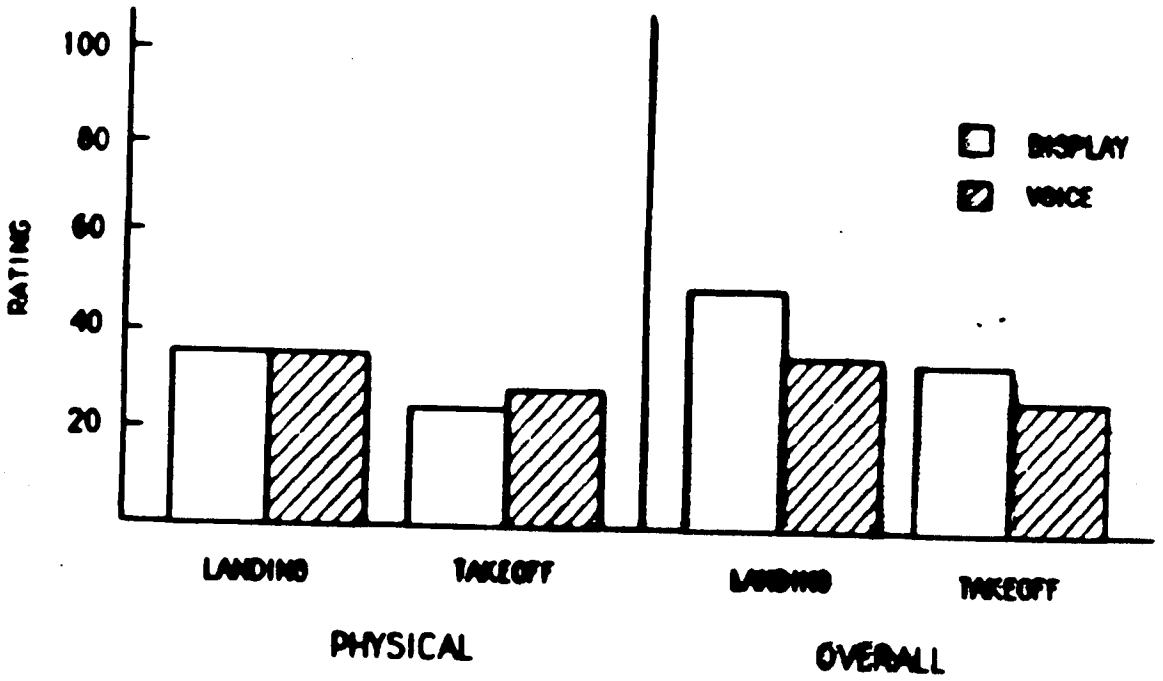
AIRCRAFT MULTI-DATA LINK ENVIRONMENT



DISPLAY-BASED COMMUNICATIONS PROTOTYPE

- GROUND-AIR-GROUND DATALINK SIMULATION (ca.1995)
- ADVANCED AIR TRANSPORT AIRCRAFT
- DIRECT COMPARISON OF CONVENTIONAL VOICE AND DISPLAY-BASED SYSTEM
- MENU-DRIVEN, TOUCH PANEL CHARACTER DISPLAY


100
80
60
40
20
RATING
DISPLAY
VOICE
LANDING
TAKEOFF
LANDING
TAKEOFF
TEMPORAL
MENTAL


100
80
60
40
20
RATING
DISPLAY
VOICE
LANDING
TAKEOFF
TAKEOFF
PHYSICAL
OVERALL