

Drones

By Steven M. Schorr, P.E.

**D**rone data makes documenting and analyzing a specific event more accurate and thorough and offers more comprehensive, compelling trial exhibits when operators use drones within the legal parameters.

# The Chronology of Another Potential New Technology in the Investigation and Reconstruction of Vehicle Collisions

As has been noted (by this author and others), technological advances forge ahead without regard to whether we want to move along with them. Over the years, readers have been introduced to (and reminded of) technologies

that can potentially help in the collection or evaluation or both of data pertaining to the reconstruction of vehicle collisions, including collisions involving heavy vehicles. These technologies range from readily available programs on the internet such as Google Earth, to data collection technologies such as total-station surveying, 3D laser scanning (*i.e.*, robust 3D measurements); 3D photography and video; computer programs that enhance photographs and videos so that accurate measurements

can be captured from still images and surveillance videos; continually evolving vehicle event data technology including GPS data, video data and data from various control modules on a vehicle, including, but not limited to those that monitor, vehicle speed, acceleration and deceleration, and steer angles; physics-based reconstruction programs that allow engineers to simulate real-world movement of people and vehicles within an accurate 3D “virtual” environment; and complex technologies such



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as finite element analysis, which analyzes forces acting on objects. One of the newer technological advances presently being utilized in the forensic field, and many other disciplines, is the use of unmanned aerial vehicles, a.k.a. drones.

### What Is a “Drone”?

A drone, otherwise known as an unmanned aerial vehicle (UAV) or unmanned aircraft system (UAS), is an aircraft that flies without a pilot onboard. The term “drone” implies autonomous flight, meaning that the aircraft can complete a task or “mission” without onboard human control. That is, a drone (or UAV or UAS) can be flown by preprogrammed flight paths, using GPS data, on-board computers, and other sensors. Alternatively, the drone, UAV, or UAS can be flown manually, via a remote transmitter, by a pilot who is on the ground, taking either a line-of-sight approach or using a first-person view (FPV) system, in which the operator flies the aircraft based on a live feed of what the drone “sees” via an onboard camera. Drones are frequently utilized to carry cameras, video cameras, or 3D laser scanners into areas not accessible by terrestrial equipment. The ability of a drone to fly over an incident area and to collect data from otherwise inaccessible areas due to their location or height is unprecedented. Drones are considered to be the “next level” of data collection. Drones come in many different sizes, which make them an even more valuable tool.

### Present Utilization

The United States government (and some private firms working with the government) is presently using unmanned aircraft under controlled conditions such as performing border and port surveillance by the Department of Homeland Security; helping with scientific research and environmental monitoring by NASA and the National Oceanic and Atmospheric Administration (NOAA); supporting public safety by law enforcement agencies; helping state universities conduct research; and supporting various other missions for other public government entities. The operating areas for these unmanned aircraft range from ground level, to above 50,000 feet, depending on the specific type of unmanned aircraft. Presently, drone,

UAV, or UAS operations are currently not authorized in Class-B airspace, the airspace which is located over major urban areas and contains the highest density of manned aircraft in the National Airspace System (NAS).

One of the simplest, lowest-cost drone technologies is a digital camera, which takes photographs and records video. More highly priced technologies include inertial measurement units (IMUs), which are electronic devices that measure and report a craft’s velocity, orientation, and gravitational forces using a combination of accelerometers, gyroscopes, and sometimes magnetometers. Another higher-priced technology is “Light Detection and Ranging” (LiDAR), the remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light (laser scanning to collect accurate, three-dimensional data). Also, companies such as Amazon and Google are attempting to clear regulation hurdles to use drones for the delivery of packages and other activities. The popularization of the attempts of Amazon and Google to take advantage of this technology for larger-scale purposes has somewhat overshadowed the use of drones for data collection of all types.

In the forensic field, police departments and private firms are taking aerial images (still and video) of collision scenes and sites, as well as aerial images of vehicles. The manner in which the data is captured can lead to the development of accurate, to-scale, 3D models. This alternate method of data collection provides access to areas previously unreachable from a stationary position on the ground.

