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Initial Assessment of the Air Combat Environment Test and Evaluation Facility To Support Operational Test and Evaluation

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This paper briefly describes the Navy's Operational Test and Evaluation Force's (OPTEVFOR's) assessment regarding the suitability of selected laboratories at the Air Combat Environment Test and Evaluation Facility (ACETEF) to support the operational test and evaluation of electronic warfare systems - Radar Warning Receivers (RWR) and, in particular, the Navy's next-generation RWR, the AN/ALR-67(V)3.

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Abstract for *Initial Assessment of the Air Combat Environment Test and Evaluation Facility To Support Operational Test and Evaluation*

This paper briefly describes the Navy's Operational Test and Evaluation Force's (OPTEVFOR's) assessment regarding the suitability of selected laboratories at the Air Combat Environment Test and Evaluation Facility (ACETEF) to support the operational test and evaluation of electronic warfare (EW) systems—radar warning receivers (RWRs) and, in particular, the Navy's next-generation RWR, the AN/ALR-67(V)3.

The use of hardware-in-the-loop and man-in-the-loop simulation facilities is one way to increase combat realism and provide the means to test more fully EW and electronic combat capabilities. Critical assumptions and model limitations, however, may adversely affect results. Thus, realistic testing in a virtual world requires the proper verification and validation (V&V) of the environment and simulated emitters.

ACETEF is a full-spectrum electronic combat test facility. One of ACETEF's labs—the Electronic Warfare Integrated Systems Test Lab (EWISTL)—can be linked with a manned flight simulator to provide a flight environment with an emitter variety and emitter density that is unattainable on any test range. ACETEF tests EW systems that are fully integrated aboard an operational mission aircraft.

At the request of the Commander OPTEVFOR, we have made an initial assessment regarding the suitability of selected laboratories at ACETEF to support the OT&E of the Navy's next-generation RWR. Our goal was to determine whether ACETEF provided a level and quality of data similar to those obtained during operational testing at an open-air test range and whether ACETEF's test support processes were mature enough to ensure that the facility could support the OT&E customer.

Based on our analysis of the models used, observations made during the RWR testing, and comparisons of the ACETEF-derived data to real-world data, we have identified and documented ACETEF's capabilities and limitations to successfully support the OT&E of RWRs. As a result of this assessment, OPTEVFOR is preparing a letter approving the use of these laboratories at ACETEF to support the OT&E of the Navy's next-generation RWR.

The assessment also highlighted other larger issues that must be addressed in order to ensure the successful use of modeling and simulation resources. Among these larger issues are user education, field data to support V&V, data standardization needs, determining who should be responsible for conducting (and funding) these overall assessments of models and simulations, extending the approach to other similar T&E facilities, and correlating test results across facilities.

Keywords: verification and validation (V&V), modeling and simulation, electronic warfare, ACETEF, operational test and evaluation, radar warning receiver

Initial Assessment of the Air Combat Environment Test and Evaluation Facility To Support Operational Test and Evaluation

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Introduction

Many limitations associated with the operational test and evaluation (OT&E) of electronic warfare (EW) systems make achieving the "realistic combat conditions" demanded by law [1] either difficult or impossible. Providing an adequate EW testing environment with a sufficiently dense and varied emitter environment would involve large numbers of personnel and hardware and would be cost prohibitive in nearly all instances. One way to overcome some of the limitations is to augment the available test resources with models and simulations (M&S).

We view the use of M&S to support the OT&E process as a complement to live testing. Although there is no substitute for open-air flight testing, the quantity and operating characteristics of open-air range emitters do not fully represent an operationally realistic EW environment. Emitters may not be available on a particular range (or on any range). At an open-air range, civilian radars and other radio frequency (RF) signals are not under test control. "Live" tests, requiring large tracts of airspace, must be closely coordinated with the Federal Aviation Administration (FAA). Test restrictions must be in place to avoid inadvertent civilian communication losses (e.g., from jamming) or the "blinding" of FAA radars (e.g., from chaff). The controlled environment of a hardware-in-the-loop (HITL) facility may help to overcome these environmental and safety limitations.

