712CD

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Aircraft Countermeasures (ACCM) Human Effects Test Analysis

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Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
01 JUN 2007	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Aircraft Countermeasures (ACCM) Human Effects Test Analysis	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Office of Aerospace Studies (OAS) 2050A 2nd St SE Kirtland AFB, NM 87117 7320-L Parkway Drive Hanover, MD 21076**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

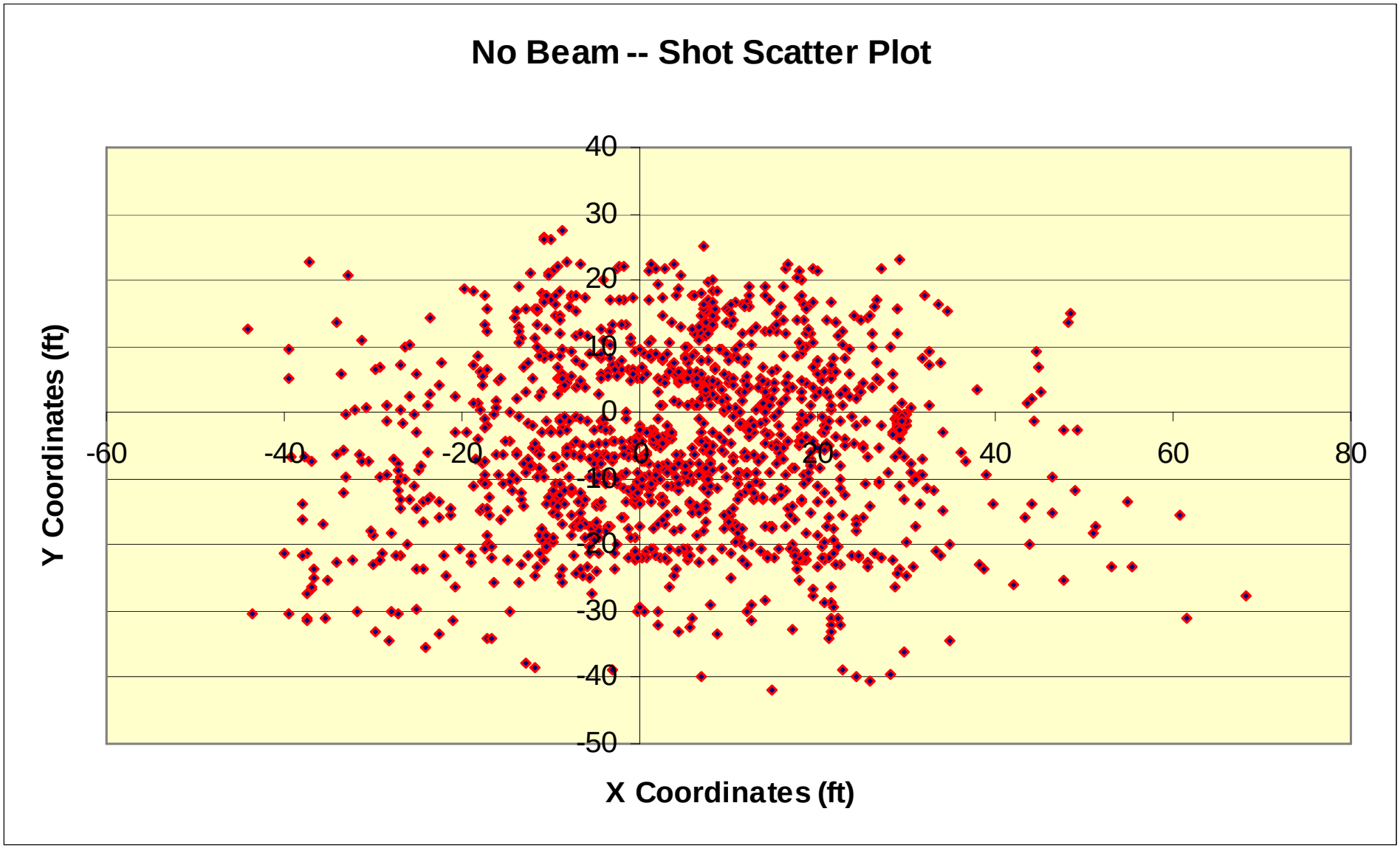
12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
See also ADM202526. Military Operations Research Society Symposium (75th) Held in Annapolis, Maryland on June 12-14, 2007, The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**UU**	**32**	


