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DIGITAL MAP READER FOR HELICOPTERS

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DIGITAL MAP READER
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This short paper does not aim to detail the technical solutions to set up either a large cartographic coverage, or computation capacity.

We would merely examine which way an industrial designer tries to analyse the aeronautical cartographic problems, particularly with respect to the helicopter use.

We keep in mind that a rotorcraft crew has still to deal with classic paper maps, as any navigation aid.

Following the two first map readers generations, using such a cartography, we think that a fully digital concept is worth being developped ; which is going on.

I - MAPS AND HELICOPTERS

As a major safety factor, an easy and accurate geographical positionning is a requirement in any flying activity.

Obviously, IMC flights depend on ground beacons and landing systems. This limits that kind of air traffic.

Moreover, being to perform a "nap of the earth" flight, the pilot must use the well known unpractical maps, or autonomous navigation systems ; for example :

* numerous versions and scales of true paper maps.
* unreadable displays of theses filmed or scanned maps.

Especially for the military rotorcrafts, it is a worrying drawback, highlighting the fact that the navigation systems are left behind the progressing performances of aircrafts and weapons.

It is a common place, but once more time, worth being stressed, to consider that avoiding any navigation mistake is not the prime business of a combat helicopter crew.

Such basic statements lead to build up a new concept of the airborne map reader, using a digital technology, the goal of which is actually to lighten the crew workload.

An interactive map indicator should be the core of an airmobile tactical system, eventually part of a future C3I system.

II - INTEREST PARAMETERS IN AIRBORNE CARTOGRAPHY

As far as THOMSON-CSF is concerned, we can be confident in the new technology to figure out the usual problems of antagonist requirements, such as :

* minimum weight, volume, consumption.
* powerful capacities of storage, computation, symbols generation.
* excellent reliability and maintainability.

The main issues make up the needs of accuracy, flexibility, legibility and new operational possibilities.

These questions call for research and development, so that the first generations map readers could be overstepped.

2.1 - Accuracy

Any airborne cartography is slaved to a navigation system.
The accuracy of the former depends on the accuracy of the latter.
The specific military use requires an autonomous navigation system.

Besides, the best coherence must be fulfilled between different parameters, such as :

* digital data base definition.
* display screen definition.
* navigation system accuracy.
* civilian and military procedures.

To date, strapdown navigation systems supply a pretty good accuracy.

On the other hand, the accuracy of the digital data bases is being improved.

For example, the present resolution of the NATO Digital Land Mass System is 60 x 90 m. We may expect shortly an improvement up to 20 x 30 m. And satellites are about to provide us with a few meters resolution.

If we look at the screen definition as a non significant parameter, we have good reasons for thinking that the whole system accuracy meet almost any present and a lot of future operational modes.

But it looks like an exception to this rule : such an accuracy does not allow a straightaway weapon efficiency.

In other words, we cannot expect a first single killing shot to a single target, pinpointed using data from such a system.

2.2 - Flexibility

During the different phases of one mission, a rotorcraft crew uses a lot of different maps, according to the countries overflown and the procedures to be followed.

Using a standardized terrain data base, the new generation map reader wipes off the various disadvantages of national cartographic methods, references, symbols or colour codes.

Storing an enormous terrain coverage, the crew does not need any unpractical manipulation ; such as :

* paper maps drawing or joining together.
* difficult display legibility, when flying over border zones.

But to date, one of the main drawback for the pilot is the necessary use of various scales along his mission.

A few examples make this statement clear :

- Whereas taking off and landing may request large scale, a VFR transit may be carried out using small scales.

- An IFR traffic uses different specific scaled charts, according to its flight phases.

- Prior to a low level night flight, using a simple sketch, the whole preparation might have been carefully carried out by the combat crew, with medium and large scales.

- A nap of the earth flight, using the night vision goggles may be prepared and performed using large scale.

Furthermore, an astounding number of geographical information is printed on the paper maps, dedicated to a variety of users, from the walkman to the fighter pilot.

A rotorcraft pilot cruising at a medium flight level, does not actually care of identifying every details on the ground ; but for another one, roaming among obstacles, to workout the best firing position, the smallest house, road, valley or wood may count.

