DETECT, MONITOR, REACT

PRACTICAL APPLICATIONS OF UNMANNED AERIAL SYSTEMS IN GEOHAZARD RISK MITIGATION
END-TO-END UAS COMPANY

• History and mission
• Services
  • Critical infrastructure inspections
  • Crisis response
• Training
• Software
UAS LIMITATIONS

REGULATORY

• Beyond visual line of sight
• Night flight

TECHNOLOGY

• Automation
• LIDAR
• 3D photogrammetry
• Observation only
HAZARD IDENTIFICATION

• Detection involves periodic collection of data in at risk environments analyzed relative to specific hazard thresholds
  • Data collection
  • Data analysis
  • Comparison to hazard thresholds

• Implied requirement:
  • Hazard criteria must be defined clearly or assessed by a subject matter expert

• UAS advantages
  • Unique vantage points and angles, safety of personnel
HAZARD IDENTIFICATION

- Targets for detection
  - Landslide / rockfall
    - Slope angle, slope loading, volumetric measurement
  - Debris flow barriers
  - Rock netting / drapery
  - Symptoms of subterranean or manmade geohazards
    - Sinkholes
    - Improperly installed fill / foundation
TECHNIQUES

• High mega-pixel still frame or HD (4k) video
• Infrared still frames or video
  • Subsurface water identification (rail ballast)
• 3D mapping
  • Interactive 3D maps
  • Contour line maps
  • Volumetric measurement
• Most useful when periodically repeated
  • Provides context which amplifies data
MONITORING POTENTIAL GEOHAZARDS

• Differs from detection in that a risk has been identified and assessed
• Techniques remain the same, frequency of observation increases relative to risk level
• Risk is measured in
  • Likelihood of realization
  • Severity relative to safety
  • Severity relative to throughput (operational risk)
<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Likely to occur, immediately or within a short period of time.</td>
</tr>
<tr>
<td>B</td>
<td>Probably will occur in time.</td>
</tr>
<tr>
<td>C</td>
<td>May occur in time.</td>
</tr>
<tr>
<td>D</td>
<td>Unlikely to occur, but not impossible.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Severity</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Complete closure. Death or permanent total disability. Loss of a critical system or equipment. Major facility damage. Severe environmental damage.</td>
</tr>
<tr>
<td>II</td>
<td>Significantly degraded throughput. Severe injury. Extensive damage to equipment or systems. Significant damage to property or the environment.</td>
</tr>
<tr>
<td>III</td>
<td>Decreased throughput. Minor damage to equipment. Minor injury or illness.</td>
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<tr>
<td>IV</td>
<td>Little impact on throughput. Minimal threat to safety. Slight equipment or systems damage.</td>
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<tr>
<td>Risk Likelihood</td>
<td>I</td>
</tr>
<tr>
<td>-----------------</td>
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</tr>
<tr>
<td>A</td>
<td>EXTREME</td>
</tr>
<tr>
<td>B</td>
<td>HIGH</td>
</tr>
<tr>
<td>C</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>D</td>
<td>LOW</td>
</tr>
</tbody>
</table>
UAS IN CRISIS RESPONSE

• Techniques
  • Safety assessment for first responders and on-scene engineers
  • Direct observation
    • High megapixel still frames
    • HD (4k) video
    • Live streaming to key stakeholders / decision makers
  • 3D mapping
    • Volumetric measurement of debris
CAPABILITY VS REACTION TIME

- Increased capability is likely directly proportional to reaction time
  - More sophisticated techniques (live streaming / 3D mapping) requires
    - Increased training and equipment
    - Generally associated with low density / centralized assets and personnel
  - Less sophisticated capability (direct observation tools)
    - Can be widely distributed / high density
REACT

CAPABILITY

REACTION TIME
INTEGRATING UAS INTO YOUR ORGANIZATION

- Define requirements
  - High density / low capability vs low density / high capability
  - Mixture
  - Outsourcing
- Develop program structure (internal leadership)
- Source equipment and training
  - FAA Part 107 training
  - Hands-on flight training
- Monitor flight operations, recurrent training, results
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