Fire Scout UAV Launch and Recovery System Performance Improvement

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Presentation Outline

- VTUAV Current System
- Deck Interface Analysis
- Endurance Upgrade Project
- Launch and Recovery Growth
- Conclusions
MQ-8B System Overview

Data Comms

FORCEnet

Comm Relay

VTUAV TCDL

CSG/ESG

FLIR & Radar

VTUAV Ground Control Station
To Program Operators the System equates:

- Scenario
  - sea state
  - wind speed
  - initial geometry
  - ship, a.v. identities
  - tactics

- Environment
  - sea
  - air

- Ship Air Wake
- Air Vehicle Downwash
- Air Vehicle Chars.
- Coupled Air Wake
- Flight Dynamics/Motion
- Safe Landing Prediction
- Flight Control & Descent Path Planning
- Touch Down Detection
- Touch Down/Tie Down

- Ship Geometry
- Ship Motion
- Ship Chars.
- Ship INS
- Tracking Sensor
- Landing Position Prediction
- Approach/Landing Algorithm
- L & R System
MQ-8 UAV
Component Descriptions

Fully Autonomous Aircraft

Airframe
- Fully Digital, Dual Redundant Control System and C2 links

Payload
- Open System Architecture facilities integration and testing
  
  BriteStar II EO/IR/LR/LD
  
  COBRA

  Vortex

  Twister

Future Payload
- Radar
- Weapons
- Data Mission Payload

Fully Encrypted, Digital Data Links; Land & Sea Ops

- Interoperable Control Station with Tactical Control System (TCS) software integrated
  
  Tactical Control Data Link (TCDL)

  UCARS-V2 for Ship Launch/Recovery

  Harpoon and Grid Ship Deck Restraint

Ship Ground Control Segment (SGCS)

- Open Architecture
- GCCS-M, JDISS, AFATDS, CCTV & JSIPS-N
- NATO STANAG 4586 Compliant
- Multi-Vehicle control

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**MQ-8 System Description**

MQ-8C provides approximately twice the performance of MQ-8B.

**Key**
- **Existing**
- **Modification**
- **New**

**Support Segment**
- 75%
  - Deck Handling
  - Refuel/Defuel
  - Non-powered A/C movement
  - Landing Grid

**Ship Control Station**
- 95%
  - Method to monitor and communicate with aircraft
  - Safety of Flight

**MQ-8B**
- Schweizer 333
- ½ Orbits
- 90% common software, 10% Vehicle Specific Module

**Common Equipment**
- ARC-210 Radios
- EO/IR Payload
- Flight Power Conditioning Unit
- Control Panel
- Aux Power Conditioning Unit
- Data Panel
- Ethernet Switch & RADALT Antennas
- GPS/INS Antennas
- UCARS Antenna
- 2 GPS/INS Antennas
- 2 RADALT Antennas
- 2 IFF Antennas
- Flight Control / Engine Actuators
- Voice Digitizing Module
- TCDL
- TCS

**What makes the System:**
- Standards
- Open Architecture
- Communication Links
- Redundant Architecture
- Software

**Updated Equipment**
- GPS/INS
- Ice Detector
- Vibration Monitoring System
- IFF (APX-123)
- TCDL
- RADALT
MQ-8 System
Current Activities

MQ-8 Program of Record

Support LCS Mission Packages in conjunction with the MH-60

- LCS-1 Dynamic Interface (DI) testing (Nov 2010); LCS-3 DI expansion (Nov 2013)
  - LCS-2/4 DI testing (2014)
  - COBRA MCM Capability land testing completed April 2013
  - LCS Assessment and Deployment opportunity 4QFY14
- Continued growth in Flight Hours, Reliability and Operational Availability

ISR Task Force Support

Afghanistan

- 2 A/C, 2 GCS, 300 hrs/mo FMV using GOCO contract
  - First flight 2 May 2011, Last flight 1 August 2013
  - 1,438 flights for 5,084.3 flight hours completed
  - Mission completed August 2013

Maritime ISR Support to SOF RDC (MQ-8B/C)

- Emergent Requirement approved in January 2012
- Phased approach using MQ-8B and transitioning to MQ-8C aircraft (2014)
- Deployments continue aboard USS ROBERTS and USS SIMPSON 2013/14
  - DDG TEMPALT installation supports 2014 deployment
  - MQ-8 on 6th FFG Deployment; flew over 350 hrs/month in August
  - System IOC 1QFY14

Weapons RDC

- Navy LSI
  - Flying qualities testing completed
  - Safe Separation shots completed May 2013
  - 12 APKWS shots completed

RADAR RDC

- Provides wide-area maritime search capability in support of UONS
  - Fwd looking capability (+/- 180 degrees)
  - 2014 deployment

MQ-8B has flown over 12,000 flight hours since 2006; currently supporting 18 hour fly days

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MQ-8 UAV
MQ-8B/MQ-8C Comparison

