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FLIGHT TESTS CONFIRMING THE OPERABILITY OF NIGHT VISION DISPLAY COCKPITS FOR THE NEW HELICOPTERS

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Summary

In continuation of a long line of flight tests the recent test series is carried out to furnish test data on new generation helicopter cockpit avionics equipment. A UH-1D helicopter has been equipped with a CRT display cockpit, a STANAG 3838 (MIL 1553B) data bus system, a FLIR sensor and a Doppler navigation system. The helicopter is flown NOE over typical central European terrain throughout all seasons night and day under various weather conditions. Test results so far confirm the approach taken.

Introduction

Performing concept studies as well as experimental investigations over the last decade Dornier layed the foundation for its present work in the field of next generation helicopter avionics. Flight tests have been the backbone of experimental investigations of the past covering the topics of:

Fly-by-wire Control - HSF (Helicopter Adverse Weather Flight Control System 1976/1980)

- Triplex fly-by-wire bus system
- Rate demand control
- Acceleration demand control with rate hold
- Side arm controller

Pilot Night Vision

- Night vision goggles
- TV and FLIR sensors
- Manually and LOS controllable sensor platform
- Head-down and helmet displays/sights
- Integrated information display

Integrated Avionics

- STANAG 3838 simplex and duplex data bus control
- Mission planning and data transfer
- Flight management and maintenance data handling.

It was recognized that the step from the conventional to the CRT display cockpit, entailing technological and financial risk, cannot be made safely by performing studies on paper alone, and that core avionics elements like night vision, navigation, controls and displays have to be functionally tested. Therefore, flight tests were scheduled which also included the military user who furnished several test pilots. It was felt that close cooperation between military user and industry will create a solid set of base data on which the definition phase of the LTH/SAR helicopter can be built.

Following this line of thinking two experimental flight test programs were initiated:

NSC - Nachtsichtcockpit (Night Vision Cockpit)
HAV - Hubschrauberausrüstungsversuchsträger (Helicopter Avionics Test Vehicle).

The NSC program covers topics which are of general importance to all new generation helicopter avionics systems. Typical points of investigation are:

Night Vision

- Night vision goggle compatibility with the CRT cockpit environment
- Color vs. monochrome CRT screens
- FLIR displays for the pilot and SAR operator.

Controls and Displays

- CRT display symbology
- Optical and acoustical warnings

Navigation

- Functional integration of map displays.

The HAV program is to provide specific informations which are needed to settle issues for the LTH/SAR definition phase requiring further examination.

System Configuration

Both programs use a modified UH-1D helicopter as a common test bed.

The test vehicle includes two front and two rear operators stations. In front are

- the safety pilot station with conventional instrumentation
- the test pilot station with new generation avionics equipment.

In the rear are

- the test cockpit station with new generation avionics equipment
- the test engineer's station.

The stations are separable by black curtains to simulate various test conditions. The helicopter is flown from the test pilot's station with the test copilot assuming the role of equipment operator, navigator and SAR operator. The test engineer controls and coordinates the tests.

Both programs use the identical avionics system architecture, which includes common hardware and software modules. The heart of the system is the multiplex MIL 1553B data bus with bus controller and 6 remote terminals. Additions are made as program objectives demand.

For NSC the following features are included:

Night Vision Aids

- Third generation night vision goggles
- FLIR sensor with SPRITE detector

Displays

- 7" x 7" hybrid color monitor
- 5" x 7" hybrid monochrome monitor.

Symbolgenerator

- VSD Formats
- HSD Formats

Navigation System

- Doppler radar sensor
- Computer controlled map display
- Position updating functions.

For HAV the NSC configuration is further expanded and modified to also include:

Displays

- 7" x 7" hybrid monochrome monitor
- Color TV monitor
- Central Warning panel

Controls

- Centralized display controls
- Spare capacity tester

Symbol Generator

- Additional HSD/VSD formats

Navigation

- Doppler Nav. System with data bus interface

Flight Control System

- Conventional duplex autopilot.

Flight Tests

The team which is reponsible for the functional design of the experimental system is also carrying out the flight tests. This team consists of company and customer members, pilots and engineers.

Six pilots and six flight engineers participate in the flight tests. They come from

- German forces flight test center
- German army, airforce and navy
- Dornier

Each pilot is required to have at least 6 flight hours, mainly in the night low level flight regime, before he is permitted to fully contribute to the program and make conclusive judgements.

