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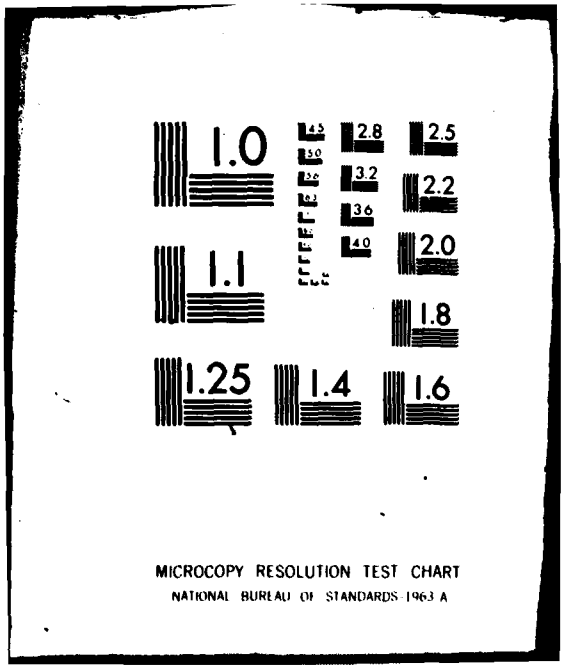
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ADVISORY GROUP FOR AEROSPACE RESEARCH & DEVELOPMENT

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AGARD ADVISORY REPORT No. 15

Technical Evaluation Report on the 30th Guidance and Control Panel Technical Meeting: Symposium on Guidance and Control Aspects of Tactical Air-launched Missiles

NORTH ATLANTIC TREATY ORGANIZATION

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ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT

(ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD)

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TECHNICAL EVALUATION REPORT

on the

30th GUIDANCE AND CONTROL PANEL TECHNICAL MEETING

Symposium on

GUIDANCE AND CONTROL ASPECTS OF TACTICAL AIR-LAUNCHED MISSILES

Eglin, 6-7 May 1980

(10)
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The GCP Symposium was held at Eglin Air Force Base, Florida, USA, 6–9 May 1980. The complete compilation of papers has been published as Conference Proceedings CP-292.

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TECHNICAL EVALUATION REPORT

BY

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GENERAL RESEARCH CORPORATION

USA

1. INTRODUCTION

The 30th Guidance and Control Panel Symposium on Guidance and Control Aspects of Tactical Air-Launched Missiles was held at Eglin Air Force Base, Florida, USA from 6 May to 9 May 1980. The Program Chairman for this meeting was Dr. O. C. Williams, Technicial Director of the U.S. Air Force Armament Laboratory's Guided Weapon Division. The program, as presented at the symposium, is included as Appendix I of this report. The complete compilation of papers will be published as AGARD Conference Proceedings CP-

2. SYMPOSIUM THEME

In 1973, the 16th Guidance and Control Panel Symposium on Precision Delivery Systems was held at Eglin Air Force Base, Florida, USA. Many important advances in guidance sensor technology, control law development, digital techniques, autopilot implementation, and overall missile system design have been made possible by the recent technological revolution in electronic components and microprocessors. This has enabled the cost effective application of theoretical techniques which hitherto were impractical for tactical missiles.

It was timely, therefore, to hold a symposium in 1980 on Guidance and Control Aspects of Tactical Air Launched Missiles. The symposium treated both air-to-air and air-to-surface missile systems with emphasis on guidance and control technology and its impact over recent years.

3. METHODOLOGY FOR TECHNICAL EVALUATION

This technical evaluation is based upon the author's assessment and integration of the individual technical presentations, the discussions which folowed each presentation, the round table discussion, the written comments made by the symposium attendees on the evaluation forms, and the author's own experience and expertise. The methodology used is to establish detailed technical objectives for each session based upon the symposium theme and remarks made in the keynote address, and then compare the collective content of each session to establish the areas where the objectives were and were not met.

