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SYSTEM CONCEPTS FOR HELICOPTER AIR-TO-AIR COMBAT

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1 - CONTEXT, SPECIFIC FEATURES.

Given the increasing use of armed helicopters, combat helicopter units are a major component of maneuver forces. In particular they represent a substantial threat to tanks.

This situation creates two problems:

-the protection of friendly tanks against enemy anti-tank helicopters.

-the protection of friendly anti-tank helicopters against enemy anti-helicopter helicopters.

From this angle, it had become a must for the helicopter to have an air-to-air capability. A quick survey of the situation shows that the problem is:

-NEW; in fact experience in the field of air-to-air warfare is very limited

-ORIGINAL; helicopters have a very specific flight envelope which includes hovering flight. Moreover they can be operated in NOE flight, i.e. low-altitude flight amid obstacles which makes them difficult to spot. Finally, air-to-air weaponry - missiles but especially guns - can be made mobile on its support which makes it possible to make the pointing of the weapon independent of the orientation of the aircraft.

2 - WORK DONE AT SNIAS/DH IN THE FIELD OF AIR-TO-AIR WARFARE: REQUIREMENTS & AIMS.

The general requirement described above finds its expression in two different types of requests from military customers.

-the fabrication of simple systems that can be developed in little time. They usually center around a gun and are available on a short-term basis.

-the definition of air-to-air firing systems. These have better performance, comprise guns and air-to-air missiles and are intended for specialized aircraft.

The general purpose of studies performed at Aerospatiale for several years already is to meet these requirements by harmonizing them, i.e. by allowing, as far as possible, an evolution of simple systems toward higher performance systems.

In all cases, the objective is to set up coherent firing control by putting a special emphasis on the characteristic air-to-air warfare parameters (target and fighter characteristics) and by quantifying the performance of the various systems via the following data:

-their reaction time viz. the time between detection and firing

-their accuracy viz. the target-destruction probability.

Such a method stems from the intuitive realization that:

> "You must fire before the foe, on the one hand, and hit him if you have succeeded in firing first, on the other hand, if you want to meet with victory in an air-to-air battle".

3 - MEANS IMPLEMENTED.

These studies rest on simulation and are adjusted through the application of realistic figures derived from sighting and firing experiments or supplied by vendors.

3.1 Model:

These simulation procedures can feature the various possible systems. From a functional viewpoint, they implement the following two models:

-Hardware models:

- Fighter helicopter
- Target
- Sensors
  - Air-speed measuring system
  - Navigation
  - Sighting/Telemetry
- Weapon

- Gun
- Air-to-air missiles

- Trajectories of shells and missiles

-Software models:

- Statistical filtering for evaluating target maneuvers

- Calculation of weapon pointing

3.2 Simulation implementation:

Firing happens when a certain number of conditions are met (firing decision module):
-correct sighting
-weapon within its operating range
-converging algorithms

In concrete terms, results are expressed by the times where firing occurred and by the number of hits or impact traces left by the shells in the target.

4 - EXAMPLES OF RESULTS.

The method and means described here have made it possible, for each of the requirements expressed,

- to determine the nature and the characteristics of the sensors involved in the various cases of firing control.

- to define and finalize the filtering, weapon-pointing and pilot-aid algorithms.

- to estimate the operating ranges, the response times and the accuracy of each firing control operation.
  As an example, we present the simulation results of a firing system comprising a gun installed on a firing turret and implementing the following equipment items:

  - co-pilot sight to observe, identify and acquire the target and measure the fighter-to-target distance.

  - clear-vision pilot sight supporting the pilot-aid data.

  - helmet sight for the designation of a target spotted with the naked eye.

  - navigation and airspeed sensors.

The system is estimated with a typical scenario for a bidimensional case (figure 1)

```
   (fighter X=0      speed=150 km/hr
   (        Y=0
t=0(
   (target  X= 0  m speed=200 km/hr
   (        Y=+500m
```

Figure 2 gives the shell vs. target closest approach with and without filtering.

Finally, figure 3 shows the results of two firing bursts of 10 shells each at t = 7 seconds and t = 10 seconds.

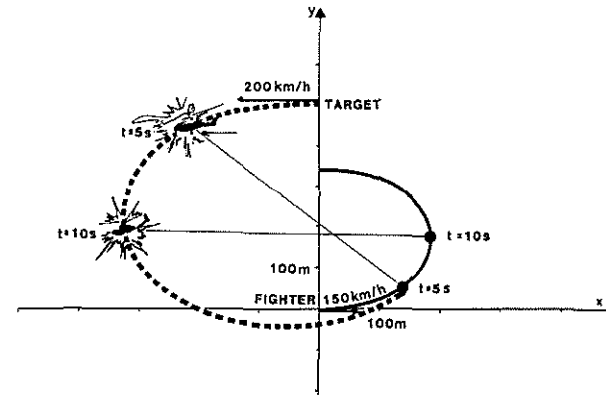

Figure 1: Fighter and target trajectories

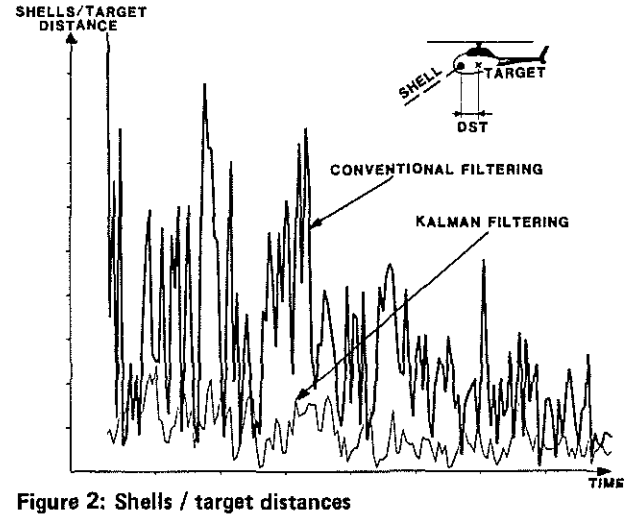

Figure 2: Shells / target distances

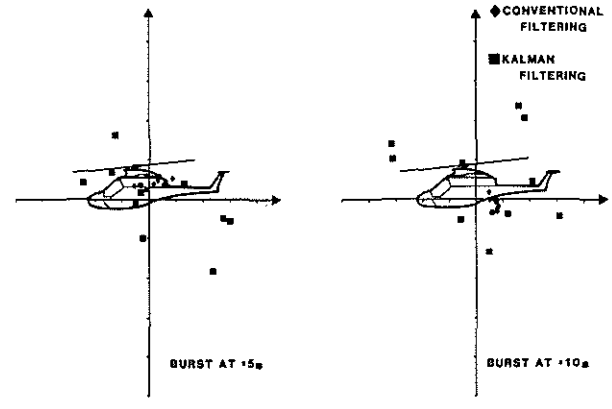

Figure 3: Firing results

In both cases we indicate the gain brought about by the statistical filtering which makes it possible to concentrate the fire on the target with a high destruction-probability.

5 - PROSPECTS.

Studying air-to-air warfare systems contributes toward reinforcing SNIAS/DH expertise in helicopter-borne systems. The policy pursued and the results achieved have allowed us and will allow us in the future to offer to our customers helicopter/systems packages capable to meet their requirements.