In addition, the use of HITL and man-in-the-loop (MITL) simulation facilities may increase the combat realism and provide the means to test more fully EW and electronic combat capabilities of increasingly complex aircraft avionics and radar systems. By more fully testing these systems with M&S resources, we are attempting to reduce further any uncertainties that the systems work as they are designed. The most significant disadvantage of these simulation resources, when compared to live testing, is that critical assumptions and model limitations may adversely affect results. When used as a risk reduction measure, M&S may introduce new risks. Thus, realistic testing in a virtual world demands that the environment and simulated emitters be properly verified and validated (V&V).

At the request of the Commander OPTEVFOR, we have made an initial assessment regarding the suitability of selected components of the Air Combat Environment Test and Evaluation Facility (ACETEF) to support the OT&E of the Navy's next-generation radar warning receiver (RWR), the AN/ALR-67(V)3. Our goal was to determine

- Whether ACETEF provided a level and quality of data similar to those obtained during operational testing of an RWR at an open-air test range.
- Whether ACETEF's test support processes were mature enough to ensure that the facility could support the OT&E customer.

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Background

The Air Combat Environment Test and Evaluation Facility (ACETEF) located at the Naval Air Warfare Center, Aircraft Division (NAWC-AD), Patuxent River, Maryland, is a full-spectrum electronic combat test facility. ACETEF tests EW systems that are fully integrated aboard an operational mission aircraft. ACETEF consists of a number of laboratories and a variety of simulations, each specializing in a particular aspect of aircraft and emitter operations. The facility is capable of simulating a wide array of radars, missiles, and jammer techniques, all of which may be linked with a manned flight simulator to provide a flight environment with an emitter variety and emitter density that is unattainable on any test range.

Six components of ACETEF were essential to this assessment: the Electronic Warfare Integrated Systems Test Laboratory (EWISTL), the Operations and Control Center (OCC), the Manned Flight Simulator (MFS), the Simulated Warfare Environment Generator (SWEG), the shielded hangar, and the Aircraft Anechoic Test Facility (AATF). We did not examine any of the other laboratories at ACETEF during this assessment.

EWISTL simulates the RF characteristics of a variety of emitters. The EWISTL emitter library contains more than 5,000 radar modes. EWISTL may use six different RF simulator systems. For our tests, we used the Advanced Tactical Electronic Warfare Environment Simulator (ATEWES) RF simulator system. ATEWES is an open loop system that can generate more than 1,000 simultaneous radar emitters by multiplexing 15 signal generators. The system can generate up to 4 million pulses per second. EWISTL can operate in a scripted-scenario mode, in a dynamic mode under the direction of SWEG commands, or in an interactive mode with a console operator.

The OCC is responsible for controlling the interactions of the various laboratories, the SWEG simulation, and the system under test. All ACETEF data collection is performed by the OCC. OCC personnel construct the overall test scenarios.

SWEG is a rule-based model that permits the modeling of players, platforms, and weapon systems. SWEG controls the interactions among the ACETEF laboratories. For example, SWEG computes when an aircraft is terrain masked from an emitter and sends a control signal to EWISTL to inhibit the transmission of signal pulses.

The MFS supports MITL testing. The MFS has both desktop aircraft simulators and state-of-the-art large-domed simulators. The domed simulator is coupled with a motion system that displays computer-generated scenes, providing the pilot with an out-of-cockpit view.

Aircraft may be tested in either the shielded hangar or the AATF. The hangar provides an RF-isolated environment. The anechoic chamber provides an RF- and electromagnetic-free environment secure from outside interference and similarly secure from outside monitoring. The chamber can safely absorb RF signals, which means systems can be tested while operating the aircraft's radar and other avionic systems.

ACETEF has been used extensively for developmental testing (DT) of both EW and avionic systems, including the AN/ALR-67(V)3 RWR, the Airborne Self-Protection Jammer, and upgrades to the EA-6B. The EA-6B program was able to eliminate ten planned DT test flights—saving millions of dollars and several weeks of effort—through the use of ACETEF[2].

The AN/ALR-67(V)3 is the Navy's next-generation RWR. An RWR is a passive detector designed to intercept, identify, and display radar emitter information to the pilot. Because the AN/ALR-67(V)3 is in early development and no real-world performance data for the RWR existed at the time of this initial assessment, we compared the ACETEF-generated results to data collected from the Navy's current fleet-wide RWR system—an AN/ALR-67(V)2.

