Rapid Simulation, Analysis, and Visualization for Navy Integrated Fire Control - Counter Air (NIFC-CA)

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Note: All performance values are notional and used only for purposes of simulation development.

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Project Overview

• Develop rapid simulation, analysis, and visualization capability to gain understanding of fighter aircraft integration in the From-the-Sea kill chain for integrated fire control operations in counter air engagements.

  – Employ integrated engagement concepts
  – Examine engagement outcomes
  – Quantify benefits of military utility and effectiveness
Approach:

• Utilize visualization techniques to develop integrated engagement concepts
• Develop Discrete Event Simulation (DES) environment
• Simulate effects-based modeling of:
  – Defensive fighter operations
  – Sea based missile defense
  – Communications / data link network
  – Threat attacks
• Generate military utility results
  – Rapid analysis of integrated engagement capabilities
  – Understanding of top-level interactions and outcomes
  – Measures of Outcome, Effectiveness, and Performance
Engagement Scenario*

• Carrier Defense:
  – Airborne fighter defense
  – Surface destroyer defense
  – Integrated operations against low-altitude targets

*Notional Data
Visualization Used to Generate IFC Conops (engagement logic, timing, etc.)
Additional Visualization Capabilities*

- Investigate the susceptibility of aircraft flying through a threat laydown
- Visualize the interdependent effects of flight conditions, terrain effects, threat system capabilities, etc.

*Notional Data
Carrier Defense DES “Desktop” View

Simulation Features
- Threat missile attack
- Missile detection and tracking
- Communications networking
- Missile engagement / defense

*notional data
Example Attack Scenario*

- 20 threat missiles launched against carrier battle group
- Surface defense provided by destroyer
- Fighter defense options...
  - Case 1: No fighter defense
  - Case 2: Integrated fighter defense (limited bandwidth)
  - Case 3: Integrated fighter defense (unlimited bandwidth)
- 25 Replications run for each option

*Notional Data

Threat missile speed = high subsonic
Threat missile altitude = Low
Destroyer supports up to 10 simultaneous engagements
Combined Kill Plot

Kill Plot

- No Fighters
- Fighters Limited Bandwidth
- Fighters Unlimited Bandwidth

**Fighter Unlimited Bandwidth:**
Average Kill Range (nm) = 0.81 $R_{\text{max}}$

**Fighter Limited Bandwidth:**
Average Kill Range (nm) = 0.58 $R_{\text{max}}$

**No Fighter Defense:**
Average Kill Range (nm) = 0.24 $R_{\text{max}}$

*Notional Data
Averages across 25 Replications
Data Link Simulation Summary

Simple message queuing and processing model captures link “bandwidth / capacity”

Data Link Loading

“Engage on Remote” Tracks Received by Destroyer

*Notional Data from Single Replication
Engagements – No Fighter Defense

Engagement Series – Single Replication
(No Fighter Defense)

No Fighters
Destroyer 19 kills, 36 shots
Leakers = 1
1 Replication

All Engagements Occur at Close Range

No Fighter Defense (across all replications):
Average Kill Range (nm) = 0.24 R_{max}

*Notional Data
Engagements – Limited Bandwidth

Engagement Series – Single Replication
(Limited Bandwidth)

- Fighters: 4 kills, 8 shots
- Destroyer: 16 kills, 23 shots
- Leakers = 0
- 1 Replication

**Few Engagements Occur at Extended Range**

**Fighter Limited Bandwidth (across all replications):**
Average Kill Range (nm) = 0.58 $R_{max}$

*Notional Data*
Engagements – Unlimited Bandwidth

Engagement Series – Single Replication
(Unlimited Bandwidth)

Fighters 4 kills, 8 shots
Destroyer 16 kills, 30 shots
Leakers = 0
1 Replication

Many Engagements Occur at Extended Range

*Notional Data

Fighter Unlimited Bandwidth (across all replications):
Average Kill Range (nm) = 0.81 R_{max}
About the Author

Ms. Tammy McNeley is a Lockheed Martin Fellow and serves as Chief Engineer of the Lockheed Martin Aeronautics’ Warfare Integration Laboratories including F-35 and Advanced Development Program facilities. She has 30+ years of experience in military Operations Analysis (OA) and human-in-the-loop simulation and is certified as an Expert Systems Engineering Professional (ESEP) by the International Council on Systems Engineering (INCOSE). She is also an active member of the National Defense Industrial Association (NDIA) Systems Engineering (SE) Modeling and Simulation (M&S) Committee.

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