The test philosophy is quite simple: all flight tests are carried out according to real missions by very experienced test and service pilots. Special emphasis is placed on night low level flying. As far as possible all weather- and night illumination conditions are covered.

Pilot questionaires are prepared to document preliminary and final results. If necessary video- and/or numerical data analysis is performed. Statistical programs for quantitative evaluation of pilot performance are employed.

At present there are four approved night NOE flight routes available leading through rolling terrain with typical central European ground coverage including frequent crossings of power lines. Mountain and coastal routes will soon be available to the program. The routes are flown under all conditions presently permitted by military flight rules. Expansion of these flight rules will be necessary to fully explore all capabilities built into the system in its present configuration.

The first of three flight test periods was successfully carried out this winter.

Test data were obtained concerning

- 3rd Gen NVG-Compatibility with light sources inside and outside the cockpit
- Symbology formats.

Out of five different symbologies available for

- Vertical situation
  - o Symbology superimposed on a video image (cruise and hover)
  - o VFR/IFR-Symbology
- Horizontal situation
  - o ROSE-Symbology
  - o RNAV-Symbology

two were evaluated in the night low level flight regime

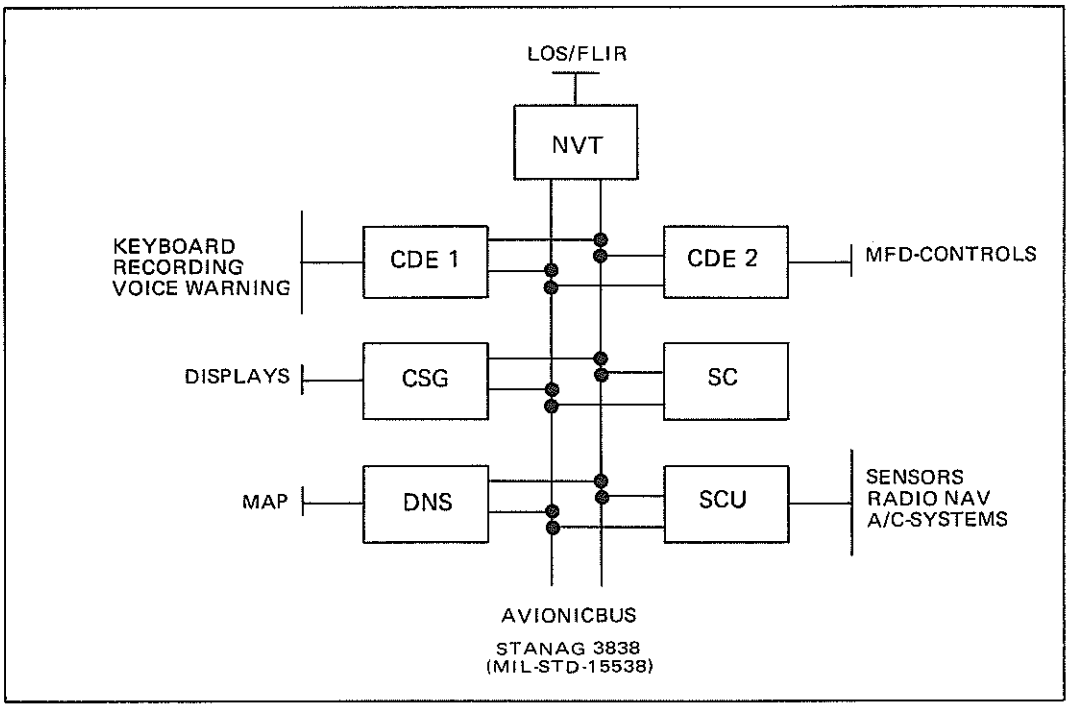
- VSD - superimposed on a FLIR-Image
- HSD - area navigation format RNAV.

Symbology format changes requested by the test pilots were implemented between flights. In this manner, at the end of this

