Chapter 8 – CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

From the work presented in the present AGARDograph, the following conclusions are drawn:

- DGPS can provide a good position, velocity and time reference solution for flight test applications.
- The optimisation criteria's to be taken into account during test missions with DGPS are the following:
  - At least 6 satellites always in view, possibly with 4 at an elevation near 50°;
  - About 50° maximum bank angle (actual CBA to be determined experimentally);
  - At least 20 sec of stabilisation before and after significant flight phases;
  - Gradual heading variations;
  - Initial heading (I-HDG) for the aircraft turns (northern hemisphere / mid-latitude):
    - Left turns: I-HDG ≠ 45° ÷ 135°,
    - Right Turns: I-HDG ≠ 225° ÷ 315°; and
  - Distance between the aircraft and the ground receiver not greater than 200 NM (to obtain an accuracy of less than 5 metres).
- Code-range DGPS performance are sufficient to:
  - Perform test missions over wide areas independently from environmental or meteorological conditions;
  - Obtain aircraft present position relieves at least as accurate as those of radar tracking systems;
  - Provide an effective backup of optical trackers for some applications;
  - Reduce aircrew workload during test missions by imposing fewer constraints to test missions;
  - Reduce data processing time with respect to other reference systems; and
  - Speed-up the test activity.
- The DGPS system performance in terms of data continuity and integrity during dynamic manoeuvres, even if acceptable for many tasks, are not sufficient to cover the entire flight envelope of modem high performance military aircraft (i.e., advanced trainers, fighters).
- The data accuracy provided by code-range DGPS is not sufficient for the higher accuracy tasks of flight-testing (e.g., precision landing systems), while carrier-phase DGPS can provide the required accuracy.
- The integration with an inertial navigation system (INS) is considered the optimal solution to most DGPS shortcomings in flight test applications.

8.2 RECOMMENDATIONS FOR FUTURE WORK

It is recommended, according to the needs of the NATO flight test community, that further studies be carried out in order to:

- Investigate on the effect of Multipath on DGPS-TSPI data accuracy, continuity and integrity.

- Optimise the procedures for post-processing data merging of DGPS with measurements provided by other on-board sensors (e.g., INS, radar systems, altimeters).
- Investigate on the effect of Doppler shift on GPS receiver tracking and signal reacquisition strategy.
- Develop DGPS/INS Position Reference Systems with real-time capability, providing on-line data for the flight test engineers and guidance information to the pilot during the test flights.

Finally, it is recommended that the current work for the development of an AAIA system suitable for high performance aircraft applications, concentrates on the following topics:

- Further numerical simulations to progressively refine the AAIA mathematical models.
- Verification of the time-to-alarm capability of different AIAA implementations, referred to specific DGPS-TSPI applications.
- Investigation of further AAIA applications other than flight test, including DGPS precision approach and landing.