SIXTH EUROPEAN ROTORCRAFT AND POWERED LIFT AIRCRAFT FORUM

Paper No. 66

WEAPON SYSTEM EVOLUTION OF ATTACK HELICOPTERS

W. Dieter, M. Riffel

Elektronik-System-GmbH
Munich, Germany

September 16-19, 1980

Bristol, England

THE UNIVERSITY, BRISTOL, BS8 1HR, ENGLAND

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by
W. Dieter, M.Riffel
Elektronik System GmbH, Munich, Germany

1. GENERAL

In the past, helicopters have proved an excellent means of transport for men and material during military manoeuvers. Subsequently, however, their capability for fighting enemy mobile units from the air was recognized. Considerable attention therefore has been spent on the fighting role of helicopters in the last fifteen years.

The developments cover higher mobility, e. g. improved flight characteristics, recognition of and defence against enemy threats and avionics and weapons equipment optimized to the various attack roles.

The basis of the improved flight characteristics, of the development of new avionic systems as well as the realisation of new system functions, is the application of modern electronic technology, especially the high-integrated monolytic techniques.

As a result the architecture of modern avionics and weapon systems shows a high degree of integration of various system functions. System control is accomplished via central control units. For display of system data, e. g. guidance and navigation information, command data and check-out values etc., cathode ray tube displays are used. These allow a highly integrated presentation of information. The data transfer between sepa-

rate equipment groups is performed by special data bus systems in conjunction with computers. The following figure 1 shows a comparison between a conventional and a modern system architecture. Example given is the radar altimeter.

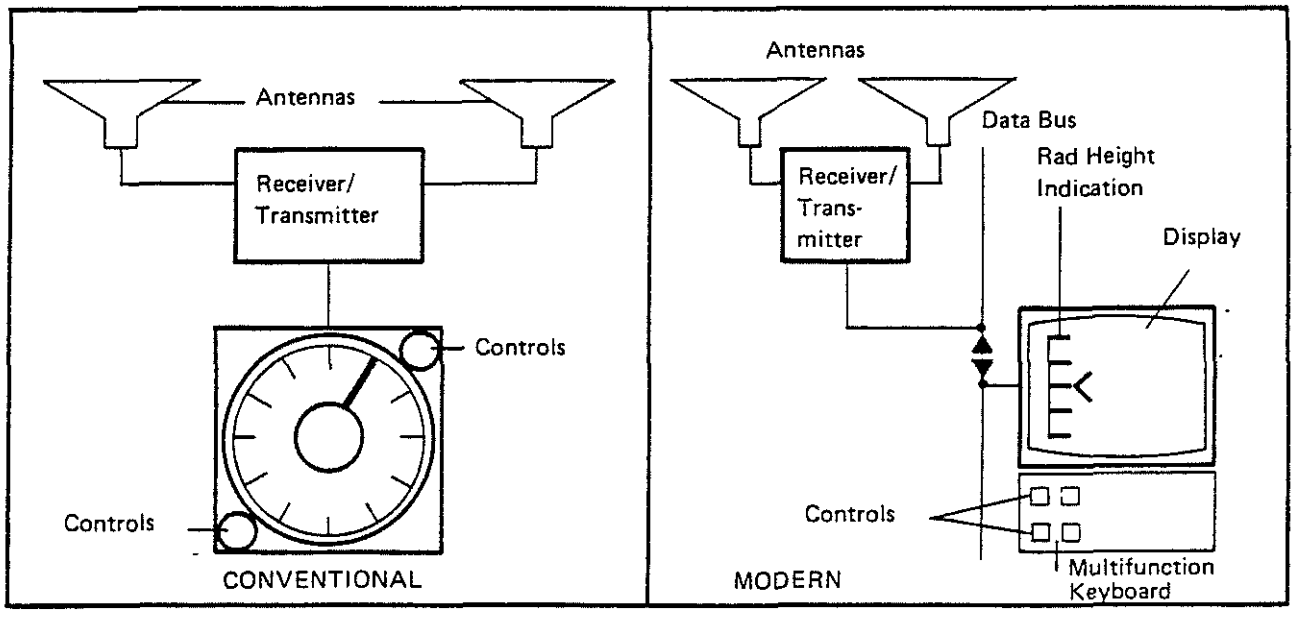

Fig. 1: Conventional and modern system architecture for the radar altimeter system

One of the most important features of modern avionic and weapon systems is the application of on-board computers for system control and performance monitoring, for diagnostic purposes and for crew support and decision making.

