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<tr>
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Original title on 712 A/B: Aircraft Countermeasures (ACCM) Human Effects Test Analysis

If the title was revised please list the original title above and the revised title here:

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No Beam -- Shot Scatter Plot

- X Coordinates (ft)
- Y Coordinates (ft)

Scatter plot showing data points distribution.
Aircraft Counter Measures (ACCM)

Human Effects (HE) Test Analysis

Capt Greg Steeger

9 Apr 07
Overview

• ACCM Background
• Test Details
• Data Collection
• Test Analysis Methodology
• Findings
• Lessons Learned and Conclusion
ACCM Background

- ACCM is a Warfighter Rapid Acquisition Program (WRAP) involving AFSOC/A5T, AFRL/DE, AFRL/HE, and Boeing Scorpworks Lab
- Laser system designed to provide significant glare source
Test Details

• **Main purpose:** to determine if the ACCM laser system works as an effective counter measure against small arms fire

• **Three test phases**
  – No laser (no beam)
  – Low power level
  – High power level

• **Players**
  – Helicopter gunner
  – Shooters
Proposed Data Collection Tools

- Video feeds
- Shot placement software
- Sensor suite
  - Accelerometer (rifle recoil), optical (MILES/ACCM beam), data logger (GPS position, time etc.)
- Shooter Data
  - Interviews and surveys
- Gunner Data
HE Test Methodology

• Measures Of Performance (MOPs) considered
• Comparing test phases
• What we wanted to do with our data
• What we were able to do with our data
MOPs Considered

- Hit ratio on the helo
  - No. of hits divided by shots fired
  - A hit was designated a shot within 11’ of the center of the gunner’s window
- Average miss distance and Circular Error Probable (CEP)
- Average number of aggressors killed
- Average number of near-misses
Comparing Test Phases

• Compare the MOPs captured via statistical tests
  – Large sample hypothesis tests
  – Determine if shooters performance was adversely affected in engagements with the ACCM laser system

• Analyze survey responses
  – Assigned a score to each response and looked at averages and standard deviation
  – Did not look at non-parametric statistics
Data – Hopes vs. Reality

• Hopes
  – Analyze each shooter’s performance individually
    • Shooter variability not an issue
    – Shot placement software would efficiently “score” the shots
• Reality
  – Without sensor suite could not analyze the shooter’s performance individually (assume ea. shooter the same)
  – Without shot placement software all of the videos had to be watched and scored by “hand”
Findings

How do you conduct meaningful analysis based on only 42% of the data points?

<table>
<thead>
<tr>
<th></th>
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<th>0.5% MPE</th>
<th>1% MPE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Fired</td>
<td>3217</td>
<td>2162</td>
<td>3034</td>
<td>8413</td>
</tr>
<tr>
<td>Total Found</td>
<td>1406</td>
<td>859</td>
<td>1272</td>
<td>3537</td>
</tr>
<tr>
<td>% Found</td>
<td>0.4371</td>
<td>0.3973</td>
<td>0.4192</td>
<td>0.4204</td>
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- Only found 42% of the shots
  - Remaining shots were either not seen/captured on the video feeds or missed the hangar altogether
  - Non-representative sample

- Most of MOPs could not be used
  - Except for hit-ratio, kills, and near-misses
Shooter Accuracy

No Beam Hits

0.5% MPE Hits

1% MPE Hits

Low Power Hits

High Power Hits
Shooter Accuracy

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<tr>
<th></th>
<th>No Beam</th>
<th>Low Pwr</th>
<th>High Pwr</th>
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<tbody>
<tr>
<td>Total Hits</td>
<td>314</td>
<td>117</td>
<td>274</td>
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<tr>
<td>Shots Fired</td>
<td>3217</td>
<td>2162</td>
<td>3034</td>
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<tr>
<td>Hit Ratio</td>
<td>0.0976</td>
<td>0.0541</td>
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- Hit ratio is statistically smaller in the Low Power test phase
- Looked into this further by analyzing hit ratio at the engagement level
  - No. of hits per engagement
  - No. of engagements with 5, 10, 15, or 20+ hits
  - Analyzed this for all of the engagements and a random sampling of engagements
- Consistent results
Findings

• One other factor changed with the power of the laser (which we were not made aware of until late into the analysis)
  – Spot size went from 29.5’ in diameter in High Power test phase to 42.7’ in diameter in the Low Power test phase
  – A difference of 744 square feet (or double the area)