Approach

Our assessment was a formal examination of selected components of ACETEF to determine their suitability to support the OT&E of the Navy's next-generation RWR—the AN/ALR-67(V)3. Before this assessment, ACETEF had not completed a formal documented V&V process. Previous informal V&V efforts of the facility had largely been undocumented.

We structured and executed a series of tests using ACETEF and an F/A-18 equipped with the AN/ALR-67(V)2. We then compared the ACETEF-generated results to real-world data collected previously from an F/A-18 equipped with an AN/ALR-67(V)2. We must note that we had a limited amount of real-world performance data and that the AN/ALR-67(V)2 is an imperfect "yardstick" for detecting, identifying, and displaying emitter information. For the assessment, the emitters of the Electronic Combat Range (ECR), located at the Naval Air Warfare Center, Weapons Division, (NAWC-WD) China Lake, California, were simulated. The real-world test flights were flown at ECR. We conducted the ACETEF tests in three phases. Each of the phases used the OCC to collect data from both the simulations and the RWR aboard the aircraft.

The first phase consisted of two sets of tests using only EWISTL to generate various emitter modes. Although this phase was artificial by OT&E standards, these tests provided us an efficient way to simulate a variety of emitter modes and to collect sufficient data to establish the basic simulation performance of the ACETEF. We attempted to maximize the number of emitters and their operating modes, while limiting the amount of computer time required to complete the tests and minimizing the amount of analytic effort required to process the data.

The second phase consisted of replicating seven test flights flown earlier at ECR. In this phase, we used both EWISTL to generate the emitter modes and SWEG to model the aircraft's flightpath and to control the EWISTL-generated radars.

The third phase tested ACETEF's ability to simulate a dynamic EW environment—typical of those possible in open-air flight tests at ECR. F/A-18 pilots from VX-9, China Lake, using the MFS "flew" through a virtual ECR range in eight basic scenarios. SWEG controlled all of the interactions among the virtual airspace, the MFS, and the EWISTL-generated radars.

In addition to the operational performance data derived from the three-phase test, we also evaluated ACETEF's ability to support the OT&E customer by examining its day-to-day procedures, testing processes, and facility documentation.

During the assessment, OPTEVFOR and ACETEF personnel carried on a continual dialogue. Discrepancies, as they were noted, were referred back to ACETEF. At the end of the assessment, we made recommendations to the ACETEF personnel regarding improvements in the facility to better support OT&E needs.

Results

We found that, in general, ACETEF can generate signals of the right amplitude and fidelity for accurate detection, identification, and display by the RWR as compared to real-world performance. We based our conclusion about ACETEF on the same criteria used in open-air flight tests (e.g., what was the range when an emitter was detected and what percentage of the emitters were correctly identified by the RWR). In general, the ACETEF-derived results were comparable to open-air flight test results. In a limited number of cases, we found differences between the ACETEF-derived data and real-world AN/ALR-67(V)2 data. These differences were due to slight inaccuracies in certain radar modes. After our assessment, EWISTL personnel made the necessary changes to these modes, although their modifications have yet to be verified and validated.

Overall, the variety of emitter modes and the technical accuracy of the emitter parameters were satisfactory to support the needs of OT&E.

In examining ACETEF's ability to replicate selected flight segments of actual flight tests at ECR, our analysis indicated close agreement with flight test events and sequences. We judged ACETEF to be satisfactory in generating these kinds of scripted scenarios to support OT&E requirements.

We initially assessed ACETEF's related documentation as unsatisfactory and made a number of recommendations regarding desired documentation. Since the beginning of the assessment, ACETEF personnel have taken aggressive action to improve their documentation. These steps include

- Starting an independent V&V of the EWISTL facility.
- Developing a formal configuration management plan.
- Developing user's guides for each laboratory. These guides, currently in draft form, will assist future users by explaining the functionality of each laboratory and discussing known limitations—including any impacts these limitations may have on potential user test objectives.

