Facing the challenges of UAS Airworthiness and Airspace Integration

AAUS, RPAS in Australian Skies 2019, Canberra 17 July 2019

By Michael Allouche, IAI UAS Airworthiness Manager

PRESENTATION TOPICS

• Introduction
• Israel Aerospace Industries & its UAS Division at a glance
• IAI Heron MALE Family UAS Airworthiness & Airspace Integration Design Features
• IAI Airworthiness & Airspace Integration Ongoing Experience
• Conclusive thoughts and reflections
Michael Allouche - Personal Background

- Born in 1953 (France)
- In Israel since 1992
- 16 years professional experience in France
  - Autopilot design (SFENA)
  - Avionics Certification Manager at Airbus Industries (A320, first Fly By Wire commercial aircraft)
- 27 years professional experience at IAI
  - Galaxy (G200) Flight Control System (Stall Protection) Manager at Engineering Division
  - UAS Airworthiness Manager managing all activities leading to UAS Airworthiness Approvals from worldwide authorities
  - UAS Rule-making activities
    - EUROCAE UAS WG73 Airworthiness Leader (2008 - 2016)
    - EUROCAE UAS (new) WG105 Co-chairman since 2016
    - JARUS WG6 & WG3 SME
    - ICAO RPAS Panel Member
    - Israeli Expert at NATO UAS Airworthiness WG (STANAG 4671)

EUROCAE 2019 Award

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Israel Aerospace Industries

World Leading Aerospace Company

- Special mission and early warning aircraft
- Satellites and space systems
- Defense systems, missiles and loitering weapons
- Unmanned Aircraft Systems
- Radar and electronic intelligence
- Passenger-to-freighter aircraft conversions
- Business Aircraft (Civilian Certification)

IAI – MALAT (UAS) at a glance...

- Founded in 1974, first operational system in 1980
- RPAS design, development, certification and production
- IAI-MALAT Core capabilities
  - System Engineering and integration
  - Unmanned Aircraft Platforms Development and production
  - Ground Control Segments Development, production and integration
  - Payloads & Communications
  - C4I Systems
  - ILS At all levels & concepts
  - Flight and Ground testing
  - "Power by the Hour" flight services
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IAI – MALAT UAS FAMILY DESIGN SAFETY FEATURES

DRIVEN BY IN SERVICE EXPERIENCE: 1,500,000 flight hours, >350,000 flight hours for Heron UAS
HERON UAS Family Airworthiness Design Features

Unmanned Aircraft System Airworthiness

- **Emergency Recovery**
  - Pre-programmed capability
  - Predefined emergency sites
  - Autonomous Emergency Landing

- **Data Link**
  - Secure link
  - "Return Home"
  - Redundancy

- **Ground Segment**
  - Flight Safety Indications
  - Redundancies

- **System Safety & Risk Assessment**
  - Uncontrolled Crash Probability
  - Hazard Risk Matrix
  - Redundancies & Backup

- **Emergency Handling**
  - Engine Cut
  - Link Loss

  - Automatic Landing On Pre-programmed Safe Airfield or Site

  **AIM: AVOID UNCONTROLLED CRASH (WORST SEVERITY EFFECT)**
  - Safe Automatic Emergency landing
  - Due Coordination with ATC
  - Automatic ATC Transponder Emergency Code activation
**Heron UAS Family Airspace integration Features**

<table>
<thead>
<tr>
<th>ATC voice communications</th>
<th>IFF / ATC Transponder</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Voice relay (UHF/VHF)</td>
<td>✓ Civil mode III/A-C-S</td>
</tr>
<tr>
<td>✓ Direct GCS to ATC</td>
<td>✓ Automatic switch to emergency code (link loss)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anti-collision lights</th>
<th>Ground Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Navigation lights</td>
<td>✓ ATC constraints overlays</td>
</tr>
<tr>
<td>✓ Strobe light</td>
<td>✓ UAV position / navigation</td>
</tr>
<tr>
<td></td>
<td>✓ ATC transponder</td>
</tr>
<tr>
<td></td>
<td>✓ Squawk code control</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Forward vision camera</th>
<th>MPR Radar</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ See &amp; Avoid during Take Off &amp; landing phase</td>
<td>✓ Air to Air mode allows air threat detection</td>
</tr>
</tbody>
</table>

**Detect & Avoid**

- Cooperative (TCAS, ADS-B)
- Non Cooperative (Radar)

**DETECT AND AVOID FUNCTION**

DAA integration in Heron RPAS, based on emerging regulations & standards
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### IAI MALAT Ongoing Experience

- **IAI HERON UAS Family has been granted Airworthiness Approvals and certificates by worldwide military and civilian aviation authorities**
  - Israel (including from Civil Aviation Authority Israel)
  - France, Germany, Australia, Brazil, Ecuador, USA, Canada etc...

