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EVALUATION OF AIRBORNE AUDIO-VIDEO RECORDING AS A TOOL FOR TRAINING IN THE A-7D TACTICAL FIGHTER

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13. ABSTRACT

This report documents the results of a study to evaluate an airborne audio video recording system in a Head-Up Display (HUD) equipped fighter aircraft, the A-7D, as a method of improving the quality of training. The results, although lacking quantitative rigor, indicate that the use of audio video recording equipment can be of real value in the training of fighter pilots. It is recommended that such capability be a basic design consideration in all new fighter aircraft.

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FOREWORD

This report is the results of research conducted by the Flying Training Division, Air Force Human Resources Laboratory. The research was conducted under project 1123, task 02, work unit 006. Major Joe A. Fitzgerald was the study manager. Major Alan E. Walker was the principle investigator. The following persons provided invaluable assistance in the preparation of this report: Capt Robert Gatewood, 58th TFW, Luke AFB, Arizona and Major Dirk Prather, Air Force Academy.

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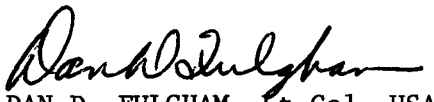

DAN D. FULGHAM, Lt Col, USAF
Chief, Flying Training Division

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EVALUATION OF AIRBORNE AUDIO-VIDEO RECORDING AS A TOOL FOR TRAINING IN THE A-7D TACTICAL FIGHTER

INTRODUCTION

The development of an Airborne Audio-Video Recording System (AVRS) for the A-7D aircraft marks the third AFHRL project to study the utilization of audio-video recording equipment in the airborne environment. The first project of this type was performed at Vance AFB on the T-37 aircraft between September 1967 and July 1969. The Advanced Systems Division of the Air Force Human Resources Laboratory (AFHRL/ASD) under contract no. F33615-68-C-1048 to the American Institutes for Research, Pittsburgh, PA with Conductron-Missouri, INC., as the equipment subcontractor designed, installed and tested this AVRS and documented their work under AFHRL-TR-69-31, dated January 1970.

A modified version of the system designed for the T-37 was installed in an F-4E aircraft at Nellis AFB. The work was conducted by the Advanced Systems Division under contract no. F33615-69-C-1816 with the Conductron Corporation and is documented under TAC Test Report 69-4F titled, "Audio-Video Recording System (AVRS)", dated 23 Sep 1970.

The experience gained in these two projects was employed in the development of the A-7D equipment. The coordination of the Head-Up Display (HUD) with the AVRS in this study makes it unique in respect to other AVRS projects. This work was performed by the McDonnel Douglas Electronics Corp., (formerly Conductron Corporation) St. Charles, MO, under contract no. F4609-70-C0035 and is documented by three reports. The contractor's report is dated 27 Nov 70 and is titled, "Technical Report for A-7 Head-Up Display and Audio-Video Recording System", and was prepared by Mr. G. F. Mussman. The TAC report TAC-TR-70A-113F, is titled, "A-7D Airborne Video Recording System (AVRS)" and is dated Feb 71. The AFHRL Flying Training Division technical report titled, "Evaluation of an Airborne Audio-Video Recording System for a Head-Up Display Equipped Aircraft", authored by Major Joe A. Fitzgerald has been submitted to AFHRL Headquarters for approval.

The initial goal of this project was two-fold. The objective of Phase I was to obtain equipment which would provide sufficient resolution to record all HUD symbology as well as the outside world cues of primary interest. After this equipment was obtained Phase II was designed to evaluate the products of the system as a method for improving the quality of training and for use in pilot proficiency assessment.