### Legislative History

The proliferation of unmanned aerial objects within U.S. airspace has created potential safety concerns and privacy concerns. As such, legislation aimed to integrate drones has been slowly developing (similar to what occurs with any new technology).

#### February 2012

The FAA Modernization and Reform Act of 2012 (FMRA), Sections 331 through 336, dictated by Congress, specified what the Federal Aviation Administration (FAA) can (and cannot) do with respect to drone regu-

lation. The FMRA contained certain drone-specific language that applied to the general public *at some point in the (then) future*, but it did not apply to the general public at that time. In 2012, Congress proposed legislation in the FMRA, Section 336, which read:

The “Federal Aviation Administration may not promulgate any rule or regulation regarding a model aircraft, or

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an aircraft being developed as a model aircraft,” if the aircraft is flown strictly for hobby or recreational use; if the aircraft is operated in accordance with a community-based set of safety guidelines and within the programming of a nationwide community-based organization; if the aircraft is limited to not more than 55 pounds unless otherwise certified through a design, construction, inspection, flight test, and operational safety program administered by a community-based organization; if the aircraft is operated in a manner that does not interfere with and gives way to any manned aircraft; and if when flown within 5 miles of an airport, the operator of the aircraft provides the airport operator and the airport air traffic control tower (when an air traffic facility is located at the airport) with prior notice of the operation (model aircraft operators flying from a permanent location within 5 miles of an airport should establish a mutually-agreed upon operating procedure with the airport operator and the airport air traffic control tower (when an air traffic facility is located at the airport)).

The section defined a model aircraft as an unmanned aircraft that is capable of

sustained flight in the atmosphere, flown within visual line of sight of the person operating the aircraft, and flown for hobby or recreational purposes. Section 336 provided “safe harbor” to pilots while flying strictly for hobby or recreation, as long as all of the conditions set forth above were met. These guidelines became the foundation of the regulations that followed.

Even in February of 2015, most individuals were cognizant that the rules were not the law and were subject to change. Additionally, it was understood that the proposal process was typically long and sensitive to public input.

Since the FAA considered “model aircraft” to be “aircraft,” then, arguably, it followed that all Federal Aviation Regulations, even those that could not logically apply to an unmanned aircraft, would apply to drones, and the FAA could use any of those regulations for enforcement purposes. To address this, the FAA then created *new* regulations pertaining to drones flown for hobby or recreational purposes, which Congress previously *expressly* had prohibited in Section 336 of the FMRA.

#### June 2014

The FAA issued an interpretation of Section 336’s Special Rule for Model Aircraft, which noted the following:

- Compensation of any sort was banned. The FAA claimed that flying a drone in a manner that was “in furtherance of a business” was illegal, although, as previously noted, there were no current (at the time), technically enforceable statutes or regulations that forbade it since the FMRA did not apply to the general public.

- The drone, UAV, or UAS operator’s (the pilot’s) own eyes must be able to see the aircraft at all times while the aircraft was in operation. Operating the aircraft using “first person view” (FPV) was prohibited. That means that the operator cannot use goggles or any modern “watch it on a monitor” system to fly, or use a second person with a separate controller.
- Flights within five miles of any airport could be denied. Providing “notice” alone, according to this interpretation, was no longer sufficient. It was necessary to provide prior notice to air traffic control (ATC) or airport operations whenever flight might occur within five miles of any airport, heliport, or other landing area, and the ATC could then deny access to that location. Interestingly, since this interpretation didn’t specify the size of the drone, theoretically someone had to call the ATC even if he or she was attempting to fly a small, 2-inch drone, UAV, or UAS several inches above the ground in his or her own yard, if the property was located within five miles of an airport, heliport, or other landing location.