No Beam -- Shot Scatter Plot
Y Coordinates (ft)
X Coordinates (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-40
-20
0
20
40
60
80

Aircraft Counter Measures (ACCM)

Human Effects (HE) Test Analysis

Capt Greg Steeger

9 Apr 07

Integrity - Service - Excellence

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

- **Multiple Integrated Laser Engagement System 2000 (MILES 2000) gear**
- **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"**

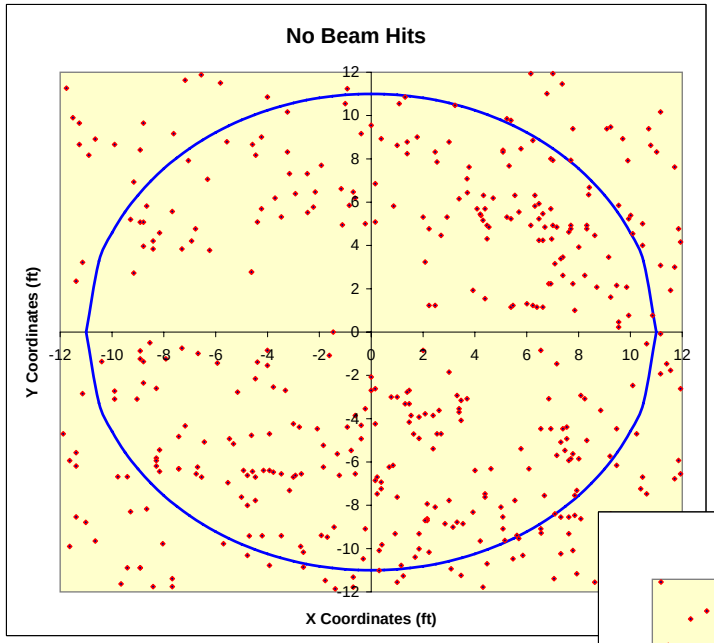
Findings

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

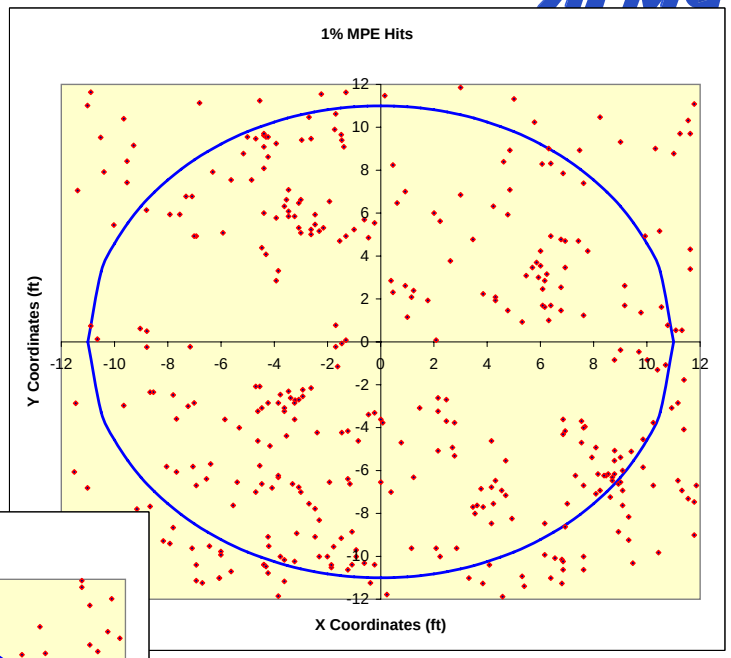
	No Beam	0.5% MPE	1% MPE	Total
Total Fired	3217	2162	3034	8413
Total Found	1406	859	1272	3537
% Found	0.4371	0.3973	0.4192	0.4204