Generally the term avionic systems is used to describe system functions and system structures necessary for the actual mission operation. Therefore the term mission-related avionics is often used. Depending from the aim and tasks of the helicopters they are equipped with different avionics and weapon systems. This, however, does not mean that helicopters with different tasks have completely different fits. For logistic purposes a more or less common equipment fit is desired; differences are only given by additional special equipment for special tasks. The following figure 2 shows broadly the planned system functions of the future German attack helicopter fleet.

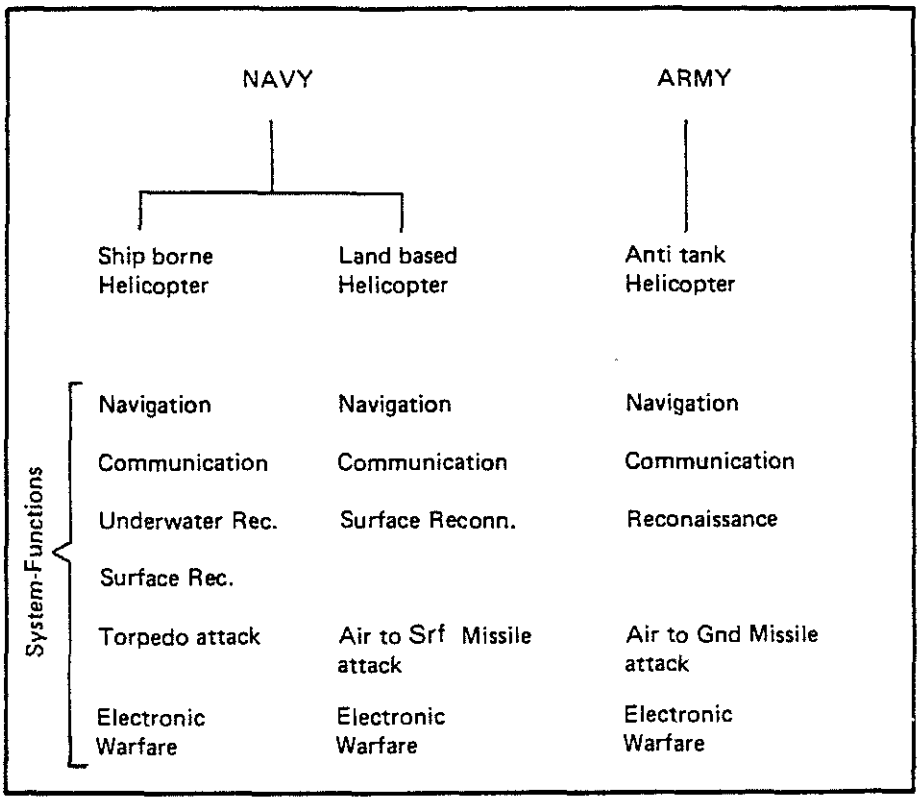

Fig. 2: Planned Systemfunctions of the German Attack Helicopter Fleet

2. NAVIGATION AND AIRCRAFT GUIDANCE

One of the system functions necessary for all tasks is navigation. To guarantee helicopter operations under all weather conditions more and more self contained navigation systems in conjunction with opto-electronic imaging systems are used.

The spectrum of the self contained navigation systems covers Doppler-Navigation-Systems as well as inertial systems. Strap down inertial systems combined with Doppler-velocity sensors represent the most cost-effective solution. In cases where vibration exceeds the usual levels laser gyros are required.

The latest development concerning radio navigation are global positioning systems, which allow a precise calculation of the helicopter position in three coordinates.

As an navigation aid, especially for purposes of safe aircraft guidance during low level or nap-of-the-earth flights at night or under bad weather conditions opto-electronic imaging sensors are used. During these mission profiles the pilot is no longer demanded to read the data for aircraft guidance on instruments located head down. It is aimed to present that information in such a manner, that an information content relating as close as possible to the real world is presented to the pilot in an optimized manner. The sensors necessary are low light level amplifiers resp. thermal imaging equipment; they present a head up video picture of the outside scene in a forward direction.