We also noted limitations with the MFS. The aircraft model was limited to a small set of external weapon stores/drag coefficients. In addition, the drag coefficients were not dynamic (e.g., dropping external fuel tanks did not reduce drag). We viewed this as a minor limitation. Furthermore, the aircraft engine model did not accelerate and decelerate correctly. Also the pilot can exceed real-world performance by exceeding normal engine throttle settings. Again, since our assessment, the engine model has been improved, but its performance has yet to be formally validated.

We documented our efforts during the assessment in considerable detail so that future users may leverage from this work. We hope that future V&V efforts of ACETEF are also well-documented. The operational tester requires very detailed information to either successfully simulate an event or avoid a potential pitfall. For example, at some frequencies the ATEWES signal generators may be unable to generate sufficient power to replicate fully the power received by the RWR when the aircraft gets close to an emitter. Figure 1 shows the minimum closing distance between an aircraft and an emitter that ATEWES can successfully simulate across a given frequency spectrum. The graph is constructed from knowing the effective radiated power (ERP) of the emitter being simulated, the maximum power output of the ATEWES signal generators for a set of frequencies, and the one-way radar range equation. When an aircraft crosses below the graph, ATEWES will be unable to generate sufficient power to successfully model the emitter. When the aircraft "flies" within this minimum closing distance, the power received by the RWR will remain constant. This lack of increase in the received power may adversely affect the test results.

From figure 1, if the tester wants to simulate an emitter whose operating frequencies range between 200 and 300 frequency units and the tester also wants to simulate flying the aircraft between 10 and 15 distance units from the emitter, then the tester needs to avoid those frequencies between 250 to 265. In this example, at a frequency of approximately 260, the RWR will not receive any additional signal power when it flies within 30 distance units of the simulated radar. Without detailed knowledge of the capabilities and limitations of the simulation, the operational tester may be unable to choose the appropriate frequencies for a successful test simulation.

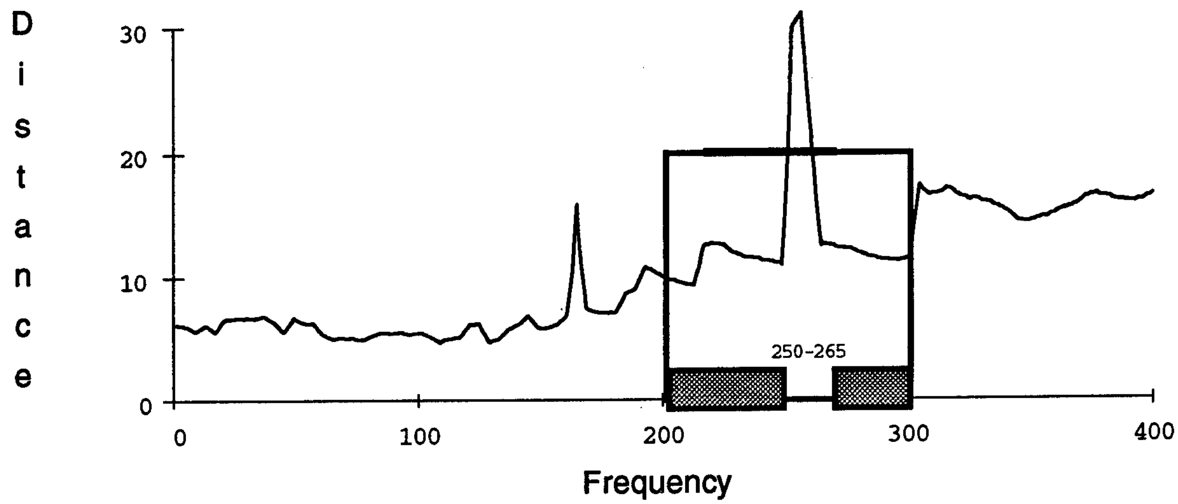

Figure 1. Closest distance between emitter and aircraft that ATEWES signal generator can successfully simulate

We found that the quantity and type of ACETEF-derived RWR data are comparable to the data obtained from an instrumented aircraft flown at ECR. The ACETEF-collected emitter data have greater resolution and precision than emitter data collected at an open-air test range, particularly for noninstrumented emitters at a test range.