Four consequences of this approach to evaluation should be mentioned. First it should be remembered that the central theme of this symposium is *guidance and control*. Hence, the consideration of any deficiencies or solutions thereto that are not directly related to guidance and control is beyond the scope of both the symposium and this evaluation. Second, all aspects of the symposium theme and keynote address are not applicable for establishing the objectives for each session. Third, the success of a symposium of this nature should not be related to the ratio of satisfied to unsatisfied objectives. Indeed, the best contribution that an AGARD symposium can make is to identify to the NATO technical community those operational requirements which are being met by current technology programs, those that are not, and the specific technology gaps which require immediate attention. Fourth, it should be emphasized that a symposium characterized by limited duration, complicated logistics, and national competition cannot address all the technical issues. Hence, the technology dificiencies identified in this evaluation may not be as extensive as suggested.

4. SESSION OBJECTIVES AND HIGHLIGHTS

The *keynote address* pointed out the realistic constraints which must apply to future guidance and control technology applications. In retrospect, the impact that this address had on the evaluation of this symposium is significant because it helped crystalize many of the technical contributions and deficiencies. The constraints cited can be divided into two broad categories: System constraints and cost constraints.

The system constraints involve the issues of aircraft compativility, C^3 integration, penetration of enemy defenses, and hostile target identification. The aircraft compatibility issue centers about avionics interface, stability augmentation at release, aircraft/missile aerodynamic interaction, conformal carriage, and payload. Of these, only the avionics and stability issues are guidance and control related. C^3 integration requires that missile deployment (especially in large numbers) against the intended targets be manageable in a battlefield scenario. This in turn requires that the guidance and control concepts (expecially for standoff missiles) not unduly contribute to the C^3 burden. Penetration of enemy defenses requires both aircraft and missile survivability. This influences both the delivery conditions and missile ECCM requirements. Hostile target identification refers to the ability to determine whether or not targets beyond visual range at launch are friend or foe prior to committing terminal guidance. Depending upon the method employed, this could be either a C^3 issue or guidance and control issue.

The cost constraint issues are more subjective than the system constraint issues. Many of them involve management and political considerations which are beyond the scope of this symposium. However, there are two areas where guidance and control technology can make significant contributions to cost reduction: increased performance (or similar performance with less costly hardware) and standardization among missile systems.

Based upon the symposium theme and constraints described in the keynote address, the following paragraphs describe the objectives and highlights of each session.

The *general objective of Session I, Operational Requirements*, was to establish a framework for identifying the critical guidance and control technology required for countering current and future threats. In particular this session should address issues such as missile delivery requirements for effective sortie/kill ratios and aircraft/missile survivability. The need to accomplish this in adverse weather is extremely important, especially in the European scenario. Low cost solutions for achieving these requirements should be given prime considerations.

The *highlights of Session I* included a discussion of Soviet air defense and two views on operational requirements for countering it. Soviet air defense was described as very extensive in terms of area coverage, mobility, and long range effectiveness. Increased effectiveness at low altitudes was projected for the 1990's. The operational requirements to counter such defense concentrated on delivery tactics to evade the

threat rather than direct methods such as the use of air-to-air or special purpose air-to-surface missiles to neutralize it. The overwhelming consensus was that, for the near future, high speed low altitude delivery is the best approach for aircraft survivability. This tactic was also considered effective for adverse weather requirements. However, it was recognized that future needs (late 1980's) will require the development of long range standoff weapons. A methodology to determine the effectiveness of current and future weapon systems against various ground targets was also presented.

The *general objective of Session II, System Considerations*, was to emphasize that the application of missile guidance and control technology must be compatible with the other system components such as aircraft, C^3, and IFFN. In particular, issues like stability augmentation during missile separation, interface between missile and aircraft avionics, launch aircraft evasive maneuvers for increased survivability, methods of targeting large numbers of missiles against multiple targets, and positive identification of hostile targets prior to terminal guidance should be considered in evaluating the effectiveness of guidance and control technology.