In the simpliest way this is accomplished by two low light level amplifiers mounted on the helmet in the form of eye pieces. Low light level amplification, however, has the disadvantage, that it requires an illumination level of at least 3×10^{-3} Lux. For lower illumination levels thermal imaging sensors are used; they are mounted in accordance with the eye datum to provide a field of view adequate to the line of sight.

For this purpose a video camera is installed on a platform which can be controlled in azimuth and elevation. A pick-off set, located in the helmet provides the required control signals. That means the platform and therefore the line of sight of the camera follows the movements of the helmet representing the movements of the pilots head. The video signals of the camera are presented to the human eye via a mini cathode ray tube. Cathode ray tube and the necessary optics are mechanically connected with the helmet, thus acting like an eye piece.

For purposes of guidance various command signals are superimposed to the videocontent of the mini cathode ray tube.

Videoinformation of the outside world can also be presented on head-up-displays which are rigidly connected with the fuselage in such a manner, that the pilot can see the scene picture at normal eye datum. The problem of small viewing angles of conventional head up displays is solved with the development of wide angle head up displays. Current experiments consider the installation possibility in helicopter cockpits similar to fighter aircrafts.The following figure 3 shows the angle of view comparison of a wide angle head up display and a conventional head up display.

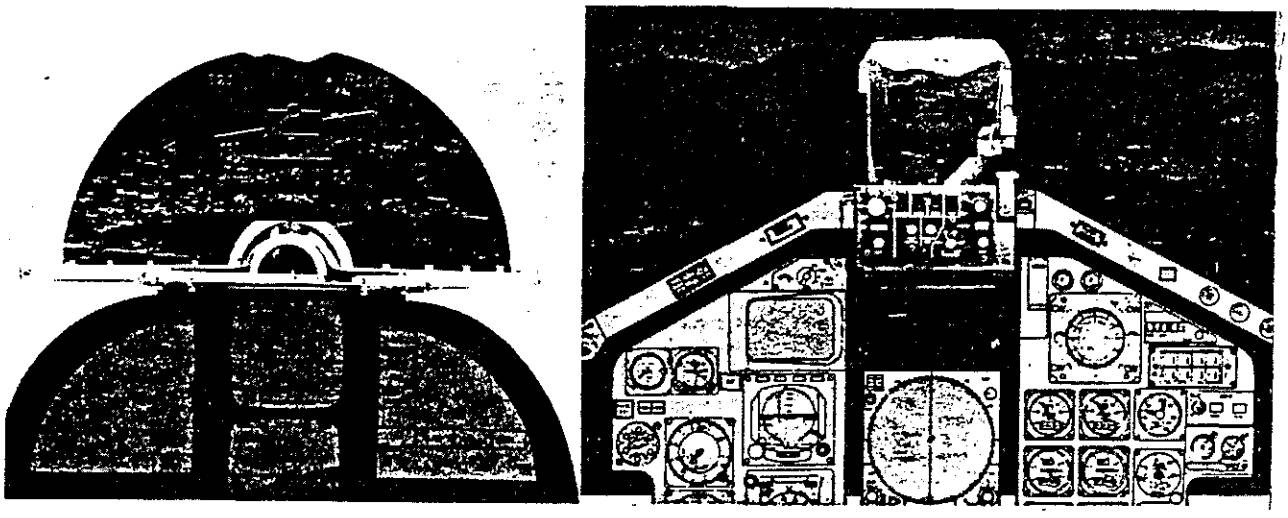

Fig. 3: Field of view comparison of a wide-angle head up display with a conventional head-up-display

3. COMMUNICATIONS

A further basic function for successful helicopter mission operation is communications. Voice communications in the UHF, VHF and HF-Band is part of helicopter standard equipment. Nowadays jam resistant broad-band data links are used with high capacity for transmission of target data respective target signatures to a ground station or vice versa. In all cases these data link procedures work on digital basis and are used to update or correct the tactical situation. The situation itself can be shown by symbolics on CRT-displays installed in the helicopter.