During our assessment, we found that the procedures in place at ACETEF, although they could be improved, were good overall. The facility and the personnel are well-suited to support the OT&E customer. ACETEF personnel have been very receptive to our recommendations and the needs of the OT&E community. As a result, ACETEF personnel have begun to make improvements in their test conduct, emitter database management, and model algorithms—in addition to the previously mentioned actions that they are undertaking.

Based on our analysis of the models used, observations made during the RWR testing, and comparisons of the ACETEF-derived data to real-world data, we have identified and documented ACETEF's capabilities and limitations to successfully support the OT&E of RWRs. As a result of this assessment, OPTEVFOR is preparing a letter approving the use of these laboratories at ACETEF to support the OT&E of the AN/ALR-67(V)3.

Advantages of using ACETEF

ACETEF is not a substitute for, but rather a complement to live testing at an open-air range. "Together, models and simulations offer the ability to expand the operational assessment, while field testing offers the means to more effectively calibrate and validate the models" [3]. ACETEF's laboratories provide the following benefits:

- Provide for adequate preparation of open-air test flights, helping to ensure that a live test is done correctly the first time and that the desired data can be collected.
- Allow the tester to tailor the open-air tests for resolving questions that cannot be satisfactorily answered through simulation. Significant costs may be avoided, if unnecessary marginal tests can be identified through the analysis of simulation-derived results.
- Provide realistic testing earlier in the life cycle, thus allowing more timely discovery and resolution of errors. During the quick-look operational assessment of the AN/ALR-67(V)3 performed at ACETEF, it was quickly determined that the RWR was not ready for open-air test flights at that time. The decision was made to postpone the test flights and the program office avoided wasting nearly $200,000 in ECR range and associated flight costs for a premature test. ACETEF costs were about $20,000.
- Allows the tester to investigate problems arising in flight tests by replicating the tests through simulation.
- Provide a means for generating sufficient data, possibly interpolating available real-world data to fill open-air test flight gaps.
- Provide increased security by operating in a closed facility, which permits the testing of classified equipment without compromise.
- Provide unique testing scenarios in a scientifically controlled environment.
- Provide emitters both in large numbers and in a variety of types.
- Extend the testing environment by simulating more realistic scenarios, involving more advanced radars in a higher pulse density environment, than can be provided by a test range. This may be especially true when simulating complex combat environments incorporating "future" emitters.

These ACETEF laboratories now become one more set of tools in the operational tester's toolbox. The use of these laboratories should translate into a more cost-effective means to deliver a more thoroughly tested system to the fleet. In addition, by extending the test environment, fewer limitations to the scope of testing should be required (albeit the tester must be cognizant of the facility's limitations).

Larger issues

The assessment also highlighted other larger issues that must be addressed to ensure the successful use of M&S resources.

The EW test facilities should adopt common standards which include emitter naming conventions and common formats for data collection. Common standards will facilitate the analysis of the data—using common analytic tools—and understanding of the results, regardless of whether the data are obtained in a laboratory or at an open-air test range. A uniform data format could enhance the correlation of test results across facilities.

There is a need for a user education process. End-users, such as an operational test director at a test squadron like VX-9, must be made aware of what M&S capabilities and tools are available and how these simulations have been used—both successfully and unsuccessfully—in the past. Furthermore, users must be provided detailed documentation about the limitations and assumptions that each simulation brings with it, and must understand how these limitations and assumptions can affect the outcome of a test.

This assessment highlights the question of who should be responsible for overall assessments—in terms of both performing the assessment and funding it. OPTEVFOR performed the assessment, with funding assistance from both ACETEF and the AN/ALR-67(V)3 program office, PMA-272. However, is this type of assessment something for which the end-user is responsible, an activity for which the individual facility should be ultimately responsible, or would an organization specializing in V&V efforts be a better choice? In general, end-users may have neither the desire nor the resources to perform formal V&V of models. A facility may have exceptional technical/software expertise, but may not have the personnel and expertise for V&V efforts. A V&V organization may be well-versed in documentation standards and V&V techniques, but may lack the technical expertise to fully capture the critical limitations of the model.