Like Session I, the *highlights of Session II* involved air-to-surface weapon delivery. Consistent with the operational requirement for low altitude high speed weapon delivery, most papers concentrated on the system components being developed for delivering various types of semi-active laser guidance weapons under these demanding conditions. It appears that technology development is progressing extremely well for the delivery of laser weapons against multiple targets by a single fighter aircraft, without overflying the target. This includes the development of aircraft heads-up/heads-down displays, laser designator pods, laser guided missiles and glide bombs, and pilot-in-the-loop integration. Simulator and flight test results were presented which demonstrate the high degree of system integration and maturity of these technology developments, at least in a benign environment.

Some mention was also made of system considerations for future air-to-air missiles. For dogfight situations, the need was cited for such developments as launch envelope protrayal on the heads-up display, cockpit designs which will allow the pilot to sustain high g's, and high g missiles with large off-boresight launch and track capability. For longer range missiles, the need for increased speed and range to satisfy F-pole requirements was cited.

Evidence was presented that establishes the maturity of analysis tools for the prediction of missile separation characteristics under the influence of aircraft aerodynamic flow-field disturbances. Comparisons made with wind tunnel and flight tests verified the accuracy of this methodology.

The *general objective of Session III, Air-to-Surface Guided Weapons Technology*, was to describe current technology developments which are capable of satisfying air-to-surface operational requirements and to identify technology gaps which need to be eliminated. In particular, this session should address guidance and control technology for satisfying the immediate requirement for low altitude high speed delivery in adverse weather and the future requirement for standoff weapons. Hostile target identification and C^3 requirements for the standoff weapons are important system considerations. Due to the large number of missiles required to counter Soviet land forces, low cost, ECCM, and multiple kills/sortie are essential. The pertinent guidance and control missile subsystems which can contribute to improvements are the seeker, midcourse and terminal guidance law, autopilot, processor, and inertial sensors.

Three papers were devoted to the seeker, none to the midcourse guidance law, one to the processor, and three to the inertial sensors. One paper also addressed terminal guidance law requirements for a special type of seeker. The fact that no papers were presented on autopilots reinforces the author's opinion that well-designed autopilots, often using digital implementation via low cost microprocessors, are within state-of-the-art technology. Thus, autopilot design is no longer a technology issue but rather a mechanization issue which can be reasonably resolved for the specific problem of concern.

The *highlights of Session III* included the presentation of additional technology refinements to the basic semi-active laser seeker developed during the late 1960's and early 1970's. (The major developments in this area appeared to be those associated with the autonomy and accuracy of the laser *designators*, as discussed in Session II.) A new strapdown seeker/guidance law concept, applicable for sensors operating in frequency bands from UV to radar, was discussed which has the potential for reducing the cost and increasing the reliability of missiles. The key to effective use of this strapdown seeker is the devleopment of compatible guidance laws and stability augmentation. The concept also simplifies the use of dual mode seekers, one of which can be strapdown and the other gimballed. These concepts have been verified via digital simulation but not with hardware tests or flight tests. It was not mentioned whether or not such tests are planned. The decreased cost and increased reliability have yet to be quantified. This concept, along with the semi-active laser seeker, were the only two seeker technologies discussed for the low altitude, high speed delivery requirement. They appear consistent with the system requirements.

An active/passive millimeter wave seeker was generically described and captive flight test results were presented which show that this type of seeker has reasonable potential for autonomous acquisition in a target rich environment for low and medium clutter backgrounds. Simulation shows that the acquisition ranges were sufficient for accurate terminal guidance. The question of identifying the *type* of target was not addressed, nor was the question of optimal search algorithms. Acquisition problems in high clutter environments and the quantity of false alarms are still problems which must be resolved. Performance in adverse weather was not discussed. This was the only seeker candidate discussed which has some potential for satisfying future standoff weapon requirements. Compatibility with system and cost constraints was not addressed.