- **Airspace Integration demonstrations** (including with SATCOM) have been and are being successfully conducted in various types of environment and airspace e.g.
  - European Space Agency (in Spain)
  - Frontex (European Coast Guard (in Greece) – starting end of September 2018

- **Towards UAS Type Certification : German HeronTP Benchmark**

- IAI is actively participating in **International Rule-making process**
IAI MALAT OPERATIONS IN ISRAEL

<table>
<thead>
<tr>
<th>Military UAV Operations</th>
<th>Non Military UAV Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight Authorization / Certification</td>
<td>Under Israel Air Force Authority / Flight Safety Board</td>
</tr>
<tr>
<td>Civil Aviation Authority (CAA)</td>
<td>Special CoA</td>
</tr>
<tr>
<td>“Experimental” CoA</td>
<td>For various IAI Heron UAS models</td>
</tr>
<tr>
<td>Flight Plan Coordination</td>
<td>Military ATC</td>
</tr>
<tr>
<td>Civil ATC</td>
<td></td>
</tr>
<tr>
<td>Vertical &amp; Horizontal Separation Rules</td>
<td>Considering Israeli Airspace Management &amp; Classification</td>
</tr>
<tr>
<td>Military Separation Criteria</td>
<td>Civil Separation Criteria</td>
</tr>
<tr>
<td>CAAI Special Certificate of Airworthiness</td>
<td>Example: G-HERON training flights in Israel with CAAI registration “4X-UMK”</td>
</tr>
</tbody>
</table>

Unmanned Aircraft treated as other Manned Aircraft in the Airspace

CAAI Special Certificate of Airworthiness

- Granted to various Heron models

Example: G-HERON training flights in Israel with CAAI registration “4X-UMK”
IAI HERON UAS WORLDWIDE AIRWORTHINESS APPROVALS

- **Special Airworthiness Certificates** (for specific demonstration) e.g.
  - Australia (CASA)
  - Transport Canada
  - FAA
  - Greece
  - Spain
  - etc...

- **Airworthiness Certificates** (operation by foreign customer in relevant country) e.g.
  - French Heron Type Certificate (military DGA)
  - Canadian DND
  - Australian RAAF
  - German Heron (Military)
  - Brazilian Special Permit (civilian ANAC)
  - Singapore (Military)
  - etc...

Back to 2008 already: Heron Flight demonstration for Australian Border Protection Command

**CASA Approval including**
- Heron Special Certificate of Airworthiness
- IAI UA pilots and maintenance personnel
- Flights in Uncontrolled Airspace (Class G)
- ATC transponder / VHF Communications
- MPR (MMR) Air to Air Mode Credit
- NOTAM publication

New technology
Same Registration... 😊
HERON MILITARY FRENCH TYPE CERTIFICATE

First UAS Military Type Certificate already granted to IAI in Nov. 2010

HERON MILITARY FRENCH TYPE CERTIFICATE DATA SHEET

TCDS Contents

• Definition
• Certification basis
• Air Vehicle
  – Type Definition
  – Engine & Propellers
  – Maximal Weight
• Limitations
ROYAL AUSTRALIAN AIR FORCE - SPECIAL PERMIT

Category 2 UASOP granted in May 2015 -
“Heron may operate in any class of airspace with appropriate operational restrictions, including limited flight over populated areas”.

Heron flying from Civilian Airport of Rockhampton

German Heron Certificate of Airworthiness (2018)
Heron Flight Demonstrations in Europe

European Space Agency Conclusions (DeSIRE Project)
“The project has demonstrated that RPAS in BRLOS conditions relying on Satcom could timely proceed with ATC instructions/clearances in non-segregated airspace (civil controlled Class C), notably with a realistic separation exercise.”