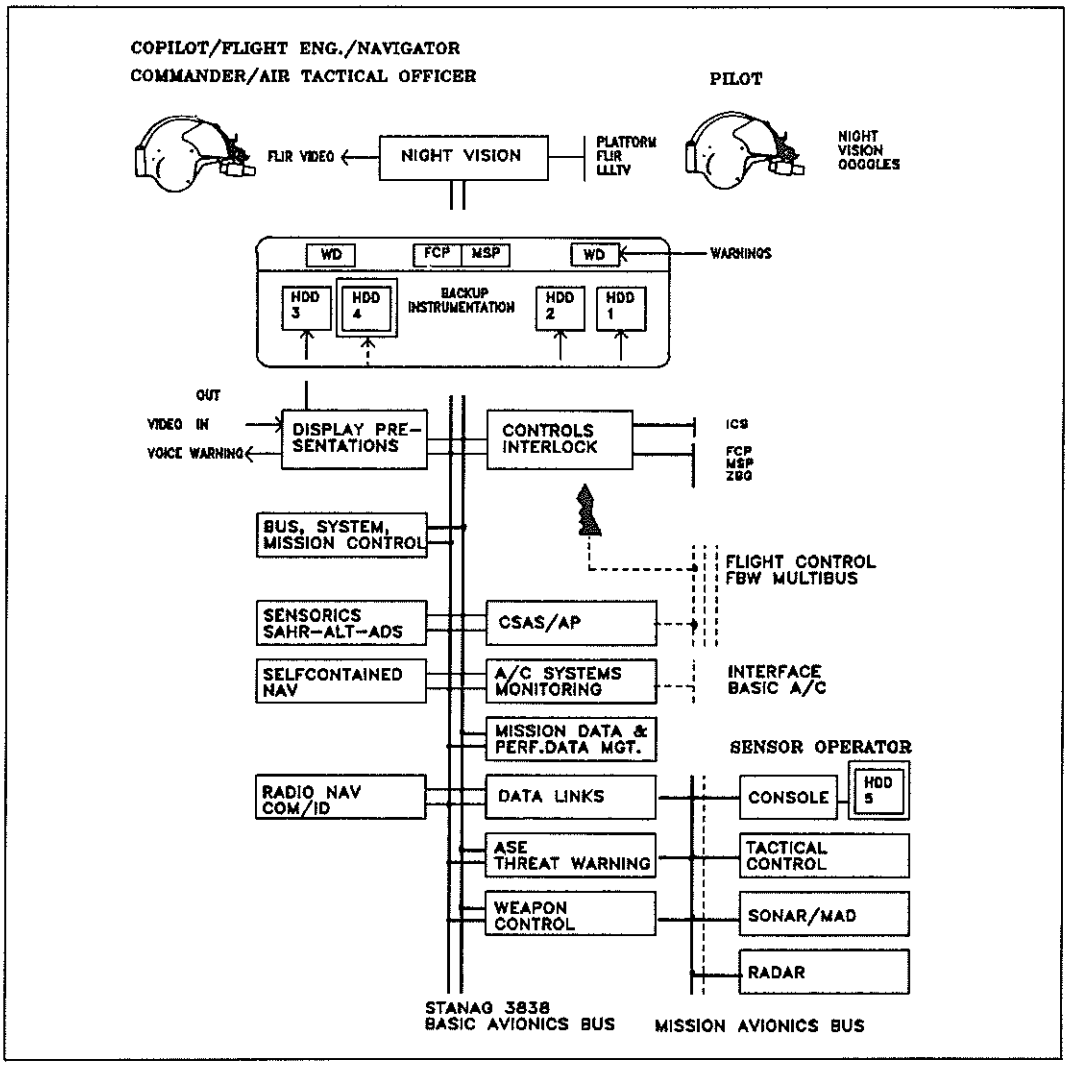
flight period a set of generally accepted display formats was established. A quantitative rating of display format acceptance was obtained using bar graphs as shown by the attached figures.

We are presently in the process of reconfiguring the system for the next test campaign which will be conducted again in the well established manner. We are confident that it will take us another significant step in the direction of demonstrating the operational capability of the night vision display cockpit for the next generation helicopters.