There is increasing evidence that the technical community is in agreement that proportional navigation is an adequate terminal guidance law for air-to-surface missiles. However, the performance of this law could be improved by increasing off-boresight capability and reducing the noise characteristics of the guidance information.

It appears that the quality of inertial instruments, along with pre-flight, captive flight, and post-launch calibration techniques, are sufficient to accommodate limited standoff capability in a cost effective fashion. Although the exact magnitude of the standoff range was unclear from the presentations, ranges of from 60-100 kilometers seem within the capability of current technology without midcourse updates. Sufficient flight test data are not yet available to verify simulation results, but such tests are planned. These techniques are also compatible with current system constraints.

A concept called DIS (Digital Integrating Subsystem) was discussed in which computational tasks for a guided missile are partitioned into common tasks and standard interfaces defined. This concept promotes interchangeable missile guidance and control components and enhances interoperability. The method utilizes a number of individual microcomputers that communicate with each other on a serial multiplex bus. The multiplex bus has now been given a tenative MIL STD designation — MIL STD 1765. Connection to the aircraft store management bus is via a MIL-STD-1553B interface. In fact, the concept is very similar to MIL-STD-1553B

in many respects, but differs in those aspects where similarity is counter-productive. Although this concept is not a technology development *per se*, it is an important technical management innovation which enables future missile designs to capitalize on the recent advances of microprocessor technology. This was the only paper presented that addressed the recent initiative for standardization and interoperability among NATO nations. This concept sparked a lively debate centering on the scope and definition of standardization which will be treated later in this evaluation.

The *general objective of Session IV, Air-to-Air Guided Weapons Technology*, was to describe current technology developments which are capable of satisfying air-to-air operational requirements and to identify technology gaps which need to be eliminated. In particular, this session should address guidance and control technology for satisfying operational requirements such as all aspect and large off-boresight launches against highly maneuvering targets for short range applications. For longer range missiles, such requirements as C^3 compatibility, IFFN, and F-pole become important considerations. Effective ECCM is essential for both launch aircraft survivability and effective kill ratios. For radar seekers, radome error slope reduction, glint reduction, increased acquisition range, and look-down/shoot-down capability deserve attention. Although terminal fuzing and warhead effectiveness is not normally considered a guidance and control issue, recent advances in modern control theory could present a low cost solution and should be addressed.

In terms of the missile guidance and control related subsystems which can contribute solutions to these problems, one paper was devoted to a radar seeker and associated microprocessor, none to midcourse guidance laws, four to terminal guidance laws, none to autopilots and one to a gyro used for midcourse guidance.

The *highlights of Session IV* centered on papers which dealt with the importance of using modern control theory for increasing terminal performance in all aspect, large off-boresight launches. Convincing evidence, via digital simulation, was presented which showed that the *proper* application of such theory can not only increase the number of launch opportunities but also improve miss distance in those launches where proportional navigation is also effective. It was clearly illustrated why these improvements occur by citing the theoretical shortcomings of proportional navigation under these demanding conditions. By flying a "smarter" trajectory, the missile is better able to conserve it's energy (maneuver capability) for critical times. The fact that, due to recent advances in microprocessors, such improvements are possible with little or no additional cost is also quite significant. However, it still appears that, although theoretically feasible, much work needs to be done in improving the quality and quantity of real-time information needed to effectively mechanize these laws.

There was also evidence presented that it is still possible to improve missile performance through novel applications of classical control theory in conjunction with other missile subsystems. This paper presented additional evidence on the advantages of bank-to-turn over skid-to-turn guidance for tactical missiles. It confirmed the results of previous studies that, if a small amount of skid-to-turn is used in conjunction with bank-to-turn, maneuverability can be significantly increased by taking advantage of assymetrical aerodynamic designs, while minimizing the roll-rate/seeker-noise interaction.