#### August 2014

The 2014 FAA interpretation was presented for public review and received over 30,000 comments. In response to the public comments, three separate legal challenges to the FAA’s 2014 interpretation were filed in the D.C. Circuit Court of Appeals. These petitions for review argued that the interpretation was “arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law, in excess of statutory jurisdiction, authority, or limitations, and without observance of procedure required by law.” The court granted a motion for abeyance on the basis that the FAA had not yet reviewed the more than 30,000 public comments. Under the terms of the court’s grant of the Motion for Abeyance, the FAA was required to provide 90-day updates on its comment review process. As of February 12, 2016, the FAA had stated that it had not even begun to analyze the public comments.

#### November 2014

The National Transportation Safety Board (NTSB) determined that drones are “aircraft” as the word is defined by federal

statutes and regulations. As such, Federal Aviation Regulation (FAR) 91.13, which, in part, reads “[n]o person may operate an aircraft in a careless or reckless manner so as to endanger the life or property of another,” applies. Effective as of January 2016, the *enforceable* federal statutes or regulations that apply to the public included FAR 91.13 (as noted above); restrictions upon all aircraft that prohibited flight within certain airspace; and, effective December 21, 2015, the Interim Final Rule of 14 C.F.R. Part 48, “Registration and Marking Requirements for Small Unmanned Aircraft.”

#### February 2015

On February 15, 2015, the FAA issued a small drone notice of proposed rulemaking (NPRM), entitled, “Operation and Certification of Small Unmanned Aircraft Systems.” The proposed rule would permit drone operation for non-hobby and non-recreational uses, thereby allowing, by regulation, commercial drone and non-hobbyist operations under certain conditions. The proposal had some potentially significant limitations in that drones could not be flown over “non-involved” people, and they could not be flown to distances greater than those which would permit the drone operator to see the drone at all times. As such, impermissible activities include the following:

- Night operation;
- “Beyond line-of-sight” drone operations (such as long distance drone delivery services);
- Flights conducted within Class-B, C, D, and E airspace (unless cleared by air traffic control).

Even in February of 2015, most individuals were cognizant that the rules were not the law and were subject to change. Additionally, it was understood that the proposal process was typically long and sensitive to public input.

For the unmanned aircraft, at the time the FAA considered the following proposals, among others:

- An FAA-airworthiness certification would not be required.
- The drone must be maintained in condition for safe operation, and before each flight, it must be inspected to ensure it is in a condition for safe operation.

- Aircraft registration would be required in the same manner that applies to all other aircraft.
- Aircraft markings would be required in the same manner that applies to all other aircraft, but if the aircraft is too small to display markings in standard size, then the aircraft simply would need to display markings in the largest practicable manner.

The FAA also considered these proposals for an operator at the time:

- An operator must be at least 17 years old.
- An operator must pass an initial aeronautical knowledge test at an FAA-approved knowledge testing center.
- He or she must be vetted by the Transportation Security Administration.
- An operator must obtain an “unmanned aircraft operator certificate” with a “small drone rating,” which never expires.
- He or she must pass a recurrent aeronautical knowledge test every 24 months.
- An operator must make available to the FAA, upon request, the drone for inspection or testing, and any associated documents/records required to be kept under the proposed rule.
- An operator must report an accident to the FAA within 10 days of any operation that results in injury or property damage.

Proposals related to the operation of an unmanned aircraft that the FAA considered included the following:

- An unmanned aircraft must weigh less than 55 lbs.
- It must remain within visual line of sight of the operator or visual observer.
- It must remain close enough to the operator for the operator to be able to see the aircraft with vision unaided by any device other than corrective lenses.
- It may not operate over any persons not directly involved in the operation.
- An unmanned aircraft may only be operated from official sunrise to official sunset (local time).
- It must yield the right-of-way to other aircraft, whether manned or unmanned.
- Unmanned aircrafts may, but are not required, to use a visual observer.
- An unmanned aircraft may be flown using “first-person view,” but either the operator or the visual observer must maintain an unenhanced visual line of sight of the craft.