NSC/HAV Flying Testbed



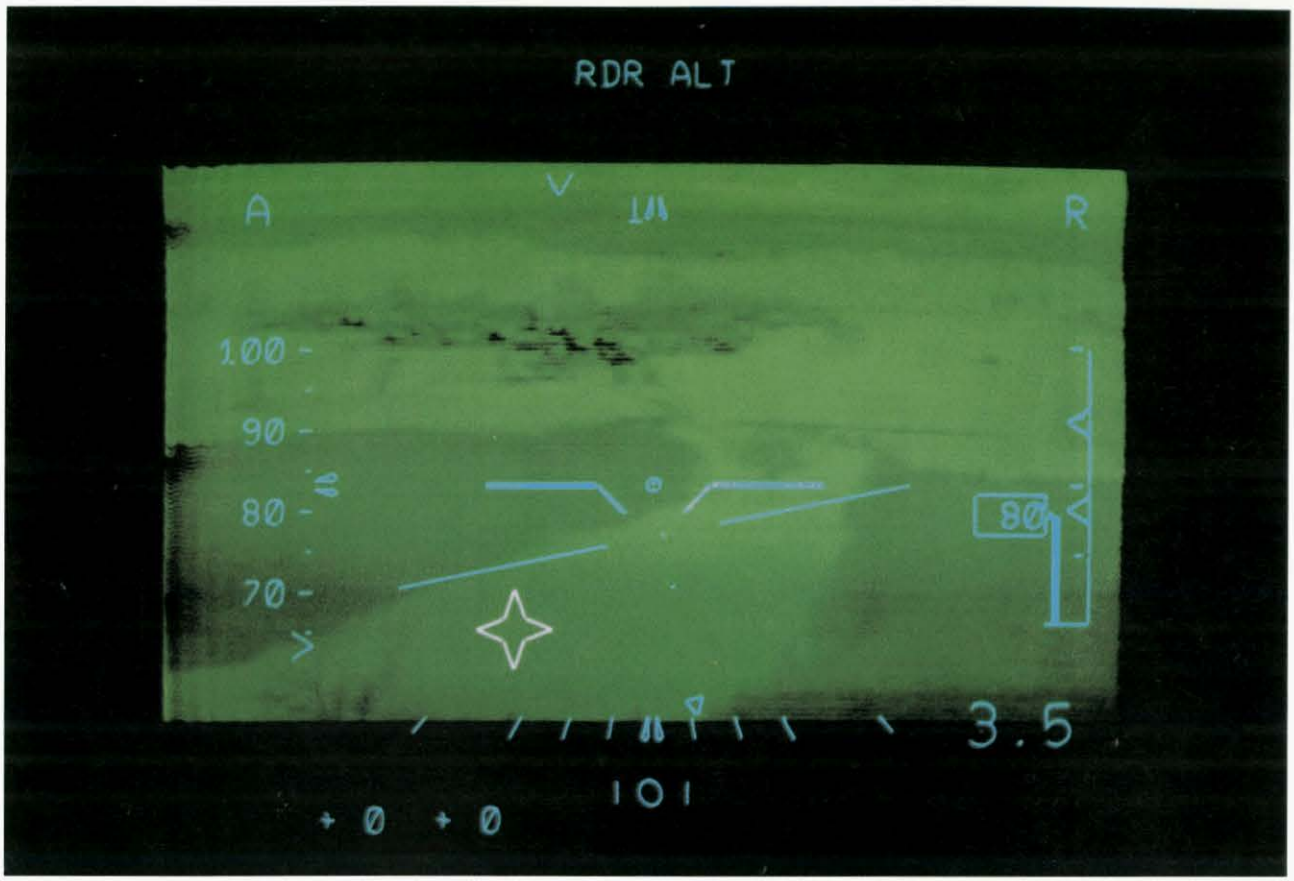
NSC/HAV Experimental Avionic System



Integrated Helicopter Avionic System

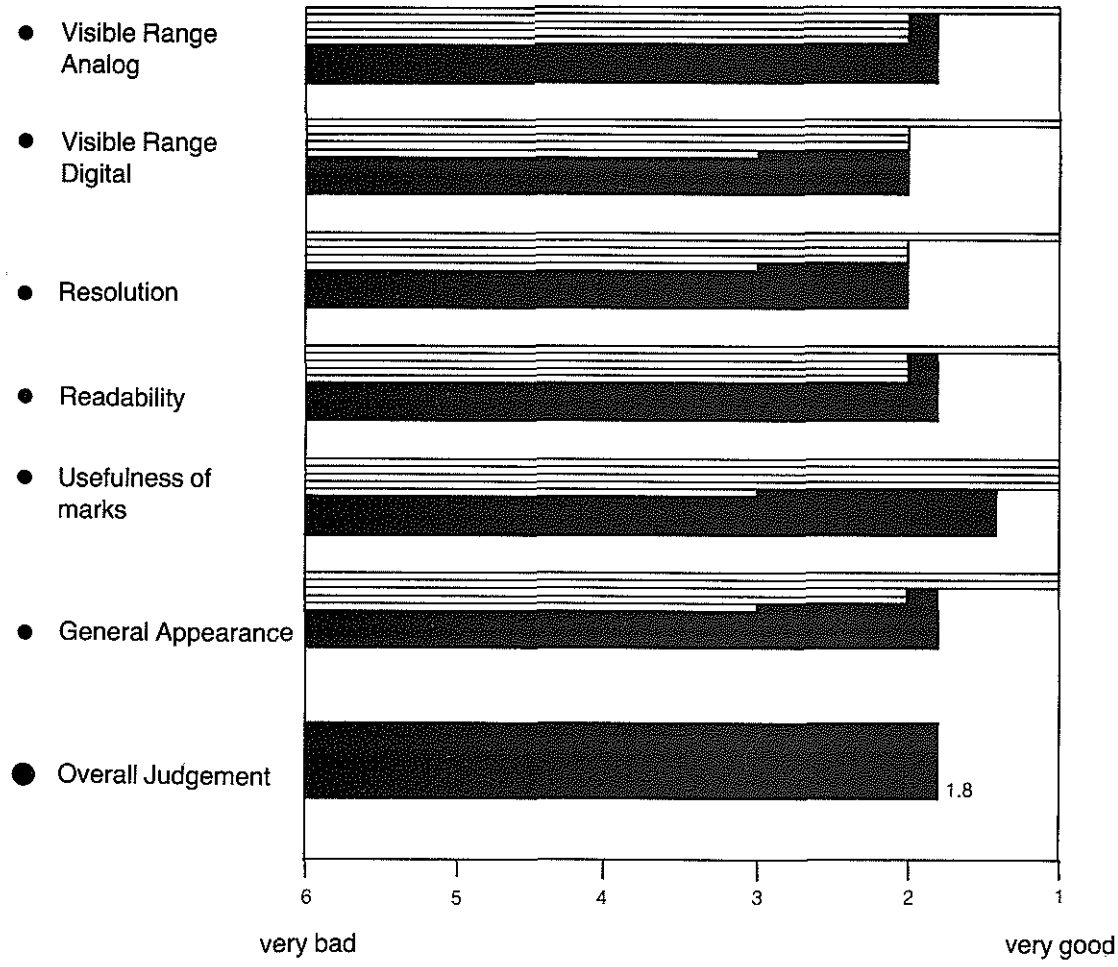
NSC/HAV Front Cockpit