The radar seeker described had the capability of rapid and multiple target acquisition and significant glint reduction. These low cost improvements have been made possible by the incorporation of a microprocessor for Fast-Fourier Transforms and Kalman filtering and the utilization of micro-miniaturization of the electronics. The feasibility of these improvements have been demonstrated in flight trials.

Midcourse guidance discussion was limited to the description of a two axes dry-tuned gyro. Laboratory tests have confirmed accuracies on the order of 0.2°/hour random drift. No cost comparisons were made.

The *general objective of Session V, Tactical Guided Weapons Evaluation Techniques*, was to describe improvements in missile non-destructive evaluation techniques. In particular, new techniques for modelling the missile system and its environment should be addressed. Improvements in digital simulation development and efficiency deserve attention, along with the description of new facilities and equipments which allow for hardware-in-the-loop testing of missile systems. Methods for validating mathematical models used in simulation thrcugh analysis of flight test data are critical for increasing the confidence which both the technical community and defense community place in simulation as a cost effective means of estimating missile system performance.

The *highlights of Session V* were summarized in the first paper which, through a historical summary of the use and benefits of simulation in the UK, established a viewpoint which was confirmed by the conference attendees during follow-on discussions: simulation is not only an effective means of establishing missile performance prior to and subsequent to limited flight trials, but it has become an essential tool in this day of increasing missile development and production costs. There was some concern expressed that care must be taken in the continuing development of more sophisticated and costly facilities for hardware testing. However, the need for such facilities was not questioned, only the prudent use and development of them.

Clutter and target modelling techniques for millimeter seekers were described in some detail, along with the presentation of experimental data for model validation. Since detailed target and background modelling is an area which has been often neglected and overly simplified in the past, this work is considered as an important development. The need for verifying models of this complexity and statistical uncertainty with actual data (corrected for instrumentation characteristics) was emphasized. Some models of simplified scenarios have been validated with reasonable comparisons between model output and actual data, but much work is left to be done.

The use of a Terminal Guidance Laboratory (TGL) for open and closed loop hardware tests for a Terminally Guided Submissile (TGSM) in the Phase II Assault Breaker Program was described. The overall facility employs a versatile real-time simulation with appropriate target and missile motion simulators to accurately duplicate the seeker-target dynamic interaction and the missile rotational dynamics. Target simulators provide dynamically and spectrally valid target signatures for seekers operating in the IR and Optical domain, the 2 to 12 GHz region of the RF spectrum, and the 0.1 to 100 GHz region of the (passive only) Millimeter Wave spectrum. The TGSM tests were restricted to IR and MMW seekers.

The initial testing consisted of open loop modelling tests on the major functional components—autopilot, fin actuator, rate sensors, and seeker. After each hardware subsystem was flown in the loop with the others simulated, the subsystems were added one at a time until the entire missile (except airframe) was flown hardware-in-the-loop. This allows for individual subsystem models to be developed and validated in detail prior to more realistic validation in an overall system's context. The effectiveness of such an evaluation was clearly demonstrated by the discovery of several problems which were corrected prior to flight test. The validation of the mathematical models using the hardware-in-the-loop simulation and limited flight test data allowed performance predictions for many scenarios which could not be economically or practically determined with flight tests.

5. TECHNICAL EVALUATION AND CONCLUSIONS

Session I - Identified Contributions. The realization of the need for more than one set of operational requirements for air-to-surface delivery (low altitude high speed delivery versus standoff) has resulted in the initiation of several technology programs in the area of low cost, accurate midcourse guidance and autonomous target acquisition.

Session I - Identified Deficiencies. The operational requirements were never clearly stated, at least to the degree required for identifying technology deficiencies. The need for near term high speed, low altitude delivery and a far term standoff capability for air-to-surface missiles was mentioned, but the pros and cons of each approach were not clearly discussed. A U.S. view on operational requirements was noticeably absent. There appears to be a clear need for the NATO community, possibly at the initiative of AGARD, to establish a unified definition of the threat and the resulting operational requirements to counter it.