We view the V&V process as reducing the risk associated with using a particular model. Although total confidence in the model is a desirable goal, for a complex simulation this goal may be prohibitively expensive. The modeling community needs to recognize that V&V is not an all-or-nothing proposition, but rather is a dynamic process. Each program will dictate the amount of V&V effort required. Our assessment of ACETEF's laboratories lays along the V&V continuum. We have documented our efforts during this limited assessment in considerable detail so that future users may build on this work. We must view these documents as *living* documents, reflecting a continuing and refining V&V effort.

The V&V problem is compounded because the M&S community lacks supporting test data. Obtaining sufficient usable real-world data was critical in preparing for a validation of the laboratories involved in the assessment. Although we enjoyed excellent cooperation from ECR and VX-9 personnel in obtaining real-world AN/ALR-67(V)2 data, it was still an arduous task. A repository of previously collected data would have been an invaluable resource. In addition, we note the lack of a conduit to feedback real-world data to the modelers. In the model-test-model paradigm, data collected during live tests should be used to refine and validate the associated environmental, threat, and system models. These data are particularly important for developing models of "leading edge" systems, with which the T&E community primarily deals. Although prior experience with a similar system under test can help to provide some validation of a model's basic algorithms, the precise performance of the system is an educated guess until real-world data become available through prototypes and testing. As more data become available, the level of V&V can be raised. Performance data from the AN/ALR-67(V)3 should begin to be archived for future V&V efforts involving this RWR.

We believe that the open cooperation among ACETEF, ECR, OPTEVFOR, and the assessors should serve as an example for future assessment efforts of complex M&S resources. In addition, we believe that this approach should be applied to other similar M&S resources used by T&E. V&V efforts will help to create a standardization among EW simulation facilities that reflects real-world performance data. This standardization will help to ensure a correlation of results across T&E facilities. Users should be able to depend on some level of consistency among models with the "same" functionality—whether the data are derived from a digital model, an HITL/MITL facility like ACETEF, or from open-air test flights.

Summary

This paper briefly describes OPTEVFOR's assessment regarding the suitability of selected components of ACETEF to support the operational test and evaluation of EW systems—RWRs and, in particular, the Navy's next-generation RWR, the AN/ALR-67(V)3. As a result of this assessment, OPTEVFOR is preparing a letter approving the use of the laboratories at ACETEF, examined during this assessment, to support the OT&E of the AN/ALR-67(V)3. We believe this assessment is an important first step in formally documenting the capabilities and limitations of ACETEF. We have extensively documented our findings in order that others might build on and extend these results.

Both OPTEVFOR and ACETEF have chosen to invest part of their resources in a project that will provide long-term benefits to the Navy and the Department of Defense as a whole. We believe it is only this type of long-term vision and investment in the necessary infrastructure that will permit M&S to be used most efficiently and most effectively.

It is less important that we found limitations, but rather that the facility's capabilities and limitations are now documented and better understood. This information is invaluable to the tester who desires to fully exploit the facility's strengths, while attempting to work around its weaknesses. Similarly, our findings are helping guide the ACETEF personnel in improving their facility.

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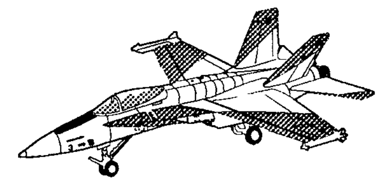
Biographies

John Bentrup is a research analyst at the Center for Naval Analyses in the Modeling and Simulation Group of the Requirements and Advanced Systems Division. For the last three years, John has focused his work on the role of modeling and simulation to support test and evaluation. In addition to the ACETEF assessment, John was a member of the Navy's technical assessment team examining the Joint Modeling and Simulation System (J-MASS) and most recently served as an analyst during the Joint Theater Missile Defense (JTMD) Distributed Interactive Simulation (DIS) exercise. John is completing his Ph.D. in Computer Science from the University of Illinois.

Don Greaser is a principal functional analyst with PRC, Inc. providing technical and analytic support to COMOPTEVFOR. For the last two years, Don coordinated the evaluation of ACETEF with CNA in support of COMOPTEVFOR's assessment. Don originated the assessment effort before retiring from OPTEVFOR in August 1994. Don, a retired Navy Commander, has 15 years experience in acquisition management and test and evaluation of electronic warfare systems. In addition to the ACETEF assessment, Don is involved in the development of OPTEVFOR's modeling and simulation planning for the Integrated Defensive Electronic Countermeasures (IDECM) program.