NSC/HAV Rear Cockpit

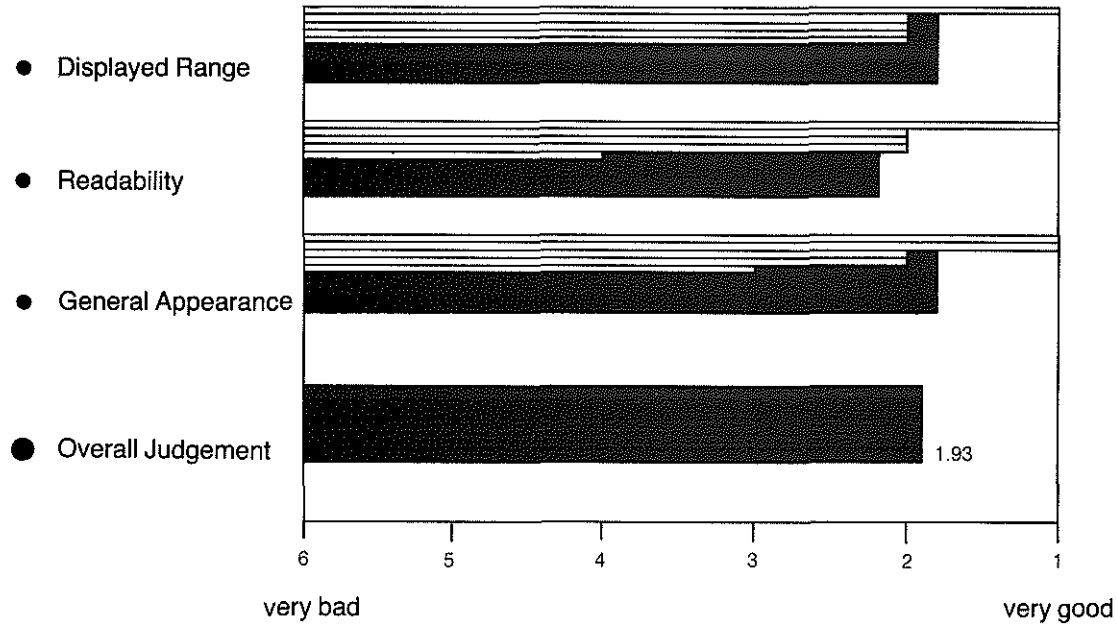


VSD Cruise Symbology

HSD Area Nav Symbology



VSD-FLIR
Radar Altitude Symbol



HSD-RNAV
Flight Path Symbology

Representation of Test Results: Pilot Judgement