Helicopter R&D Infrastructure Data Needs

Presented to:

USHST Infrastructure Summit

Presented By:

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Helicopter Research at the FAA

• **Focus:** Certification of New Technologies, Standards for Continued Airworthiness, Occupant Protection, and Hazard Avoidance/Risk Mitigation, Training, etc.

• **Three Key Projects of Interest for Infrastructure:**
  – Helicopter Flight Data Monitoring Research for Aviation Safety Informal Analysis & Sharing (ASIAS)
  – Helicopter Advanced Vision Systems Research
  – Steep Angle Approach Criteria (TERPS)
Rotorcraft HFDM Research for ASIAS
Concept of Rotorcraft HFDM Research Repository for ASIAS

Participating Operators

Own-Access User

FAA, Sponsor
System Developer & Administrator

PEGASAS Research Team for Rotorcraft ASIAS

Rotorcraft ASIAS

Database
Analysis Toolkit
Interface & Display

Analysis Tools

Visualizations, Algorithms, Event Definitions

Secure System

De-identified Data Access User

All Missions
Flight Training
Charter
EMS
Oil/Gas
Logging
Police
News
Cargo Lift
…
Helicopter Advanced Vision Systems
Helicopter Advanced Vision Systems Concept of Operations

Visibility for the approach (Top View)

- EVS/CVS Vision
- Natural Vision
- MAP
- ATD
- Helipoint
- Final Course
- ATT

Visibility for the approach (Profile View)

- Visual Segment
- MDA
- EVS/CVS Vision
- MAP
- ATD
- Helipoint
- Natural Vision
Steep Angle Approaches (TERPS)
TERPS Operational Concept

Legend:
DA=Decision Altitude
FAF=Final Approach Fix
FHP=Fictitious Heliport
FTP=Fictitious Threshold Point
HCH=Heliport Crossing Height
TCH=Threshold Crossing Height
Common Theme - Data

• All 3 Projects have demonstrated the need for Accurate and Reliable:

Heliport Infrastructure Data!!!
HELIPORT INFORMATION

FAA Airport Master Record (5010 Database)
FAA Airport Master Record 5010

- Designed for Airports not Heliports
- Limited Heliport information collected
- Not intuitive to find information
- Prone to inaccuracies
- Does not include all U.S. heliports
Case Study: NJ Heliports Not in FAA 5010 Database

• Looked at NJ Heliports and Helipads
• Found 4 Facilities that we perform flight testing @ within a 25 nm radius of KACY not in database:
  – NJ State Police Troop A Helipad
  – Hammonton Health Park
  – Inspira Hospital Southern New Jersey
  – Trump Taj Mahal (former casino)
• There are others…
NJ State Police Troop “A” Helipad
AtlanticCare Hammonton Health Park
Inspira Medical Center
Trump Taj Mahal (former casino)
Heliport/Helipad Diagram

Note: Layout diagrams should be drawn to scale with key dimensions shown such as TLOF size, FATO size, Safety Area size, distances from safety area perimeter to property edges, etc.
• 4. An acceptable evaluation of the visual segment for flyability, obstacles, and visual references must be completed in both day and night flight conditions. The heliport or heliport visual references must be in clear view at the MAP, e.g., it cannot be completely obscured behind a building. A heliport is the area of land, water or a structure used or intended to be used for the landing and takeoff of helicopters, together with appurtenant buildings and facilities. Buildings and facilities associated with the heliport such as hangers, administration buildings, AWOS equipment, windsock, beacon, etc. located within 500 ft are acceptable visual references. Surrounding buildings and landmarks are not allowable visual references, unless approved by Flight Standards. At least one of the following visual references must be visible or identifiable before the pilot may proceed visually:

a. FATO or FATO lights.
b. TLOF or TLOF lights.
c. Heliport Instrument Lighting System (HILS).
d. Heliport Approach Lighting System (HALS) or lead-in lights.
e. Visual Glideslope Indicator (VGSI).
f. Windsock or windsock light(s).*
g. Heliport beacon.*
h. Other facilities or systems approved by Flight Standards (AFS-400).