CDR Rick Bainbridge is the Section Head for Airborne EW Systems at COMOPTEVFOR. He coordinated the operational testing of the ALR-67(V)3 and sponsored the assessment of ACETEF to support operational test.



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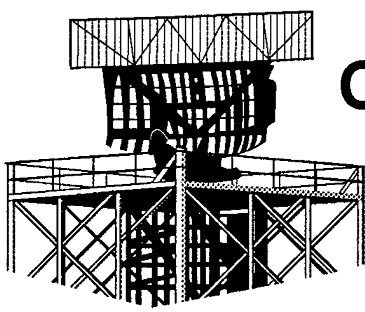


Overview

- ACETEF
- Radar warning receiver
- M&S to support operational test (OT) of electronic warfare (EW) systems
- Our approach
- Results
- Advantages of using ACETEF
- Larger issues

Air Combat Environment Test and Evaluation Facility (ACETEF)

- Patuxent River, NAWC-AD
- Electronic combat test facility
- Principal use - developmental testing (DT)
- Multifaceted facility

- Examined in the assessment
  - Operations & Control Ctr
  - Shielded Hangar
  - Anechoic Chamber
  - EW Integrated Systems Test Lab
  - Manned Flight Simulator
  - Simulated Warfare Environment Generator
- Not examined
  - Aircrew Sys Eval Facility
  - Threat Air Defense Lab
  - Communications, Navigation, & Identification Lab
  - Offensive Sensors Lab
  - Electromagnetic Environment Lab

COMOPTEVFOR's Immediate Interest in ACETEF

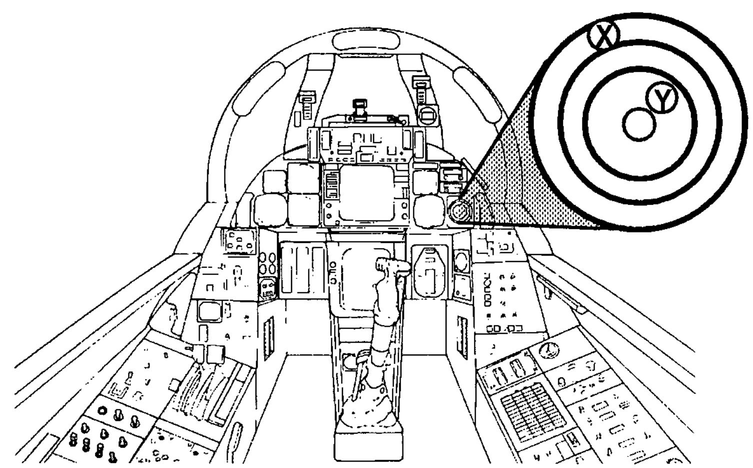
- Radar Warning Receiver (RWR)
  - intercept, identify, display radar emitters
- Specifically:

  ALR-67(V)3
- Baseline with:

  ALR-67(V)2

Radar-X

Radar-Y



M&S to Support OT of EW Systems

- "Realistic combat conditions" demanded by law
- Open-air range (OAR) limitations to the scope of EW testing
  - emitters unavailable
  - insufficient quantity and power, parametric deficiencies
  - airspace restrictions
- Cost prohibitive to provide large numbers of personnel and hardware

- M&S as a risk reduction measure
  - Can ACETEF support Operational Test and Evaluation?
  - What are the critical assumptions and model limitations?