4. RECONNAISSANCE

For battlefield reconnaissance in a broad sense, identification and target detection equipment are used. Up to now target detection is done in most cases by on-board radars. In cases where passive reconnaissance is required, TV-imaging systems are available. Of great importance is the passive reconnaissance during night with thermal imaging sensors.

In the simplest case target identification is done by observing the radar or TV-image. Automatic procedures, however, allow the interrogation, the automatic evaluation of the interrogation result and the corresponding presentation, visual and audio.

Thermal imaging sensors for target acquisition and target identification are located either in the front part of the helicopter or on top of the roof. Latest disigns show mast mounted arrangements, that means the sensors are placed above the rotor blade datum, thus performing target acquisition and identification without leaving cover. In most cases the video channel is coupled with an optical telescope to allow observation at day and night via the same ocular eye piece. As the realisation of optical telescopes in the mast mounted version provides considerable technical difficulties, reconnaissance has to be accomplished by ordinary TV-systems in this case.

Primary task of shipborne helicopters is the convoy protection against enemy submarines. The measures herefore are underwater reconnaissance, attack and destruction. Underwater reconnaissance is performed by various sensor- and detection-systems, e. g. active and/or passive dipping sonar equipment, and magnetic anomaly detection devices.

Sonar systems detect emissions caused by a noice source and prepare the signals for display. With magnetic anomaly detection devices the existence of submarines can be recognized by measuring changes of the earth magnetic field caused by the submarine, however, precise location is still difficult.

Shipborne helicopters equipped with on board radars and used as a reconnaissance platform also contribute to the long range reconnaissance by extending the range of the own ship unit. The surface targets detected are transmitted via digital data links to friendly command and control stations for purposes of upgrading the tactical situation.

Land based maritime attack helicopters, which have less problems at take-off- and landing-manoeuvres in comparison to shipborne helicopters normally belong to heavier weight classes. Their main task is the counter attack of small enemy ship units, like missile-carrying fast patrol boats, coastal escort vessels etc. Due to the long range capability of on-board radar-systems surface target detection and tracking can be performed before the enemy ship units can reach own missile firing range.

A second task land based maritime helicopters have to perform is target data transmission by data link to a ship- or airborne command and control station for purposes of correction or upgrading the overall tactical situation.

Latest development concerning the reconnaissance role of helicopters aim to perform the targetdata extraction on ground stations. That means, that the radar raw signals are transferred via data link.

5. WEAPON DELIVERY

For engagement of land based enemy units, especially enemy tanks, air to ground missiles are required. Depending on the target acquisition system, the actual sight, the missiles are controlled either via an unwinding wire during flight or by self evaluation of target reflections. In both cases the gunner has to keep the line of sight of his acquisition system on the target.

The required missile tracking set of wire guided systems consists of an infrared measuring device which provides deviation signals of the missiles hot exhaust against the line of sight datum. In a weapon computer the corresponding correction signals are calculated and transmitted via the wire to the missile.

Missile guidance by evaluating reflections is based on laser systems. In this case the target is illuminated by a laser designater; the beam reflections on the target are evaluated by the missiles laser detecter and the control signal are derivated.

Considerable effort has been spent, to accomplish target recognition, identification as well as missile guidance by microwave radars. Microwave radars have the advantage of an excellent atmospheric penetration compared with opto-electronic imaging sensors. They have, however, at clear weather conditions less resolution than the TV-imaging sensors. The target recognition and identification of camouflaged targets, such as tanks, still provides difficulties as no sufficiant experience about typical radar target signatures are available.

The increasing threat to helicopters by specially armed enemy helicopters requires anti-helicopter armament. Practical experiments were undertaken for installation of a fixed machine gun. However stabilised and movable machine guns in connection with sights and target acquisition systems are required.

Maritime helicopter are equipped with torpedos or air to ship missiles, depending upon the mission to be carried out. Up to now the shipborne helicopter performs the attack of enenemy submarines by torpedos launched from the helicopter. The torpedo itself tracks the target automatically after lock on.

Land based maritime helicopters performs the attack by radio-, radar- or optically guided air- to -ship missiles.

The latest requirements to maritime helicopter performance cover the combination of the tasks of shipborne and land based helicopters.

