Drones: Cost-Effective Roof/Facade Evaluations Using Unmanned Aircraft Systems (UASs)

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History

- One of the first recorded uses was by Austrians in July 1849.

- 1898 Spanish-American War when the U.S. military fitted a camera to a kite, producing one of the first aerial reconnaissance photographs.
History

► The term “drone” originated from the British produced unmanned radio controlled aircraft in 1935 that were used as anti-aircraft practice targets

► A Lightning Bug Drone was used during the Vietnam war, it was one of the first drones used for surveillance by the USAF
History

- Whatever the size of the drone, they all perform the same functions:
  - Providing intelligence, surveillance, reconnaissance (ISR) via photographs and/or videos
  - Rescue missions
How Does a (sUAS) Drone Work?

An unmanned aerial vehicle system has two main parts: drone itself and control system. Majority of (sUAS) are used by hobbyists. Multi rotor drones (commercial use) are inherently unstable and require an on-board computer to stabilize flight.
Roll, pitch, yaw, and thrust can be changed by speeding up or slowing down:

- **Roll** - moves the UAS side to side
- **Pitch** - moves the UAS forward or backwards
- **Yaw** - changes the direction the UAS faces

**History**
FAA Regulations

- 2015 - FAA created regulations and rules for drone use due to safety concerns.
- Ch 14 CFR - Part 107
- Certification was originally required for hobbyist and for commercial pilots (Pilot Certificate).
  - As of 2017 certification is only required for commercial pilots.
# The rules for operating an unmanned aircraft.

<table>
<thead>
<tr>
<th></th>
<th>Fly for Fun</th>
<th>Fly for Commercial Use</th>
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</thead>
<tbody>
<tr>
<td><strong>Pilot Requirements</strong></td>
<td>No pilot requirements</td>
<td>Must have Remote Pilot Airman Certificate</td>
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<tr>
<td></td>
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<td>Must be at least 16 years old</td>
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<td></td>
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<td>Must pass TSA vetting</td>
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<tr>
<td><strong>Aircraft Requirements</strong></td>
<td>Must be less than 55 lbs.</td>
<td>Must be less than 55 lbs.</td>
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<td></td>
<td>Aircraft does not need to be registered.</td>
<td>Must be registered if over 0.55 lbs. (online)</td>
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<td>Must undergo pre-flight check to ensure UAS is in condition for</td>
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<td>safe operation</td>
</tr>
<tr>
<td><strong>Location Requirements</strong></td>
<td>5 miles from airports without prior notification to airport and air traffic control</td>
<td>Class G airspace*</td>
</tr>
<tr>
<td><strong>Operating Rules</strong></td>
<td>Must ALWAYS yield right of way to manned aircraft</td>
<td>Must keep the aircraft in sight (visual line-of-sight)*</td>
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<tr>
<td></td>
<td>Must keep the aircraft in sight (visual line-of-sight)</td>
<td>Must fly under 400 feet (elevation)*</td>
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<td>Must follow community-based safety guidelines</td>
<td>Must fly during the day*</td>
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<td>Must notify airport and air traffic control tower before flying within 5 miles of an airport</td>
<td>Must fly at or below 100 mph*</td>
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<td></td>
<td>Must NOT be physiologically impaired</td>
<td>Must yield right of way to manned aircraft*</td>
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<td></td>
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<td>Must NOT fly over people*</td>
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<td></td>
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<td>Must NOT fly from a moving vehicle*</td>
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<tr>
<td></td>
<td></td>
<td>Must NOT be physiologically impaired</td>
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<tr>
<td><strong>Example Applications</strong></td>
<td>Educational or recreational flying only</td>
<td>Flying for commercial use (e.g. providing aerial surveying or</td>
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<td>photography services)</td>
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<td>Flying incidental to a business (e.g. doing roof inspections or</td>
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<td>real estate photography)</td>
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<tr>
<td><strong>Legal or Regulatory Basis</strong></td>
<td>Public Law 112-95, Section 336 - Special Rule for Model Aircraft</td>
<td>Title 14 of the Code of Federal Regulation (14 CFR) Part 107</td>
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<tr>
<td></td>
<td>FAA Interpretation of the Special Rule for Model Aircraft</td>
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</table>
- Commercial sUAS pilots typically operate in Class G Airspace
- Class G airspace extends from the surface to the base of the overlying Class E airspace
- A remote pilot will not need ATC authorization to operate in Class G airspace
The FAA has an automated air space waiver program (LAANC) for all other airspaces, is fully operational by fall 2018. Above is an example of flight limits around Logan Airport. Area’s showing a limit of 0, will require a formal request thru the FAA which can take up 90 days.
Drone Capabilities