• So we conclude that the laser’s spot size is the most important factor, but more testing needs to be done to confirm this
Findings

• Shooters killed and near-misses by gunner
  – A lot more kills and near-misses from the No Beam to the High Power test phase
  – Explanation: Gunner’s are used to aiming using tracer rounds, cannot do that when using blanks
    • Laser became their aiming device

• Overall our findings were not inherently conclusive
  – Missing a lot of data
  – Need data on each shooter’s performance
  – Better way to score/find the shooter’s shots
Lessons Learned

- Test environment is ever changing
  - Flexibility
  - Back-up plans
- Understand all of the possible variables/factors prior to test
  - Control as many as possible
- Everything sounds great on paper (but chances are things will not work as advertised)
- More testing to obtain conclusive results is never a conclusion that wants to be heard
Questions?
Backups
ACCM Background

• Main purpose: to determine if the ACCM laser system works as an effective counter measure against small arms fire

• ACCM is a Warfighter Rapid Acquisition Program (WRAP) involving AFSOC/A5T, AFRL/DE, AFRL/HE, Boeing Scorpworks Lab, and AFMC/OAS

• Laser system designed by Boeing Scorpworks lab to provide significant glare source
  – Green light laser of particular wavelength, found to create a ‘dazzling effect’ on the human eye

• Designed to fill weapons engagement zone gap from 1Km to terminal area of recovery
Test Details

• Helicopter gunner
  – On scissor lift in hangar (gunner’s window)
  – Goal was to “kill” as many shooters as possible during each engagement
  – Weapon was a M-249 (equipped with MILES 2000)

• Shooters in the field in front of hangar
  – Two teams of 5 shooters
  – Goal was to get as many shots on the helicopter as possible (aim point - center of the gunner’s window)
  – Weapon – M-4 rifles (equipped with MILES 2000)
Test Details

• Multiple Integrated Laser Engagement System 2000 (MILES 2000)
  – System of sensors and transmitters that the shooters and gunner wear
    • Gunner did not wear a sensor so we could not determine when he was hit – did not want his weapon to be disabled during engagement
  – Record hits and near-misses (disables weapon if hit)

• Main purpose: to determine if the ACCM laser system works as an effective counter measure against small arms fire
OAS Involvement

• Independent review of the Human Effects test for the ACCM program
  – OAS holds no stake in the outcome of the WRAP
• Test design, implementation, and analysis of results
  – OAS was involved in previous phase of HE test
• Production of study report to include findings and future recommendations
Data Collection

• 3 cameras for video shot placement
  – IR sensitive cameras pickup MILES 2000 pulses
  – Shot placement software proved to be ineffective
  – All video had a time stamp that was synchronized with all other data by GPS time
  – Each video was scanned by team from Scorpworks lab to identify and assess time and location of each shot

• Scorpworks sensor suite
  – Data loggers were found, during test, to be unreliable
    • Made other sensors useless
  – Voice recorders were used but not analyzed

• Combat camera footage on field during engagements to verify sequences of action
Data Collection

• MILES gear downloads
• Shooter data
  – Interviewed shooters after each engagement to record shots fired, misfires, jams etc.
  – 3 cameras for video shot placement
• Gunner data
  – Shots fired, etc.
• Shooter surveys
  – Handed out at end of each phase per night
Hopes For Our Data

- Wanted to locate and measure the miss distance of all shots fired by the aggressor teams
  - Use this data to compare test phases or conditions
- Show from surveys whether or not the aggressors had opinions about particular test conditions that were later verified through analysis of shot data
- Show number of kills and near-misses against the aggressors
Reality of Our Data

- Without a working Scorpworks sensor suite, we were unable to identify shots by shooter or show when a shooter was in the ACCM beam
  - No way to determine (by shooter) if a shot was better or worse while the shooter was in the laser’s path
- Without the shot placement software all of the videos had to be watched and the shots scored “by hand”
  - Capturing a MILES 2000 pulse on hangar, finding the center, and then calculating the radial miss distance
Findings

• Shooter’s accuracy
  – No notable difference between the no beam and 1% MPE test phases
  – Hit ratios were significantly lower in the 0.5% MPE test phase than in the other two
  • If laser had a negative effect on shooter accuracy wouldn’t the trend continue as the power of the laser went up (brighter)?
Findings

- Not much difference seen, with similar numbers of shots found, in the No Beam and High Power scatter plots
Findings

- In the Low Power condition we had significantly fewer data points to work with than in the No Beam or High Power conditions