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<thead>
<tr>
<th>Parameter</th>
<th>MQ-8B</th>
<th>MQ-8C</th>
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<tbody>
<tr>
<td>Maximum Speed</td>
<td>85 kts</td>
<td>135 kts</td>
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<tr>
<td>Cruise Speed</td>
<td>80 kts</td>
<td>115 kts</td>
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<tr>
<td>Service Ceiling</td>
<td>12,500 ft</td>
<td>16,000 ft</td>
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<tr>
<td>Std Day Maximum Endurance (with 300lb payload)</td>
<td>5.5 hrs</td>
<td>12 hrs</td>
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<tr>
<td>Hot Day Maximum Endurance (with 300lb payload)</td>
<td>4.5 hrs</td>
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<tr>
<td>Empty Weight</td>
<td>2,000 lbs</td>
<td>3,200 lbs</td>
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<tr>
<td>Std Day Fuel &amp; Payload</td>
<td>3,150 lbs</td>
<td>6,000 lbs</td>
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<tr>
<td>Length (folded)</td>
<td>31.5 ft</td>
<td>34.7 ft</td>
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</table>

MQ-8C: 3 ft Longer (folded), 1 ft Taller, 2.5 ft Wider & 1200# Heavier than MQ-8B
Operational Environment

Reduce the need of conducting at-sea experimentation; redauce risk to man and machine; define capability characterisations of weapon systems quicker for the warfighter.

Want to address design and systems interoperability issues before buying & building hardware

Once hardware exists, want to optimise operational performance of the ensemble

Challenging physics and engineering problems
Landing Requirements/Current CONOPS

DMC: Deck motion Compensation
IAF: Initial Approach Fix
RP: Recovery Perch
TDP: Touch Down Point

Approach (IAF)
Perch (RP)
TDP
(DMC) → High Hover
Low Hover

(close) (approach)
UCARS Functional Diagram
Back-up Landing Systems
Key Attributes

• Landing Accuracy / Impact
  ✓ (Target Acquisition range, Perch, High & Low Hover, Landing impact & dispersion)

• Technology Readiness Level

• Ease of Integration (Cost / Schedule)

• Shipboard Components & Mods Required

• AV Mods Required / Impacts (SWAP)

• Operational Availability / Reliability / Maintainability

• Spoofing / Jamming Susceptibility

• Denied GPS Functionality

• Emission Control

• Deck Motion Requirement (separate input)

• Adverse Weather Performance
  ✓ (Low visibility, day/night, near all-weather)
## Cause and Effect Matrix

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<th>Metric No.</th>
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<tr>
<td><strong>Process Outputs (Big Y's)</strong></td>
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**Legend**

- Rating of Importance to Client (Rank 1-10)
- Weighted
- Total Ranking
Back-up Landing System Roadmap
UAS Component Deck Interface and Ship Suitability Analysis

RQ8 x FFG37 : 10300607(4, 2, 7.2, 2.5): roll, pitch, EIA

degrees vs ES

roll
pitch
yaw
zite

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Risk reduction
Encountered Motions/forces on the Deck
Sample Recording MQ-8b x FFG56
Sample Recording MQ-8b x FFG8
Sample rec. MQ-8b x LCS2 -110419

Ship = 'LCS2' Aircraft = 'MQ8b' ROLL MAX = '5.00'
PITCH MAX = '3.00' ZVEL = '7.20' ft/s LAT VEL = '2.20' ft/s

RISETIME EVENT BEGINNING @ TIME '2238.43' EIA '1.17' ENDING TIME '2246.92' EIA '15.08'
Risetime event = '8.49' seconds
ROLL = '1.11' PITCH = '1.50' ROLL VEL = '1.86' PITCH VEL = '0.83' m/s ZVEL = '0.57' m/s YVEL = '0.69' m/s

There are '4505.00' points in run
Green Deck in run = '178.50' seconds which is '7.92' percent of run
Green-Amber Deck in run = '398.50' seconds which is '17.69' percent of run
Amber Deck in run = '1117.00' seconds which is '49.59' percent of run
Red Deck in run = '558.50' seconds which is '24.79' percent of run

Total deck availability in run = '1694.00' seconds which is '75.21' percent of run

Good risetimes in run + 5.0 seconds = '18.00'
OK risetimes in run + 4.0 - 4.9 seconds = '3.00'
Error risetimes in run < 4.0 seconds = '5.00'
Total number of risetimes in run = '26.00'

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Rise time Platform Stability

Rise time Distribution by ship in percent: LCS-1, LCS-2, FFG-8, WMLS-751

Comparative rise time events by duration: LCS2, LCS1, FFG8
Sample Recording MQ-8b x LCS1
MQ-8 Systems

- System concept used to meet warfighter needs
- PB14 includes 56 systems for LCS and supports SOF
- Current documentation governance (Dashboard, DAMIR, APB) is by aircraft and needs to be re-characterized to systems
  - The DAMIR reporting system automatically compares the Proposed Estimates to the historical APB thresholds and objectives and will report artificial breaches for APUC and PAUC unless the Original APB Unit Definitions are also re-characterized to systems

Existing MQ-8B Based System

- Aircraft
- Payloads
- UCARS
- Control System
- 8 of 56 Systems
- 24 Aircraft

Planned MQ-8C Based System

- Aircraft
- Payloads
- UCARS
- Control System
- 48 of 56 Systems
- 96 Aircraft

Existing MQ-8B Based System

- Aircraft
- Payloads
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- 8 of 56 Systems
- 24 Aircraft

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**What Have we Learned?**

**Endurance Upgrade Dynamic Interface computations:**

- Method for operators to quantify mission improvements.
- Defining aircraft deck motion will permit increased NATOPS deck limits leading to better aircraft availability and deck definitions.
- Having defined operational envelopes, DI strives to increase the UAS tactical flexibility.
- Increased confidence in computational DI will reduce need for extensive experimentation.