- It may be flown at a maximum airspeed of 100 mph (87 knots).
- It may be flown at a maximum altitude of 500 feet above ground level.
- An unmanned aircraft may be flown in minimum weather visibility of three miles from the operator.
- Unmanned aircraft may not be flown in Class A (18,000 feet and above) airspace.
- They may be flown in Class-B, C, D, and E airspace with ATC permission.
- They may be flown in Class-G airspace without ATC permission.
- They may not be flown carelessly or recklessly.
- They require a pre-flight inspection before each flight, including specific aircraft and control station systems checks, to ensure that the drone is safe for operation.
- An unmanned aircraft may not be flown by a person if he or she knows, or has reason to know, of any physical or mental condition that would interfere with its safe operation.
- No person may act as an operator or visual observer for more than one unmanned aircraft operation at one time.

Some state and local governments passed legislation that attempted to regulate drone flight. Legal scholars noted that if they were challenged in a court, any such laws would be considered *preempted* by the federal government’s intent to control the airspace and would therefore be invalid. Legal scholars pointed out that by federal statute, the United States government had exclusive sovereignty over the airspace of the United States. The passage of the FMRA confirms the federal government’s intent to continue to control the airspace, thereby invalidating any state or local laws that attempt to regulate it. With that said, state and local governments may regulate any of their own agencies’ drone flight operations, and they may regulate the locations on the ground from which drones may be launched, landed, or operated. State and local governments may also invoke other laws (*i.e.*, voyeurism, reckless endangerment, nuisance, for instance) to prohibit certain drone, UAV, or UAS activity.

On December 17, 2015, the FAA released a fact sheet on state and local regulations, which provided to state and local officials

insight into the FAA’s stance on federal preemption of state and local laws with respect to the regulation of flight.

### December 2015

Effective December 21, 2015, all persons, 13 years of age and older, who operate drones for hobby or recreation had to register themselves with the FAA if the drones that they operate weighed more than approximately one-half pound (0.55 pounds) but less than 55 pounds. Drone owners who operated their aircrafts before December 21, 2015, were granted until February 19, 2016, to register. Those who purchased their drones on, or after December 21, 2015, were required to register themselves before conducting their first outdoor flight.

Drone operator registration required a registrant to provide the FAA with the registrant’s full name, home address, and e-mail address, and he or she had to acknowledge his or her intent to follow certain well-known safety guidelines to complete the registration. The FAA charged \$5.00 for the registration, and it had to be renewed every three years.

The Drone Authority Small Unmanned Aircraft System registry is the result of the FAA’s Interim Final Rule of 14 C.F.R. Part 48 and is an online, web-based system. Those who operate their drones for any reason other than hobby or recreation *may not* register their drones using the online, web-based system but have to, instead, register their drones using the existing paper-based system of Part 47.

The penalties for a person operating a drone if the person was not registered were significant and included civil penalties up to \$27,500, and, if it was warranted, criminal penalties of up to \$250,000 and three years in prison. Exactly how the FAA planned to enforce the registration requirements was unknown. The FAA released an enforcement paper (UAS Enforcement Q&A) and other guides for local law enforcement agencies to address the enforcement issue.

Interestingly, drone, UAV, or UAS operator registration required the registration of persons, as opposed to the unmanned aircraft. Legal scholars argued that the regulations noted that the FAA “shall” register aircraft, but no statute permitted the FAA

to register persons. During the registration process, drone operators were required to acknowledge their *intent* to abide by certain voluntary safety guidelines. The safety guidelines suggested during the registration included the following:

- Don't fly above 400 feet above ground level.
- Don't fly beyond visual line of sight.

## Federal agencies must

publish information within one year describing how to access their drone policies and procedures. Agencies must examine their drone policies and procedures before deploying new unmanned aircraft technology, and then at least every three years.

- Don't fly in areas that are under Temporary Flight Restrictions.
- Don't fly directly over people.
- Don't fly over stadiums or sporting events.
- Don't fly near emergency response efforts, such as fires.
- Don't fly near airports or manned aircraft.
- Don't fly while under the influence.