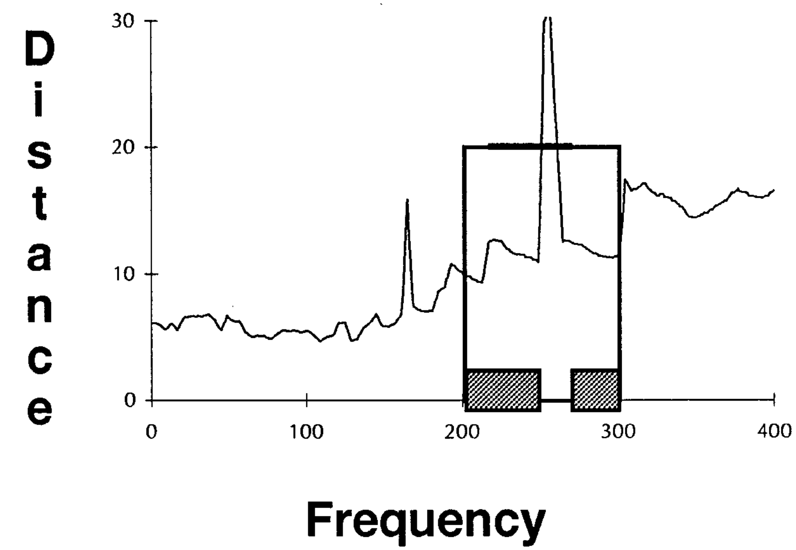
Our approach

- Legacy M&S
  - no documented V&V
- Compare ACETEF-derived ALR-67(V)2 data to real-world ALR-67(V)2 data
  - data collected during OT and DT test flights at China Lake
  - ALR-67(V)2 imperfect yardstick
- Conduct series of simulations
  - Basic RWR/ACETEF performance (EWISTL)
  - Flight test simulations (EWISTL, SWEG)
  - Man-in-the-loop scenarios (EWISTL, SWEG, MFS)
- Use same operational criteria as in ALR-67(V)2 OPEVAL
- Examine day-to-day procedures, documentation
- Recommend improvements

Is ACETEF-derived data representative of real-world ALR-67(V)2 data?

- Used same criteria as in flight tests
  - e.g., detection range, emitter identification
- In general, data were of comparable quality
- Important to understand limitations of the simulation
  - Example: Want to "fly" within 20 units distance from the emitter
  - Emitter operates at a frequency of 200-300
  - Safe if do not simulate in 250-265 frequency range

Range where max signal power received



Range determined by: emitter radiated power, signal generator power, radar-range equation

Results of Our Analysis

Objective	Assessment	Remarks
Generate simple and complex emitters	Partially Satisfactory	Simulations revised. To be verified.
Generate scripted scenarios	Satisfactory	
Variety of emitter signals	Satisfactory	
Technical accuracy of emitter parameters	Satisfactory	
Documentation	Unsatisfactory (Improving)	Aggressively developing formal CM plans, user docs, SOPs
Flight Dynamics	Partially Satisfactory	Models improved. Not yet validated.

Summary of Our Analysis

- ACETEF-derived data quantity and type
  - comparable/superior to open-air range
- In general, data derived results appear reasonable
  - must understand capabilities and limitations of simulations
- Day-to-day procedures: Overall good
  - some improvements in test conduct, emitter database management, documentation, data processing algorithms
- ACETEF very receptive to our recommendations
  - already improving their process, documentation, models

Advantages of Using ACETEF

- Rehearse and tailor open-air range (OAR) test flights
- Review readiness for OT&E flight tests
  - predict basic RWR performance
- Investigate problems arising in flight tests
- Generate sufficient data points (augment OAR data)
- Secure facility
- Scientifically controlled environment
- Large number and types of emitters
- Scenario variations not achievable on OARs
- Identify early / reduce extent of limitations to the scope of testing
- More thoroughly tested system

Can ACETEF Support Operational Test and Evaluation?

- YES!
- Approved for supporting ALR-67(V)3 OT&E tests
- Complement to, not a replacement for, flight tests
- Increases cost-effectiveness of OT&E
- More thoroughly tested system

- Because of quick-look operational assessment
  - determined ALR-67(V)3 not ready for OAR tests at that time
  - avoided ECR range and associated flight costs ~= $200K

Larger issues

- Data standardization
- Need for user education process
  - lack of incentives to pursue M&S approaches
- Verification & Validation (V&V)
  - Who is responsible for overall assessments?
  - view as continuum, rather than binary process
- Field data to support V&V
  - repository
  - feedback through life-cycle
- Extending DT M&S to support OT
- Apply this approach to similar T&E facilities
- Correlate results across T&E facilities
- 1996 and Beyond... Are We Progressing?

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