- **Only found 42% of the shots**
  - **Remaining shots were either not seen/captured on the video feeds or missed the hangar all together**
  - **Non-representative sample**
- **Most of MOPs could not be used**
  - **Except for hit-ratio, kills, and near-misses**

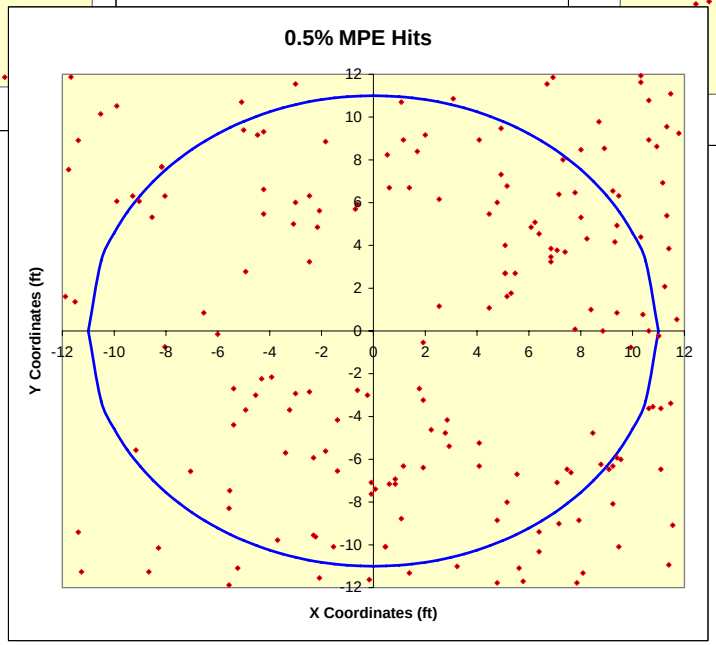
Shooter Accuracy



No Beam Hits



High Power Hits



Low Power Hits

Shooter Accuracy

	No Beam	Low Pwr	High Pwr
Total Hits	314	117	274
Shots Fired	3217	2162	3034
Hit Ratio	0.0976	0.0541	0.0903