Again, although all of the above caveats might have amounted to sensible guidance, they were technically not regulatory in nature. They were, at the time, "suggestions" about what the FAA believed that drone operators should not do.

### Section 333 Exemption

Until August 29, 2016, those who wished to fly a drone, UAV, UAS commercially, with the FAA's approval, could petition the FAA for a Section 333 exemption. If the peti-

tion was granted, an operator could fly the exempted aircraft commercially, albeit with restrictions. Legal scholars noted that this was not the original intent of Section 333. The original intent, as defined by the actual language of the section, was for the FAA Administrator to determine *which types of drones* could be operated safely in the NAS before the final rule was adopted. The original intent was not to have the FAA Administrator determine on a case-by-case basis who was entitled to use the aircraft commercially.

FMRA Section 333 reads:

SEC. 333 SPECIAL RULES FOR CERTAIN UNMANNED AIRCRAFT SYSTEMS.

(a) IN GENERAL—Notwithstanding any other requirement of this subtitle, and not later than 180 days after the date of enactment of this Act, the Secretary of Transportation shall determine if certain unmanned aircraft systems may operate safely in the national airspace system before completion of the plan and rulemaking required by section 332 of this Act or the guidance required by section 334 of this Act.

(b) ASSESSMENT OF UNMANNED AIRCRAFT SYSTEMS—In making the determination under subsection (a), the Secretary shall determine, at a minimum—(1) which types of unmanned aircraft systems, if any, as a result of their size, weight, speed, operational capability, proximity to airports and populated areas, and operation within visual line of sight do not create a hazard to users of the national airspace system or the public or pose a threat to national security; and (2) whether a certificate of waiver, certificate of authorization, or airworthiness certification under section 44704 of title 49, United States Code, is required for the operation of unmanned aircraft systems identified under paragraph (1).

(c) REQUIREMENTS FOR SAFE OPERATION—If the Secretary determines under this section that certain unmanned aircraft systems may operate safely in the national airspace system, the Secretary shall establish requirements for the safe

operation of such aircraft systems in the national airspace system.

According to the FAA, the Section 333 Exemption Portal permits the Secretary of Transportation to exempt a petitioner from certain existing FARs before future drone regulations are finalized if a petitioner meets the following conditions:

- The petitioner can demonstrate that existing FARs burden them;
- The petitioner can provide a level of safety that is the same or greater than the regulation from which an exemption is sought; and
- The petitioner's request is in the public interest.

In making that determination, the Secretary of Transportation considers:

- What type of drone is it?
- How big is the drone?
- How fast can it fly?
- What can it do and not do (flight capability-wise)?
- How close would it be flying to airports?
- How close would it be flying to populated areas?
- Will the drone operator be able to see it at all times?
- Will it create a hazard to the NAS?
- Will it create a hazard to the public?
- Will it pose a threat to national security?

If the FAA granted an exemption, the holder was still subject to certain restrictions, including the need for an airman certificate. The FAA policy (at the time) stated that the certificate may be an airline transport, commercial, private, recreational, or sport-pilot certificate, as opposed to the private pilot certificate previously required. The drone operator also needed to (at the time) hold either a current FAA airman medical certificate or a valid U.S. driver's license. Previously, an airman medical certificate was required. Under the *new* policy statement, the FAA would grant a "blanket" Certificate of Waiver or Authorization (COA) that could be exercised "anywhere in the country except restricted airspace and other areas, such as major cities, where the FAA prohibits UAS operations." The blanket COA could be granted to any drone operator who had been granted a Section 333 exemption, as long as the drone weighed less than 55 pounds, was flown at or below 200 feet, was operated during daytime Visual Flight Rules (VFR) conditions,

was operated within the visual line of sight (VLOS) of the drone operator, and was operated at certain distances away from airports, heliports, or designated landing areas. If a drone operator wished to fly outside the blanket parameters, he or she had to first obtain a separate COA that was specific to the airspace into which the operator intended to fly during that operation. The specifics of the exemption could be found on the FAA's Section 333 exemption portal, along with the "Guidelines for Submitting a Petition for Exemption."