Thus, depending on criteria to be sharpened, the new map reader must be able to select the only requested geographical information, according to every kind of mission.

It also must allow the scales alteration, without any display break.

Coupled to a powerful computer, able to operate an expanded zoom effect, the fully digital map reader looks like being the best solution to meet the flexibility requirement.

2.3 - Legibility/readibility

With regard to the man-machine interface, legibility and readibility are not the less difficult problems to be figured out, as well in ergonomics as in software area.

A virtual sun, shining from the upper left corner of the display screen, make: easy the feeling of the terrain, which is of a major interest for a combat helicopter crew.

Moreover, due to a real time computation, this shading effect operates whatever the direction of the map and its turning rate.

This has been successfully carried out, without any flicker effect. We have now to set up the display of geographical objects, civilian and military conventional signs, alphanumerical information.

Their nature, shape, size, number are actually to be fitted to every scale, while remaining perfectly legible.

For example, are the alphanumerical information to be turning, or not, along with the map ; growing in size, or not, with the scales alterations ?

These sorts of questions call for detailed analysis, concerning hundreds of signs.

As a result, there is a trend towards a dramatic increase in the computation capacities.

We have to optimize our processes to refrain from this tendency. It could be partly balanced by the declutter effect expected from the analysis and the flexibility requirement previously mentioned.

III - NEW POSSIBILITIES

So, it is clear that any interest in an advanced airborne map reader, versus the paper reference, is built on a proved accuracy of its own, and improved legibility and flexibility.

Then, civilian and military users will take significant advantages from a lot of new functions.

3.1 - New functions

Most of them are now available, built in a hardware compatible with the aeronautical constraints :

3.1.1 - The terrain profile along the aircraft course, presents the safety margin to ground obstacles, when cruising, landing or taking off.

3.1.2 - The three dimensional mode is particularly useful, not only for performing airmobile tactical operations, but also for tactical mission preparing ; for example night flight simulation, investigation of combat positions, storage of flight routes.
Moreover, such a mode may provide the crew with an interesting help when piloting in marginal weather conditions.

3.1.3 - The three dimensional contour mode, using a one to one scale, may be displayed on an electronic HUD, in front of the pilot.
This mode, compatible with the night vision goggles use, might emphasize the terrain feeling, so that the night flight area could be enlarged, when operating by a very low light level.

3.1.4 - The ground avoidance mode consist of red coloring any point of the ground above the flight level.
Operating along with two or three dimensional and profile modes, it can be coupled to a selected vertical safety margin, and therefore, improving the flight safety.

3.1.5 - From any location on the ground or in the air, visible and concealed ground zones are worked out and displayed, taking in account the different operational means and geographical parameters.

3.1.6 - The selectivity of geographical objects allows to build maps really fitted to the variety of operational conditions, while keeping combining possibilities to meet some particular, or temporary, needs.

3.1.7 - Geographical, aeronautical and tactical updating will be extremely fast, if not instantaneous.
In fact the updating duration will depend on the delivery time of the data link or the parameter inserting device.

3.1.8 - A powerful multicriteria calculation will allow an automatic display of the last trajectories according to any kind of taking off, landing, transit or tactical procedures.

3.1.9 - Finally, we may foresee the digital cartography as an important part of a future multisensors concept, dedicated to provide the pilot with a really usable image of the outside world, whatever the weather conditions.

IV - CONCLUSION

As a conclusion, this shallow review enlightens the valuable advantages that we may expect from an airborne digital map reader.

As far as the civilian air traffic is concerned, the only improvement in the navigation area seems to be worth of an interest.

But in the specific field of combat rotorcraft, such a system can bring a deep alteration in on board procedures, operational capabilities and flight safety.

As study items, a few interesting prospects may be underlined, for example :

* navigation means optimization.
* IMC autonomous landing procedures, for non IFR airfields.
* definition of a basic map reader dedicated to VFR aircrafts.
* automatic choice and display of the best IMC tactical procedures.
* usefulness in a tactical station keeping system.
* airborne interactive tactical display.

But, whatever promising might these prospects be, the pilot basically, and above all, expects an immediately legible chart.

As responsive designers, we are aware of having to stick this simple rule :
"Any airborne map must look like a map".