- **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

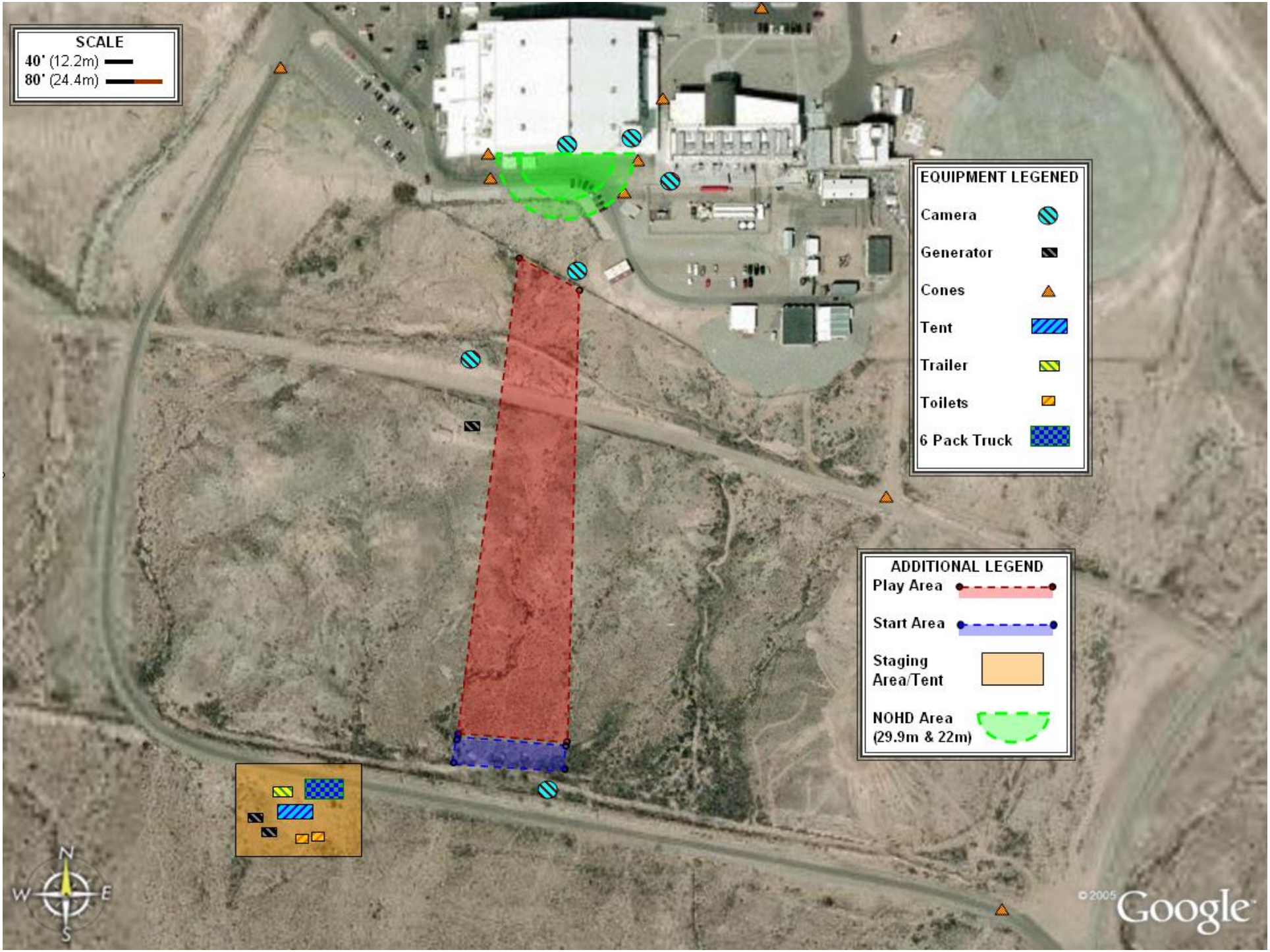
- **Main purpose: to determine if the ACCM laser system works as an effective counter measure against small arms fire**
- **ACCM is a Warfighter Rapid Acquisition Program (WRAP) involving AFSOC/A5T, AFRL/DE, AFRL/HE, Boeing Scorpworks Lab, and AFMC/OAS**
- **Laser system designed by Boeing Scorpworks 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**


SCALE
40' (12.2m)
80' (24.4m)
EQUIPMENT LEGENED
Camera
Generator
Cones
Tent
Trailer
Toilets
6 Pack Truck
ADDITIONAL LEGEND
Play Area
Start Area
Staging Area/Tent
NOHD Area (29.9m & 22m)
N
W
E
S
©2005 Google