PART I - EQUIPMENT

The contract statement of work specified the use of low cost commercial grade equipment modified for installation in the airborne environment of the A-7D aircraft. In fulfillment of these specifications, the contractor chose the Sony 3400 audio-video system to be used in conjunction with appropriate shielded cables, a light baffle and a combining glass (referred to as a beam splitter to distinguish it from the HUD combining glass). This system provides 300 line video resolution and automatic adaption to light levels ranging from 30 to 10,000 foot candles. The pilot was able to add the audio portion of the tape by pushing the call button and speaking into the standard helmet microphone. In addition, tapes were able to be reviewed immediately after the mission with the aid of the Sony AV-3600 videocorder and CVM 180/U television playback monitor. The equipment at this point was tested and considered adequate to fulfill the objective of Phase I.

Modifications of this equipment were made so that the components of the system could be installed in the A-7D aircraft. The video-recorder was placed in the avionics bay while the vidicon camera, light baffle, and beam splitter were installed in the cockpit. The control unit was placed in the avionics bay in one aircraft and in the cockpit of the other aircraft.

PART II - DATA

The data from this project include a number of video tapes and the critiques filled out by students who were taught with the aid of these tapes.

Because safety considerations were paramount, it was decided to allow only experienced instructor pilots to fly the AVRS equipped aircraft. As a result, student proficiency assessment using the tapes during debriefing could not be accomplished. The following audio-video tapes were made by experienced instructor pilots and used in the classroom:

1. HUD Update - original prediction problems
2. Four-Way Update - ranging methods' calibration
3. Attach symbology - escalation
4. Visual attack - three aiming methods
5. Radar attack

6. Zero destination radar attack

7. Nav bomb

8. Actual range mission

PART III - RESULTS

The tapes were shown immediately following introductory discussions on the subject and served to reinforce original learning. In 60% of the course critiques, students mentioned the AVRS tapes as "the most effective training aid." Only 5% of the students listed the tapes as "the least effective training aid", and even these students qualified their statements by saying that it was only because of technical flaws such as EMI hum or lack of proper editing. This is particularly interesting in view of the generally poor quality of the tapes.

PART IV - DISCUSSION

Although the contractor's design proved deficient in some respects, it should be noted that the commercial grade equipment reflected a fairly high reliability: Electronic reliability was especially good. The performance of the recorder was excellent although video quality was degraded when over 3 g's were placed on the aircraft - a minor difficulty.

The problems that arose can be placed in two general categories - Design and Maintenance.

Design: Certain deficiencies in equipment design were identified quite early in the program, but because of fiscal constraints could not be corrected adequately or, in some cases, at all. Some of these deficiencies follow.

All the tapes which were made contained an objectionable quantity of electromagnetic interference (EMI) in the audio. This manifested itself as a steady tone and could probably be eliminated by adding a filter to the system.

In some light conditions HUD symbology and ground contract were lost. The addition of a medium green filter brought the video quality up to an acceptable level.

Vidicon burn was caused by the direct impingement of sunlight on the vidicon tube. The burns healed themselves with time but detracted from tape quality nonetheless. A diode matrix vidicon would solve this problem.

When the glareshield was in the correct position it presented a knife-edge surface to the pilot, but when misaligned or when the pilot moved his head from side to side the glareshield proved to be an undesirable visual obstruction. It was primarily for this reason that it was decided to allow only experienced A-7D instructor pilots fly the AVRS equipped aircraft.

Maintenance: The contractor supplied two weeks of field support proved insufficient to adequately train the Air Force Maintenance personnel tasked with maintenance responsibility. They were unable to repair some malfunctions both because of lack of knowledge and difficulty in obtaining parts.

PART V - CONCLUSIONS AND RECOMMENDATIONS

1. This study demonstrates the value of Airborne Audio-Video Recording as a training technique in the A-7D aircraft, and therefore, to other aircraft equipped with a Head-Up Display.

2. It is recommended that serious consideration be given to the incorporation of an Airborne Audio-Video Recording System in the design of all new fighter aircraft that are to be equipped with a Head-Up Display. Such incorporation in the basic design could eliminate all of the problems that have derived from designing an "add-on" for a fielded system.