Frontex, the European Border and Coast Guard Agency, has demonstrated the use of HERON Remotely Piloted Aircraft Systems (RPAS) in non-military controlled airspace (last quarter 2018) (Flight Permit by Hellenic CAA)

Frontex Demonstration in Crete – Sept. to Dec 2018
- Maritime Surveillance over sea and shores
- Operated from Tympaki HAF airbase
- Commanded by Hellenic Coast Guard
- 600 Flight hours
- 52 Flights, FL 050
- Mission time 8~18 Hours

- HCAA Flight Permit based upon
  - CAAI Special Certificate of Airworthiness
  - Submitted technical documentation of the system and the training certificates of the operating personnel

- Stepwise Airspace Operations in due coordination with ATC
IAI Participation in UAS-RPAS Rule Making Activities

MOD Certifying Authorities
- National Regulation & Requirements

NATO
Joint Capability Group UAS
UAV Control Specialist Team (ICAO/FAA/EURAS/ASTM/STANAG 4671)
- Sense and Avoid
- UA Pilot training & qualification

ICAO (International Civil Aviation Organization)
- UAS Study Group / RPAS Panels

Civil Aviation Authorities
FAA UAS Integration Office AF5-80 (USA)
EASA, Eurocontrol ATM (Europe)
National Authorities e.g. CASA Australia, ANAC Brazil, CAA Israel

JARUS
Joint Authorities for Rule-Making on Unmanned Systems
- International advisory forum & WGs of CAA experts co-chaired by EASA and FAA

R & D Projects (Civil & Military) Inputs
- e.g. EC SESAR, EDAMIDAS, FAA NASA DoD, In-House

Standard Organizations (UAS WGs)
- USA: RTCA SC 228 – 147, ASTM F-38
- Europe: EUROCAE WG105

IAI ACTIVE PARTICIPATION
- ICAO RPAS PANEL MEMBER
- EUROCAE UAS WG105 – CO-CHAIRMAN
  - IAI experts in various subgroups
- JARUS RPAS WGs & WG3 SUBJECT MATTER EXPERT
- RTCA UAS SC 228 Member
- R & D UAS Projects (SESAR, Airworthiness, Detect and Avoid...)

UAS-RPAS RULE-MAKING OVERVIEW – IAI INVOLVEMENT

- ICAO RPAS PANEL
  - Annex 8 Airworthiness (SARP – Standards & Recommended Practices) – new RPAS Parts
  - Airworthiness Manual update

- EASA New Drone Regulation (11-06-19) – Specific & Certified Categories
  - Inputs to previous EASA UAS Policy (though EC Project USICO)
  - Establishment of Acceptable Means of Compliance (though EUROCAE)

- JARUS Subject Matter Expert
  - WG3: CS-UAS preparation (CS-23 tailoring)
  - WG6: Safety
    - AMC “1309” EUROCAE-JARUS Conciliation Report
    - Specific Operational Risk Assessment Methodology (“SORA”)

- NATO USAR (UAS Airworthiness Requirements) Subject Matter Expert
  - Inputs to first French DGA USAR
  - Inputs to STANAG 4671 Editions
IAI G-HERON™ TYPE CERTIFICATION BENCHMARK

• Heron™ was subject to a successful detailed certification assessment against NATO STANAG 4671 (Uav System Airworthiness Requirements) by German Military Aviation Authority (GMAA) as a prerequisite for contract award

• Detailed Type Certification Program agreed with GMAA in accordance with NATO STANAG 4671 currently under process following contract award

• Heron™ Certification Assets can be used as a benchmark for future civil certification of IAI Heron RPAS family

Heron™ basic characteristics
• MTOW : 5400 kg
• Wingspan : 26 m
• Total length: 14 m

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CONCLUSIVE THOUGHTS AND REFLECTIONS
ON WORLD UAS RULE MAKING (1/2)

• Pragmatic Approach while preserving safety

• Stepwise confidence building process
  – “Crawl, Walk and... Run”

• Correct understanding of similarities but also differences
  between manned and unmanned aviation

CONCLUSIVE THOUGHTS AND REFLECTIONS
ON WORLD UAS RULE MAKING (2/2)

• Risk based approach
  – Operational versus Design Mitigations: the proper balance
  – “SORA” (or equivalent): promising methodology – harmonization issues?
  – Legacy System / In Service Experience

• Forthcoming regulatory challenges
  – Fully autonomous systems
  – Unmanned cargo aircraft

IAI, as a large aerospace company, will continue to bring its manned and unmanned
aviation expertise and experience in the World UAS Rule-making process
AN OLD ADAGE
and its applicability to the UAS Rule-Making World Community...

<table>
<thead>
<tr>
<th>QUOTE (*)</th>
<th>APPLICABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>The day is short,</td>
<td>YES</td>
</tr>
<tr>
<td>the work is much,</td>
<td>YES</td>
</tr>
<tr>
<td>the workers are lazy.</td>
<td>WHY? CERTAINLY NOT!...😊</td>
</tr>
<tr>
<td>the reward is great,</td>
<td>YES</td>
</tr>
<tr>
<td>and the Master is pressing</td>
<td>YES</td>
</tr>
</tbody>
</table>

(*) Talmud, Ethics of the Fathers 2, 15

THANK YOU