UAV Regulation - Fallback or Fallout?

Raymond Strom, Calgary Rock and Materials Services Inc., #3 3610 - 29th Street N.E., Calgary, Alberta Canada T1Y 5Z7, rocktell@telus.net
Thomas Rice, Cedarville University, 251 N. Main St., Cedarville, Ohio, 45314 USA, trice@cedarville.edu

Abstract:
As U.S. UAV users anticipate introduced regulation, it is thought that regulators may follow the lead legislation that was adopted in Canada and brought into law in November, 2014. The Advisory Circular, AC 600-002[1], issued by the Government of Canada, represents a framework that may generally be adopted in the U.S. These regulations have the potential to be a model that can be considered a "fallback" position, or worse, a "fallout" position for U.S. users. Canadian users are faced with a choice to follow a protocol for an application (Special Flight Operations Certificate - SFOC) to the federal government's Civil Aviation Authority, or follow detailed instructions as provided in the exemption provision, "Guidance Material for Operating Unmanned Air Vehicle Systems under an Exemption" - AC 600-004[2], a 30 page document requiring strict knowledge of the requirements for an SFOC. The discipline of geology has benefitted greatly already using UAVs to monitor transient and static phenomenon, educational use and geologic modelling. Closely related to this is the aspect of safety in the oil and gas business as well as open pit mining operations. Restrictive regulation has the potential to unduly restrict these fields of application and prevent competitive spirit in this new area where entrepreneurialship can benefit all involved. International regulations can vary from complete commercial civilian bans on use of UAVs (Spain, Jordan) to less restrictive laws regulating UAVs. U.S. prospective geological users must be proactive in assisting in discussions and review of regulations introduced.

Canadian regulations and training systems were birthed largely out of the operations of the military establishment. As a result, regulations are very rigorous. The unfortunate expectation is that operation of commercial UAVs will be in conformance with operational parallels to the airline industry, or military research or operational sorties. In some cases, this may be justified, but in others, the requirements may be inflexible or overbearing.

UAV utilized by Meggitt, a Canadian company based in Medicine Hat, Alberta, Canada which is closely connected with military and high-end UAV applications. This twin turbine powered UAV is intended to be flown beyond visual line-of-sight (BVLOS) at very high speeds.

Canadian regulations regarding the use of UAVs, have come about because of their perceived increased use. Safety, commercial and privacy issues lie at the center of the rationale behind the somewhat restrictive laws governing the use of UAVs in Canada. As an example, a farmer is not allowed to overfly their own private land and crops as this may provide a commercial advantage to that farmer. In a similar fashion, geologists coming under these same regulations are restricted by a common mindset of controlling the commercial interests that could be generated. Safety issues also become of importance as consideration is made for the airspace that UAVs will occupy. In light of this, private firms in Canada, such as the Canadian Centre for Unmanned Vehicle Systems (CCUVS) have established training for individuals currently using and anticipating use of UAVs in a commercial setting. (UAVs in Canada are already routinely used for investigation purposes by operations such as the Royal Canadian Mounted Police, especially in traffic accident scenes.) Privacy issues, to a large degree, are already covered under extensive complimentay regulation.

This popular automotive advertisement portrays the fear that the public has for UAV (drones) use. Note the use of "drone packages". This public perception of "invasion" by UAVs has a clearly negative effect on the legitimate use of UAVs in a variety of industries, including geology.

These issues must be balanced against the entrepreneurial potential for the use of UAVs. In the field of geology, much can be gained by the use of UAVs, and should the United States adopt a Canadian model for legislation, the restrictions may be formidable to the application of this burgeoning technology. Canadian regulations have been heavily influenced by ex-military personnel, and as such reflect the protocols established internally by the military. The CCUVS training course, for example, begins by a declaration that trainees will be brought up to an operational awareness level approaching that of a commercial pilot. The training is rigorous and is of considerable benefit to the student. Presumably, having competed the course will provide some credit for operators when applying for their Special Flight Operations Certificate (SFOC) which is necessary to undertake commercial operations.

Experience in flight training is not a necessity to operation of these UAVs. In fact, the U.S. military and the FAA have discovered that previous training may be a hindrance to safe and efficient operation of UAVs as they have seen in the use of Predators and Global Hawk UAVs for surveillance and other operations[3]. It appears that "gamers" may be the pilots of choice for operation of UAVs, as the virtual graphics are much more familiar to them than the "real world/live-time" perception that most commercial, military and private pilots are familiar with.