The ability of the low altitude high speed delivery tactics to meet the adverse weather requirements was not established. The role of missile ECCM for increasing survivability was neglected. Air-to-air operational requirements were not mentioned. The role of too stringent Military Specifications (Mil Specs) in increasing the cost of hardware components for tactical missiles was debated during the Panel Discussion. The basic question was this: It is more advantageous to *decrease* shelf-life requirements of hardware components, thus decreasing unit cost? It was argued that the rapid advancement of technology and unavailability of missiles for proper training due to high cost negate the advantages of longer shelf-life.

Session II - Identified Contributions. For the low altitude high speed delivery of air-to-surface laser guided weapons, the development of associated technology to satisfy systems requirements is well in hand. Satisfactory progress is being made in areas such as heads-up/heads-down displays, laser designator pods, accurate and relatively low cost laser guided missiles and glide bombs, and acceptable pilot workloads for multiple delivery on a single pass. The analysis of weapon separation characteristics from fighter aircraft using semi-analytical/empirical techniques is now feasible.

Session II - Identified Deficiencies. There was no mention of system considerations for standoff air-to-surface weapons. This is most significant since it is today's technology which will build the weapons to satisfy the operational requirements of the late 1980's. There was no treatment of C^3, ECCM, or IFFN for any weapon system. Although some of the system considerations for air-to-air missiles were mentioned, no detail was given on current capabilities in these areas. Now that reasonable tools are available to *analyze* weapon separation characteristics from fighter aircraft, emphasis should be placed on applying these tools in the *design* phase to improve both missile and aircraft performance.

Sessions III and IV - General Comments. Possibly as a result of the lack of focus on the relationship between guidance and control technology and the operational requirements/system considerations, the long range technology requirements (and corresponding technology gaps) were not clearly identified. Some very good papers dealing with technology developments were presented in these two sessions, but the technology discussed appeared not to stem from a clear coherent prioritization of needs but rather individual opinions and developments capitalizing on opportunities at hand. The author is also aware of some important tactical missile technology developments which were not discussed, probably due to a combination of aggressive international competition, logistical problems of coordinating such a symposium, and lack of time.

With the exception of the DIS concept and the low cost inertial guidance unit described, low cost and high reliability seemed to be an occassional fallout of the technology discussed rather than a prime objective. This approach to developing new technology for tactical systems cannot survive much longer in today's economical environment, especially when one considers the magnitude of the threat. A related issue involves the conceptual approach to developing new weapon systems. Is it more cost effective to continue updating existing systems or do the operational requirements dictate the need for totally new systems?

The presentation of the paper on standardization for missile avionics sparked a lively philosophical debate on the very meaning of standardization. Although the concept is very similar to the MIL-STD-1553B which applies to aircraft avionics, there are some differences. One school of throught maintained that these differences violated the very spirit of standardization, and that there should be only *one* avionics standard. The other school maintained that common standards should only apply when the system requirements are similar, and overly strict standards for missile avionics, solely for the sake of commonality with aircraft avionics, is not cost effective. Thus, the missile avionics standard is not a violation of standardization, but simply an attempt to promote the NATO IRS concept by establishing such a long needed standard for missile avionics. This latter approach appears to be the best compromise between the advantages and disadvantages of standardization.

Session III - Identified Contributions. The development and application of technology for low altitude high speed delivery of air-to-surface laser guided missiles appears to be progressing adequately and receiving the proper emphasis. Autonomous acquisition for medium clutter backgrounds now seems feasible, at least for millimeter wave seekers. Reasonably inexpensive inertial sensors, when appropriately calibrated and updated, are available to perform midcourse guidance with the accuracy required for air-to-surface standoff missiles. The attempt to modularize and standardize missile avionics is an important step in reducing cost and promoting standardization.

