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Defending Commercial Airliners against Missile Attacks

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1. SUMMARY

The events of 11 September 2001 reminded us all that we live under the constant threat of terrorism and its associated impact on the media. The attack on the Arkia Boeing 747 in Mombassa and the attack on the DHL A300 in Baghdad highlighted the vulnerability of commercial aircraft to Man Portable Air Defence Systems (MANPADS) infrared-guided surface-to-air missiles, which are easy to conceal and use and have proliferated in recent years.

As a consequence the protection of commercial airplanes against missile attacks is a problem of growing importance in the aerospace community. The protection of military platforms against any kind of threat from long range radar guided air defence to very short range IR guided MANPADS has been widely addressed for more than 40 years by the Electronic Warfare industry. The protection of commercial airplanes against missile attacks drives new requirements for VIP / HOS platforms and commercial passenger transport aircraft (airliners) or cargo aircraft.

This paper and its associated presentation will be at first concerned by an overview of the system options that may be considered, including their relative merits. It will then present the various approaches chosen by Thales to address these challenges, in the short term and in the long term.

2. THREAT AND MAIN SYSTEM OPTIONS

The main threats are man portable Air Defense missiles (MANPAD). They are widely spread, very mobile and very difficult to detect as they present no advance notice (like radar, laser…) of use. However they are well known by counter-measure experts, and protection solutions exist in the military domain.

In the commercial aircraft domain and ffrom the target point of view even if commercial airplane present a naturally reduced IR signature (high air dilution ratio to reduce noise) compared to military aircraft or helicopters they may be detected and engaged even by older generation, un-cooled and limited sensitivity IR seekers, with potential dramatic outcome of this engagement during the take-off and approach/landing phases.

Furthermore ground based risk mitigation options such as the permanent control of the corresponding ground area remains impossible in most cases for the largest number of airport in the world.

As a consequence onboard protection of aircraft is the preferred choice against this threat, with a very large potential market, estimated in terms of tens of billions of US $.

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3. ONBOARD PROTECTION OF AIRCRAFT SYSTEM OPTIONS

The first challenge consists in the detection of the threats, with options consisting of passive detection (UV or IR detection), active detection (Doppler radar missing warning) or combination of both.

The second challenge is the choice of counter measures action options against the missiles, with either passive means such as adapted flares, or active means (DIRCM or Directed IR Countermeasures) such as IR lamp or laser DIRCM. In the short term adapted flares offer proven effectiveness against proliferating threats, while laser DIRCM is the preferred option for medium and long-term systems.

Furthermore commercial aircraft self protection systems must satisfy the "civil requirements" specific to commercial air traffic, such as performance (detection and false alarm, multiple target capability), safety (for crew/passengers and for airport and neighbourhood), regulations (today no existing regulation is really applicable for the certification of such counter-measure systems), logistics and maintenance, traffic impact (of false alarm rate) and affordability.

4. THALES APPROACH – SHORT TERM SOLUTION

As indicated previously one of the most critical aspect is the detection of threats with very high probability of detection and very low false alarm rate. This must occur at large enough distance and then allow tracking of threats for successful application of the countermeasures.

Using its long experience in radar, IR detection, Electronic Warfare and data fusion gained in the military, Thales has chosen to satisfy the detection and tracking requirement by using dual active/passive detection and tracking. In particular state of the art modern active detection technology such as the latest generation pulse-Doppler missile warning radar under production, well known for its reliability, provide surveillance around aircraft and detection of any incoming object. This detection is based on all-weather perception of the threat radar cross-section and velocity; it is performed with a very low false-alarm rate and includes processing after end of propulsion of the missiles.

The radar outputs are very accurate measurements of distance and radial velocity, providing an accurate estimate of time-to-go, essential for countermeasures effectiveness. The full requirements on probability of detection and false alarm rate, as well as the high accuracy on the angular parameters are provided by the fusion of the active pulse-Doppler radar with a passive IR-UV missile detection system. The outputs of this fusion process are used to dispense timely and automatically the counter-measures, without any crew intervention. The proposed counter-measures for the short-term solution are based on adapted safe flares.

This is illustrated by the system developed, installed and qualified (FAA approved) on an A340 HOS aircraft.

5. THALES APPROACH – MEDIUM TERM SOLUTION

At medium term the effectiveness of the self-protection system may be significantly improved through the use of laser DIRCM. The system proposed by Thales is based on the same dual-mode sub-system for primary detection and tracking of the threat but in association with an active countermeasure based on a closed-loop laser detection, tracking and illumination system.

Contrary to existing open loop systems, the laser sub-system allows not only for threat jamming, but also for threat confirmation and effectiveness assessment in presence of multiple threats, even in case of the latest and future seeker generation.

Such a system, named FLASH (Flying Laser self-defence system Against Seeker Head missiles) has been proposed by a consortium between Thales, EADS and Diehl Aerospace for the A400 M in the military transport domain.

An adaptation by an enlarged consortium of this system concept has been proposed to the European Commission in the field of Security Research programs.

6. CONCLUSION

The protection of commercial airplanes against very short range IR guided MANPADS missile attacks is a problem of growing importance in the aerospace community.

Thales has capitalised on its long-term experience in self-protection systems for military aircraft to propose several systems aimed as solutions to this problem.

The main characteristics of these systems are:

- Dual technology (highly efficient pulse-Doppler radar and IR/UV sensor) to comply with the extremely low false alarm rate required by the civil transportation rules, while satisfying 100% probability of detection requirements
- Use of adapted safe flares as counter-measures for short term solutions
- Use of laser directed counter-measures, providing higher effectiveness in the presence of multiple threat through closed loop jamming and effectiveness assessment, for medium and long term solutions