### Part 107: Small UAS Rule

On August 29, 2016, the Small UAS Rule went into effect. While not directly replacing the 333 exemption, this new rule will surely be the mechanism that individuals and organizations looking to take to the skies for commercial purposes will use. This of course included any commercial organization that collects data for forensic purposes.

Similar to the 333 exemption, the following items are still applicable:

- Drones weighing between 0.55 pounds and 55 pounds must be registered with the FAA.
- Drones can weigh no more than 55 pounds.
- Drone height limit is 400 feet.
- Commercial UAS operators must maintain visual line of sight (VLOS).
- Air Traffic Control approval is required before flying in controlled airspace (Classes A, B, C, D, and E).

- Operations must take place within civil twilight hours.
- Flights directly above non-participation people are not permitted.

In comparison with the 333 Exemption, the main differences of Part 107 are shown in Table 1.

### Privacy Issues

A presidential memorandum issued in February 15, 2015, requires federal agencies to ensure that policies and restrictions are placed on government drones to protect the public against the potential for abusive use. It has been stated that the policies should "prohibit the collection, use, retention, or dissemination of data in any manner that would violate the First Amendment or in any manner that would discriminate against persons based upon their ethnicity, race, gender, national origin, religion, sexual orientation, or gender identity, in violation of law."

Federal agencies must publish information within one year describing how to access their drone policies and procedures. Agencies must examine their drone policies and procedures before deploying new unmanned aircraft technology, and then at least every three years. The Commerce Department, working with other agencies, must launch an effort that includes business groups, privacy advocates, and others within 90 days to develop privacy rules for commercial and private drones. The American Civil Liberties Union, while praising the memorandum as an important step,

has stated that it still falls short of fully protecting the privacy of Americans in that the proposal allows the use of data gathered by domestic drones for any "authorized purpose," but that term is not defined, leaving the door open to inappropriate drone use by federal agencies.

### Summary

As is the case with many new technologies, it takes time for rules and regulations, which are designed to protect society from itself, to develop. The rules and regulations to integrate unmanned aircraft into air space previously occupied only by manned aircraft are still a work in progress. As the chronological history previously noted indicates, the evolution of the requirements to integrate unmanned aircraft is taking shape and providing an unmanned aircraft user with an understanding of what is (and what is not) allowable. Anyone hiring an expert to reconstruct a vehicle collision, just as anyone hiring an expert in any area of medicine, science, or engineering, must be cognizant of whether the expert that he or she retains is aware of and capable of utilizing the latest technology in the expert's field and has a full understanding of when that technology can legally be used. It is reasonable that an opposing party might question the legality of any data collected without the proper permits and permissions.

The understanding of this new technology not only allows for a potentially more accurate and thorough documentation and analysis of a specific event, but it can lend itself to more comprehensive and compelling trial exhibits to help demonstrate the results of the analysis. Drones, when they are brought into play properly, are simply another in a long line of continually evolving technological advances that will be available for use by forensic experts in varying disciplines. However, to take full advantage of this technology it must be done appropriately by a qualified expert within the regulatory parameters.

Table 1

Section 333	Part 107
Approximately six months to process 333 exemption	More structured process will streamline licensing
Must hold at least a sport-pilot's license	Remote Pilot Certificate, renewed every 24 months
FAA medical certificate	Medical certificate self-reported
Two-crew minimum (pilot + visual observer)	One-crew minimum (operator can act as visual observer)
Aircraft allowed specified by FAA	Any aircraft under 55 lbs. is allowed
Notice to Airmen (NOTAM) must be filed before flight	NOTAM not required
400 ft. maximum allowable altitude	May fly higher than 400 ft. when operating within 400 ft. of a structure