6. ELECTRONIC WARFARE

One of the most impressive innovations within the armament of modern fighter helicopters are represented by Electronic Warefare Systems, which are still handled with a lot of secrecy and with some optimal controversy.

Such Electronic Warefare Systems serve for electronic self-protection reducing the launch- or hit probability of hostile weapon systems. There are available passive and active countermeasures against radar guided as well as infrared guided threats. Passive countermeasure systems indicate the appearance of emissions of hostile guidance radars, showing the direction and kind of threat, thus allowing the pilot to change his flight profile and/or to fly at low altitude.

In cases where it is impossible to counteract the threat with low altitude profiles,active countermeasures like chaffs jammers are very effictive, but need a conscientious adaption to the helicopter, its tactical requirements and the hostile weapon parameters. Modern computer controlled EW-Systems assist flight crews by automatic detection and identification of threats and the immediate selection of optimized countermeasures.

An important threat for helicopters is caused by infrared guid missiles. Careful painting and a new kind of permanent "Infrared-Countermeasures", which permit a contineous protection during the whole mission to quarantee a high degree of survivability even in dense threat environments.

7. CONCLUSION

The trend of development of the avionics resp. weapons systems for helicopters leads more and more to integrated systems with a high degree of automatisation. For the crew themselves only the task of aim settings and decision makings remain. If they can finally be replaced, however, remains questionable.