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**

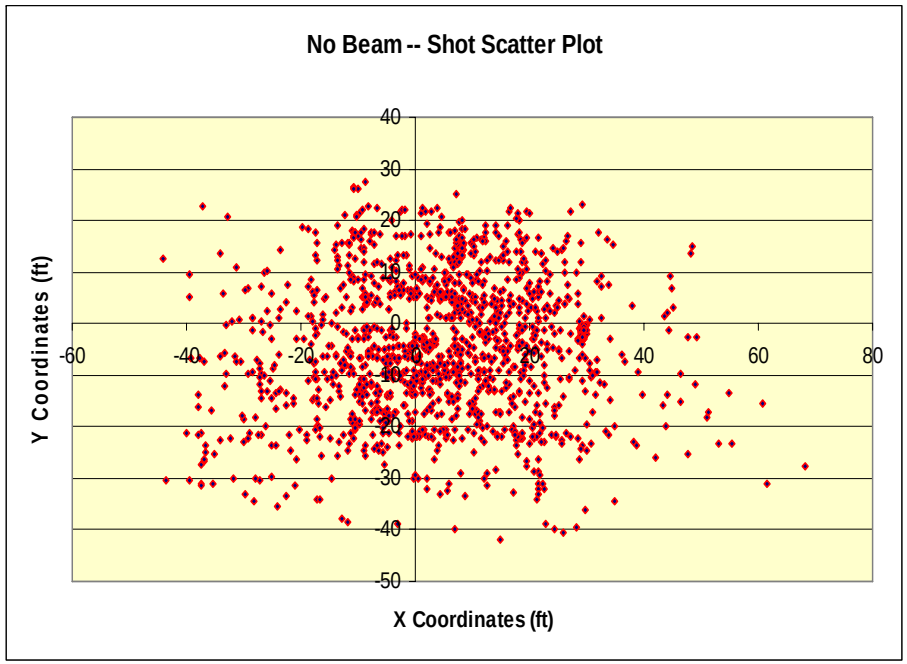
Reality of Our Data

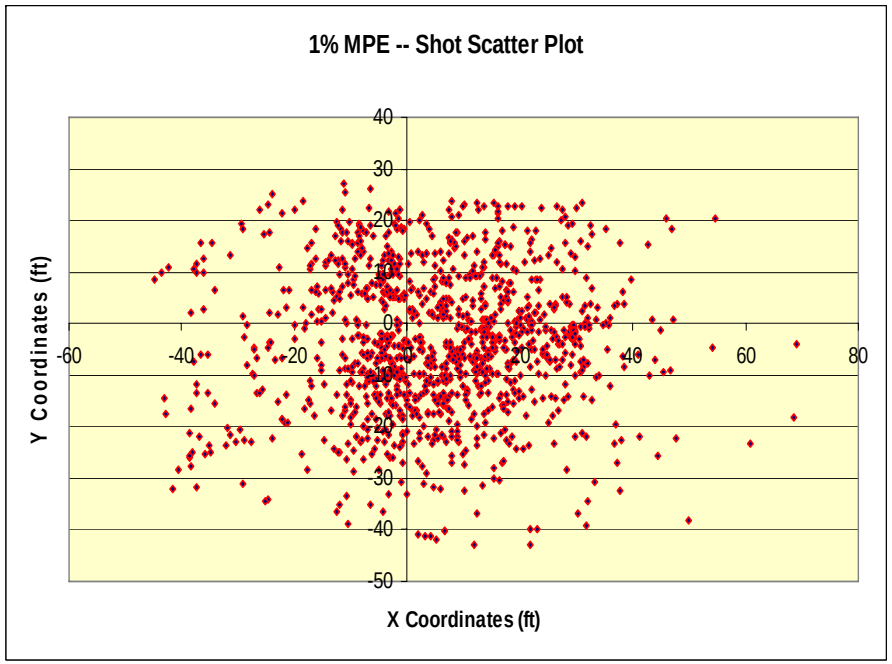
- **Without a working Scorpworks sensor suite, we were unable to identify shots by shooter or show when a shooter was in the ACCM beam**
  - **No way to determine (by shooter) if a shot was better or worse while the shooter was in the laser's path**
- **Without the shot placement software all of the 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)?**