Session III - Identified Deficiencies. The problems and solutions associated with target acquisition and missile homing in adverse weather were not discussed. Autonomous target acquisition and identification was not treated in sufficient detail. An examiniation of generic target characteristics which can be exploited in the development of future sensor technology would have been helpful. The system requirements for delivering large numbers of standoff missiles beyond the visual range of ground targets with uncertain locations and characteristics were not addressed. ECCM requirements for increased missile survivability were not considered. The role of modern control and estimationg theory for improving air-to-surface missile performance was not discussed. In general, much more work needs to be done in the area of terminal guidance for standoff weapons against a wide variety of targets and backgrounds.

Session IV - Identified Contributions. The increased interest for employing low cost software solutions through the application of modern control theory techniques for improving air-to-air missile performane dominated this session. Although significant results have already been achieved, well-planned and coordinated exploration of more sophisticated techniques should result in even greater performance. It should be mentioned that, in past years, there have been attempts by guidance and control engineers who are not schooled in the modern techniques to minimize the potential advantages of these methods. These disparages usually involve irrelevant side issues such as claiming that the methods are not really modern or insisting on a clear definition of what is meant by "optimal". Other criticisms take more subtle forms such as citing all the bad things that will happen if the modern theory is not applied properly. (They nevery say what happens if the *classical techniques* are not applied properly.) It is time for the technical community to

recognize that, although these techniques are not a panacea for all of our problems they do have the *demonstrated* potential of providing cost effective improvements in missile performance in a large number of applications.

Bank-to-turn air-to-air missile designs for improved terminal guidance should be given serious consideration for future technology development. A bank-to-turn missile using modern control and estimation techniques has the potential of satisfying the all aspect, large off-boresight operational requirements of future dogfight engagements involving highly maneuverable fighter aircraft.

The radar seeker described is indicative of current technology being pursued for air-to-air missile guidance. The use of sophisticated signal processing made possible by extremely efficient microprocessors is the major factor in the rapid and multiple target acquisition and the glint reduction capabilities. This is another excellent example of what can now be accomplished as a result of computational power catching up with mathematical theory.

Session IV - Identified Deficiencies. The development of large off-boresight, g-hardened gimbals to take advantage of the improved guidance techniques was not discussed. C^3, IFFN, ECCM and F-pole were not discussed. Target acquisition and track in high clutter radar environment (e.g., look-down/shoot-down) were not treated. The application of guidance and control to improved fuzing and warhead effectiveness was also not considered. Finally, there was no mention of improved midcourse guidance, including range extension.

Session V - Identified Contributions. The importance of mathematical modelling and simulation for cost effective missile technology and system development, although difficult to quantify, has once again been thoroughly confirmed. The potential of even more sophisticated modelling, especially for target and background characterization, has also been established. The need for open and closed loop hardware tests to verify mathematical models prior to flight testing is also extremely important. However, the expense in developing and using these facilities must be properly balanced with the benefits.

Session V - Identified Deficiencies. There was no discussion of improvements in modelling or simulation efficiency, such as better simulation languages or better utilization of computer capacity. Improved metnods of using flight test data to validate simulations were also not considered.

6. RECOMMENDATIONS

Whereas this conference had its failings, it nevertheless performed a vital function for setting the stage for technical discussions in tactical missiles.

Future symposiums need to be held which address *specific smaller* areas such as

- digital missile integration and standards
- autonomous search and acquisition for A/S standoff weapons
- terminal guidance for A/S standoff weapons
- optimal control and estimation as applied to tactical missiles
- direct fire A/S weapons

A Working Group might be warrented in areas such as

- DIS MUX (draft MIL STD 1765) digital integration standards for missiles
- terminal guidance for standoff weapons

An AGARDOGRAPH on digital standards for missiles might also be warrented.