Fig. 4 : Mast mounted sight on 500-D Helicopter

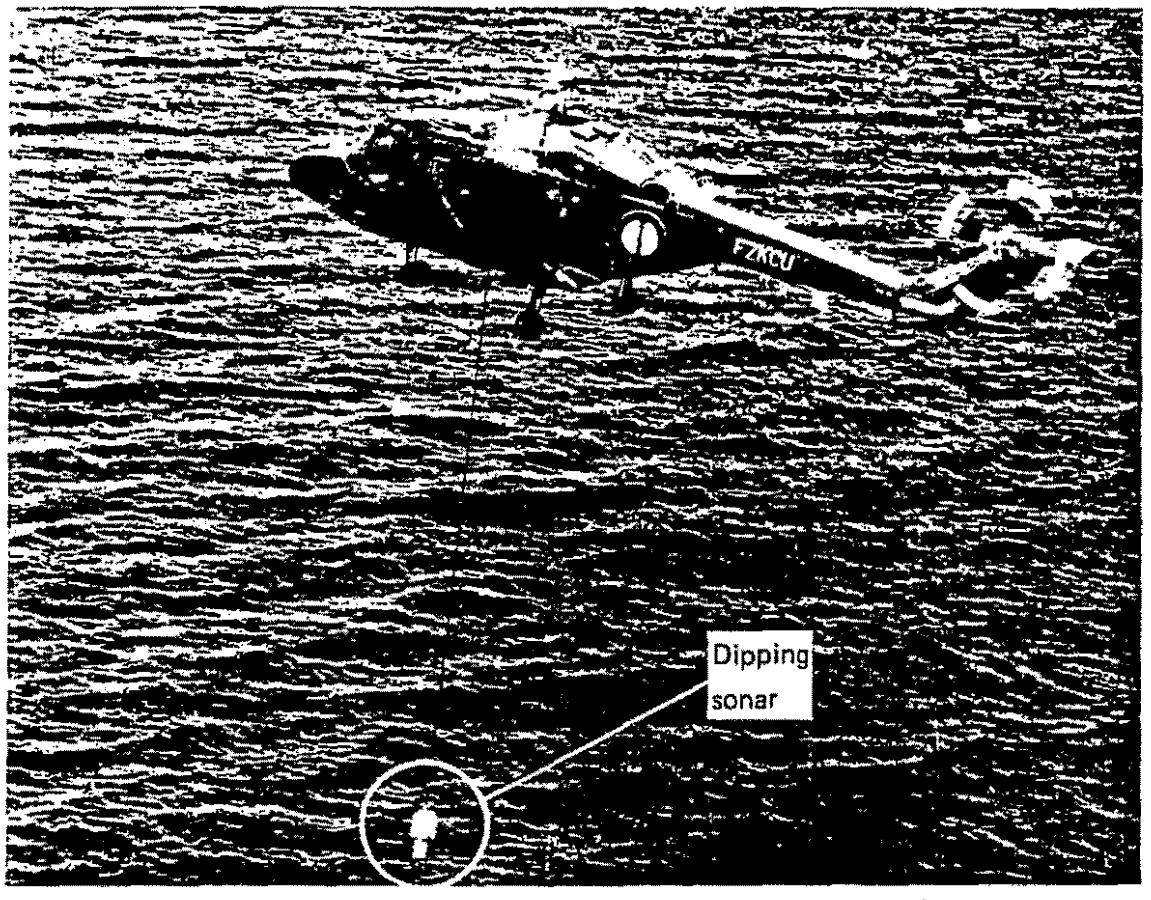

Fig. 5 : Navy helicopter with dipping sonar for underwater reconnaisance

Fig. 6 : Land based Navy helicopter carrying air-to-surface missiles

Fig. 7: B0105 Helicopter with Automatic Cannon

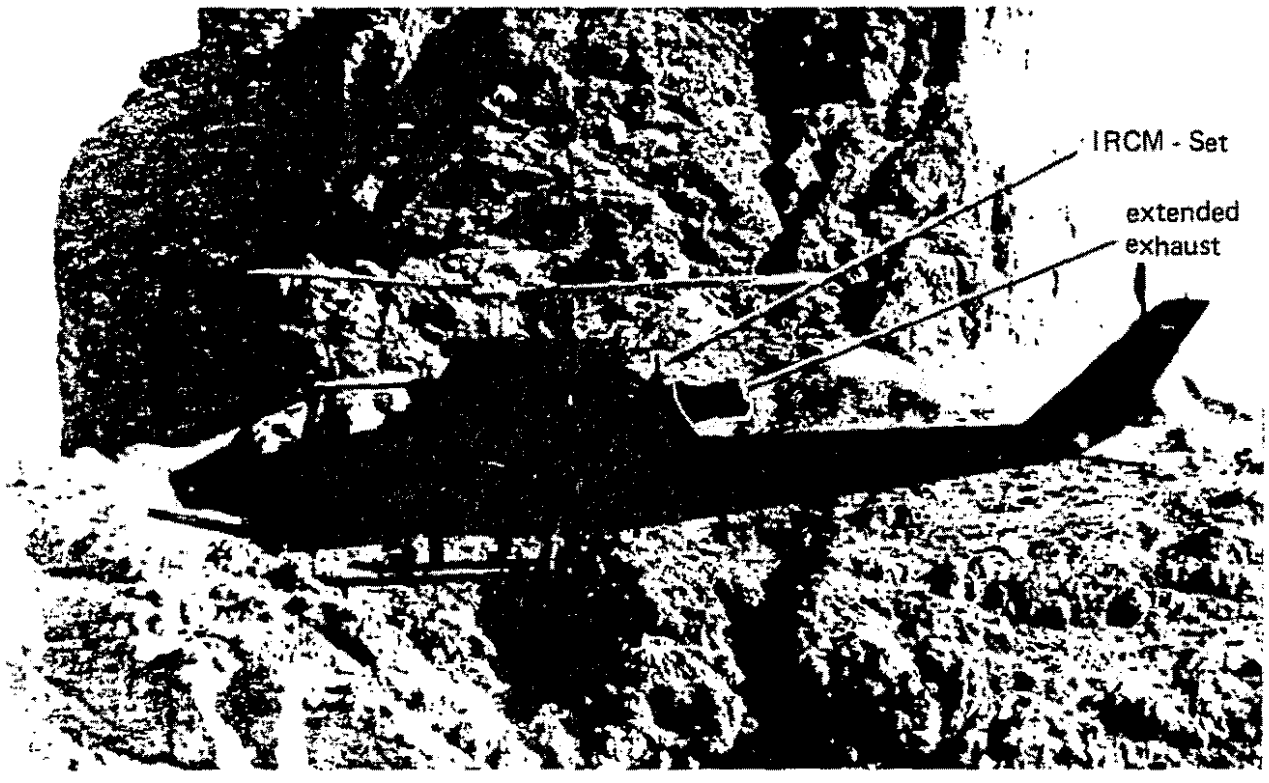

Fig. 8: Anti tank helicopter equipped with infrared countermeasures