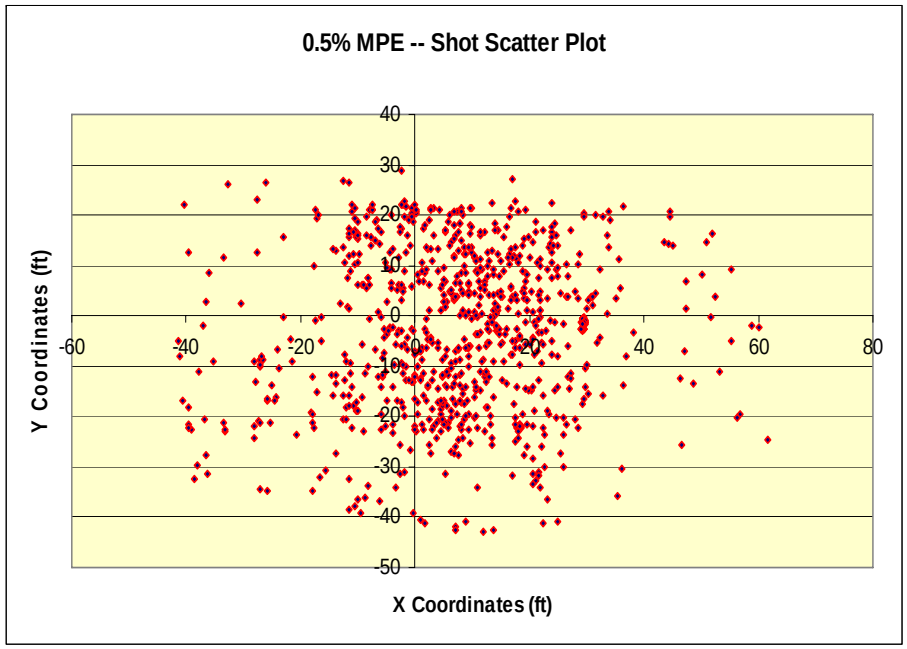
Findings

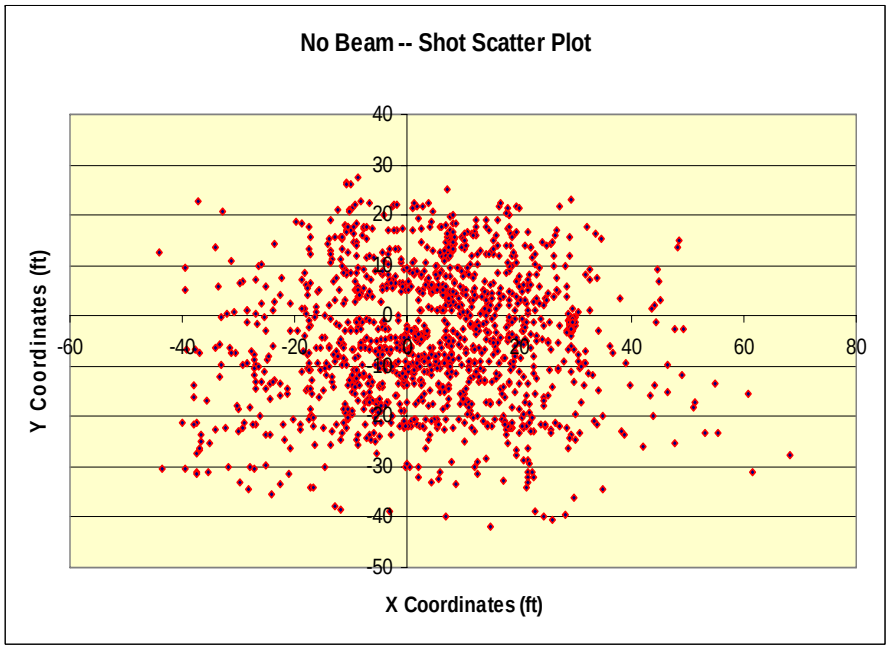




- **Not much difference seen, with similar numbers of shots found, in the No Beam and High Power scatter plots**

Findings





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