ANNEX

GENERAL COMMENTS

(1) SELECTION OF PAPERS

Eighty abstracts were received in response to the call for papers. The committee had a difficult task in selecting 26 papers, which were considered to be the optimal number for a four-day symposium, and was obliged to reject a large number of the abstracts submitted. The objectives were to provide a selection of high-quality papers for each of the sessions that would fit well within the theme of the meeting and give a good impression of the range of interest and quality of work in the countries participating. The contribution of papers per country was as follows:

France	:	4 papers
Germany	:	3 papers
Norway	:	1 paper
United Kingdom	:	6 papers
United States	:	12 papers

(2) ATTENDANCE

The total number of participants was 220 including Panel members. The National distribution was:

Belgium	3
Canada	5
France	28
Germany	24
Greece	1
Italy	4
Netherlands	2
Norway	1
Portugal	1
United Kingdom	42
United States	109

(3) LOCAL ARRANGEMENTS

The symposium was held in the theatre of Eglin Air Force Base. The facilities were unanimously recognized as one of the best ever offered for a GCP meeting. Major General Bond, Commander, Armament Division, Eglin AFB, and his Staff, and specially Dr Williams, GCP member and Program Chairman, are to be commended for the thoroughness and success of the arrangements. A special mention must be made of the outstanding support provided by the host co-ordinator, Major L.A.Ankeney, and his Staff.

A very relevant and much appreciated keynote address was presented by Dr Hermann, Assistant Secretary for Research, Development and Logistics, USAF.

Participants were entertained at two official receptions. The first one was held at the Officers' Club on the Base. The other hosted by Mr Jerry Melvin, Executive Vice-President of the Greater Fort Walton Beach Chamber of Commerce, took place at the wonderful Liza Jackson Park in Fort Walton Beach. The participants also enjoyed a visit of the Air Force Armament Museum.

APPENDIX I

FINAL PROGRAMME

GUIDANCE AND CONTROL ASPECTS OF TACTICAL AIR-LAUNCHED MISSILES
Eglin AFB, FL, USA, 6–9 May 1980

OPENING CEREMONY
Opening address by Major General Bond, Commander Armament Division, Eglin AFB, FL, USA

KEYNOTE ADDRESS*
by R.J.Hermann, Assistant Secretary for Research, Development and Logistics, USAF, US National Delegate to AGARD

* Not available at time of printing.
† Published in CP-292 Supplement (Classified).

† Published in CP-292 Supplement (Classified).

APPENDIX II

(EVALUATION FORM)

COMMENTS ON AGARD GCP SYMPOSIUM
6–9 May 1980 – Eglin AFB, FL, USA

TO ALL ATTENDEES

Considerable time and effect was expended by a number of countries in the organization and hosting of this symposium. As a result, the Program Committee Chairman is obligated to prepare an evaluation report. To aid him in preparing a timely, meaningful report, and since we have assembled here leading technical experts in the field, we solicit any feedback or comments you may desire to submit. These may be handwritten notes, and anonymous. If you have any questions, please contact the AGARD staff, the Program or Panel Chairman.

The following are typical examples of areas in which observations, comments and assessments are desired:

(a) General observations

1. Quality, and relevance of papers, sessions and questions;
2. Did papers support the theme?
3. Did symposium live up to your expectations?

(b) Technical observations

Views on operational use and requirements;
Assessment of technology (State of the Art);
Views on pacing technology or critical need for R&D;
What do you see as major challenges and trends?
Views on systems integration;
What areas or problems are unresolved?

(c) Suggested improvement for symposium (procedures for enrolment, authors' instructions, logistics, etc.)

Please write your comments overleaf and hand them in to the Authors' Desk before the end of the Symposium.
Thank you for your contribution and cooperation.

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The GCP Symposium was held at Eglin Air Force Base, Florida, USA, 6--9 May 1980. The programme as presented at the Symposium is appended to this report. The complete compilation of papers has been published as Conference Proceedings CP-292.

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