There is some considerable debate over utilizing the technique of first person view (FPV). In the category of sport or casual use of radio controlled devices, line-of-sight (LOS) is a requirement for operation of airborne vehicles. When it comes to the technical application of UAVs however, beyond-line-of-sight can be very useful and perhaps even preferential. Even when LOS is a given on specific missions, FPV becomes very useful in order to orient, and distance place the objects of interest from onboard cameras and sensors. This is true for both visual imaging as well as spectrometric analysis techniques. Current legal restrictions prevent that from becoming a common practice, except in the cases where second operators or observers are present. It should be noted that control for Mars Rovers is done totally by time delayed FPV.

First person View (FPV) devices commonly used for monitoring mission flights. These aids provide valuable information for flight precision when used with additional input. Recording monitors provide a record of on-board systems checks of the UAV craft.

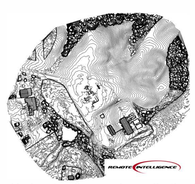
Closely related to this is the aspect of height above ground level or AGL. AGL restrictions limit the geologist's ability to access subjects of interest, except in the case where the object of interest has limited vertical relief. Cliff faces, or objects having significant vertical relief become inaccessible above 400 feet of the launch ground level datum point. Clearly, cliff faces would be of little interference to private and commercial aircraft operators, so these types of circumstances must be taken into consideration in regulation review.

A Case Study - Remote Intelligence Exemption 333 Application[4]
Remote Intelligence (RI) applied for a Section 333 Exemption from the FAA in April, 2015 which was approved in September (a 5 month wait time). In spite of RI's request to fly beyond visual line of sight in very remote, unpopulated areas, the approval was returned with all the standard restrictions, including limiting flights to visual line of sight of the pilot in charge. Other requirements include the limitation that the on-site pilot in charge must be a licensed pilot, an observer must be used, night flying is prohibited, only registered aircraft can be used and all flights must occur within the conditions of either a blanket Certificate of Authorization (COA) or a project-specific COA along with other restrictions.

Potential clients have been open to the use of UAVs for mapping projects following the approval of RI's Exemption. In our experience, they have also noted that the pricing and image quality using UAVs vs. manned aircraft for aerial imaging flights has been advantageous. Sub-centimeter resolution is achieved on UAV-generated imagery. The imagery collected can be processed via software into a variety of products including geo-referenced orthomosaics, 3D topographic models, topographic contours and digital elevation models. With the use of survey-grade ground control points, the imagery can be rectified with very high precision, suitable for land survey projects.

Highly sophisticated hexacopter used as an aerial photographing platform for image acquisition. Multiple, overlapping images using these costly platforms provides the basis for sophisticated mapping applications.

Aerial imaging of geological features provides opportunities for detailed study of objects using UAVs, difficult to evaluate using any other means. This image is of a house-sized pair of rocks from which precise geometrical measurements can be made, including dimension, volume and spectral characterization. This application can be made to static objects like these as well as dynamic objects such as landslide and volcanic flow sites.



3D topographical contour line mapping application derived from systematic overlapping imaging of the subject area using UAV hardware and software applications.

Conclusions

1. **Exceptional opportunities exist for utilization of UAVs in geological applications.**
2. **Canadian regulations, which may be precursors for United States federal law create undue restrictions on operators.**
3. **Recent regulations to be brought into power with respect to registration of all UAVs, including recreational users may assist in safety issues.**
4. **Efforts must be made now to circumvent establishment of regulations that may be difficult or impossible to change in the future in order to avoid the "fallout".**
5. **The GSA may be compelled to establish a study committee to provide further input to regulatory bodies.**

References
1. **http://www.tc.gc.ca/media/documents/ca-opssvs/ac-600-002.pdf**
2. **http://www.tc.gc.ca/media/documents/ca-opssvs/ac-600-004.pdf**
3. **https://www.youtube.com/watch?v=N8_9JX382_k, PBS, NOVA, Military Drone Technology 2015, Mary "Missy" Cummings, MIT Humans and Automation Lab**
4. **Remote Intelligence Exemption 333 Permit, courtesy of Merlin Benner, Remote Intelligence**