- Aerial photography
- Aerial Thermography
- Laser Scanning for As-Builts
- 3D Mapping
- Facade Condition Studies
- Allows Focus on Actual Issues
- Storm Damage Assessments
- Bridge Inspection
Facade Inspection Methods

- Typically use ladders, lifts, hoists, rope access or swing staging
- These methods are time consuming and expensive
- The more complex the configuration, the more expensive
Binocular Inspection
Man Lift
Swing Staging
Rope Access Methods
Smart Unmanned Aircraft Systems (sUAS) - Drones
Avoids Expensive Access Methods

- Allows access to hard to reach locations
- Up to 400 feet above the structure*
## Costs for Traditional Access Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Average Costs for Evaluation Use</th>
<th>Limitations</th>
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<tbody>
<tr>
<td>Binoculars</td>
<td>$135/hour</td>
<td>No ability to capture images observed for later use.</td>
</tr>
<tr>
<td>High Reach Equipment</td>
<td>$2,500/120’ lift per week (not including operator or engineer)</td>
<td>Costly, coordination with facility operations critical, potential for mechanical failure. Tremendous attention to safety.</td>
</tr>
<tr>
<td>Swing Stage</td>
<td>Initial installation $2,000, Relocate for each drop $1,200 (if on same building level), $1,000 per drop for operator and engineer</td>
<td>Costly, coordination with facility operations critical, Delay in observation due to mobilization and relocation of staging for each drop.</td>
</tr>
<tr>
<td>Helicopter</td>
<td>$1500 to $2000 per hour.</td>
<td>Weather and FAA Clearance</td>
</tr>
</tbody>
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| Drone              | The average cost for drone survey is approximately $3,000-$4000 total (this includes pilot, engineer and report). Exact price may vary depending on your area and project details. | FAA Regulations, Battery Life, Weather (wind, rain, etc.) }
Overall View of an Entire Site
Photos for Design and Renderings
Infrared Thermography for Moisture or Air Leakage
Aerial View for Paving Analysis
Roof/Masonry Inspection
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Roof/Masonry Inspection
Roof/Masonry Inspection
Roof/Masonry Inspection
Roof/Masonry Inspection
Roof Inspections of Areas Not Visible From Grade
Aerial Views for Measure Ups
Evaluation after a Major Weather Event

- FAA issued 137 authorizations to local, state and federal agencies for support to Hurricane Harvey Recovery
- Insurance, utility, and AE firms used drones to assess damage
Storm Damage Assessment

- Quickly assess damage to facilities
- Easy access
- Minimal safety issues
Additional Uses

- Amazon announced it was exploring using drones to deliver packages in 2014
- Exploration of delivering medicine
- Law Enforcement & Emergency Rescue
  - Used to deliver life jackets to flood victims
  - Use IR on Drones for Search & Rescue
  - Disaster Relief
- Real Estate Surveys
- Mining and Oil - Site Assessments and Geological Mapping
- Used in Africa for Anti-Poaching Missions
- Agriculture - Crop Monitoring
Conclusion

“The Drone Age” is here to stay

- They inspect hard to reach places
- They can be deployed quickly
- They are popular - multiple uses
- They are spreading
- Evaluating building enclosures can be performed annually at lower costs