*Note: Windsock lights and heliport beacons should be located within 500 ft of the TLOF.
Current 5010 Heliport Information Placement

- TLOF Length: Currently stored in A31 (Runway Length)
- TLOG Width: Currently stored in A32 (Runway Width)
- Maximum Gross Weight: Currently stored in A35 (Runway GW)
- Surface Type: Currently stored in A33 (Runway Surface-Cond)
- FATO Length: Currently not stored.
- FATO Width: Currently not stored.
- Helipad Location(Ground/Elevated): Currently not stored.
- Variation: Currently not stored.
- Preferred Approach/Departure Path: Currently not stored.
- Maximum Rotor Diameter: Currently not stored.
- Hazards: Currently not stored.
- Address: Currently stored in A12 (Owner’s Address)
## 5010 Form Proposed Changes

### Heliport Data

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touchdown &amp; Liftoff Area (TLOF)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Gross Weight (MGW)</td>
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<td></td>
</tr>
<tr>
<td>Surface Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Approach &amp; Takeoff Area (FATO)</td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Ground</th>
<th>Elevated</th>
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<tbody>
<tr>
<td>Helipad Location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variation</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Approach</th>
<th>Depart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preferred Approach/Departure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Rotor Diameter</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Hazards</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>Address1</td>
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</tbody>
</table>

### Address

<table>
<thead>
<tr>
<th>Description</th>
<th>City</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address1</td>
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<td></td>
</tr>
</tbody>
</table>
Why is This Important?

• Promote Safe Operations

• Prevent Unsafe Operations & Accidents
Proximity to Obstacles – Safety Metric

- **Closure Distance to Obstacle (feet)**
- **Time steps**
- **Closure Speed (knots)**
- **Helicopter Speed**
- **Proximity to Obstacles**
- **Speed vector**
- **Closure speed**
- **N (lat,long)**
- **E (lat,long)**
- **Federal Aviation Administration**
- **Aviation Research Division, ANG-E**
- **FOR OFFICIAL USE ONLY**
Unstabilized Approach Safety Metric

- Calculate the approach angle and the distance of helicopter from the “virtual touchdown” point at each point along the approach trajectory

Accumulated Path distance: \[ \int_A^B ds \]
At B distance = 0

\[ ds = V_g \, dt \text{; path distance} \]
\[ dh = V_v \, dt \text{; vertical distance} \]

\[ \theta = \tan^{-1} \left( \frac{|V_v|}{|V_g|} \right) \text{; approach angle} \]
Risk of Helipad Overrun (Energy-Based) Safety Metric

$$\begin{align*}
\epsilon_k &= \frac{1}{2} m (V_g^2 + V_v^2) \\
\epsilon_p &= mgh
\end{align*}$$

Helicopter Performance

Kinetic Energy

Potential Energy
Required Data for computing all metrics:
1. FDM data: altitude, groundspeed, vertical speed, latitude, longitude, glide slope (calculated), and distance traveled (calculated).
2. Airports/helipads data (FAA): latitude, longitude, elevation, etc.
3. Runway database: latitude, longitude, helipad dimensions, etc.
Mobile Helicopter Safety Applications that Require 5010 Database Information

- ForeFlight
- LZControl
- HADRAS
- Garmin Pilot
- B4UFly

General Aviation Airborne Recording Device (GAARD) Application for use by Helicopters Helicopter Airborne Data Recording and Analysis System (HADRAS) – Developed by MITRE and FAA
Recommendations

• Update the Information Collected on the 5010 Form to include additional safety data
• Re-organize the data storage/database fields so queries are more transparent and heliport focused rather than aircraft focused
• Automate 5010 form data collection/submission (i.e. web-based) and establish an error-checking process to mitigate issues
• Look into closer collaboration with State Agencies (i.e. NJDOT) that maintain their own repositories
• Work with developers of mobile safety applications
Discussion/Questions?