

## NEW PARADIGM OF AERIAL SHOOTING

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**Summary:** Fast technological development and exponential growth in production of Unmanned Aerial Vehicles (UAV's) has created a completely new situation in the domain of aerial shooting. Small UAV's equipped with Global Navigation Satellite System (GNSS) receivers and Inertial Measurement Units (IMU's) carrying digital cameras supported by new software tools are able today to deliver products in the quality equal or very similar to equivalent products produced by airplane photogrammetric cameras. Due to the low purchase and production costs of UAV's, they are used today intensively and in great number for a broad spectrum of applications. This development created new paradigm of aerial shooting, challenging regulators worldwide to deliver new ordinances on usage of UAV's and shooting from air covering also UAV technology. The necessity to change the present and adopt new paradigm of aerial shooting is discussed in this paper respective to the present situation in Croatia and Serbia.

**Keywords:** Aerial shooting, Unmanned Aerial Vehicle, Ordinance on aerial shooting

### 1. INTRODUCTION

Only five years ago, the usage of UAV's for civil purposes was very rare and exotic. Today UAV's, or drones, have become easily accessible commodity applicable for serious engineering tasks and fun at the same time. Compared to a rather negligible number of serially produced UAV's few years ago, there were almost 4 million UAV's produced worldwide in 2015 triggering the expectation to raise this figure up to 16 million UAV's shipped worldwide in 2020 [1]. With the selling prices being less than 1.000 € for simple but capable quadcopters like DJI Phantom equipped with basic serial digital camera (see Figure 1), or 10.000 € for serious copter UAV like DJI Spreading Wings S1000+ Pro Octocopter, up to some 35.000 € for fixed wing UAV's (see Figure 2) like senseFly eBee RTK with RGB camera, UAV's have become very competitive products in the global aerial shooting market developing new applications permanently.

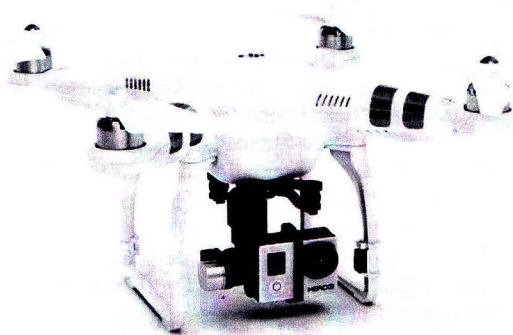
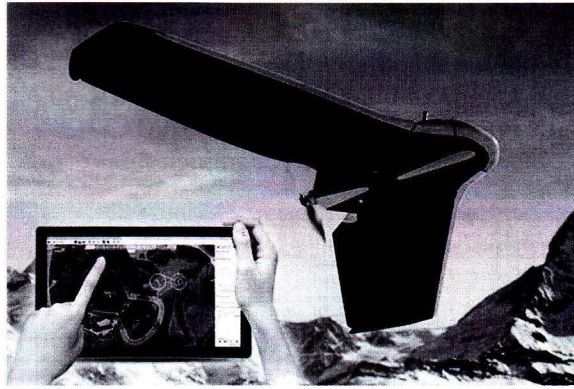


Figure1: DJI Phantom 2. Source DJI



**Figure 2:** senseFly ebee RTK. Source senseFly Ltd

UAV's with digital cameras are used today frequently for shooting various kinds of temporal activities like sports, music, political or social events, traffic situation, accidents and disasters, border security and similar, periodical surveillance of constructions (bridges, roads, dams, chimneys, towers, plants, etc), open mining facilities, agriculture production, archaeological and environmental activities, and finally for different types of mapping and map production.

The main advantages of UAV technology for aerial shooting are its simplicity and automated operation, high achievable accuracy, short time for engagement and capacity to be used directly on location of interest. The main disadvantages of UAV technology are short period of engagement due to the battery life span, limited area that can be covered by one flight and the reduction of accuracy on edges of observed area if the surface is not optimal for software adjustment. Despite mentioned disadvantages, the application of UAV's is growing rapidly.

## **2. USAGE OF UAV's AND LEGAL FRAMEWORK**

Rapid growth in number and usage of UAV's worldwide, connected with flight security risks and incidents occurred, as well as with the threats of potential UAV's misuse for criminal activities, has forced the authorities to deal with UAV's and their usage. When preparing the ordinances, the regulators are challenged by the request to enforce secure usage of UAV's but also, at the same time, to promote implementation of new technology by removing administrative barriers.

Many countries have already adopted regulations regarding UAV's that relay mainly on the applicable legislation that has been extended to cover UAV's specific issues. The solutions are different. USA introduced mandatory registration of all UAV's heavier than 0,250 kg since December 21<sup>st</sup> 2015. The registration is done online and costs 5 US\$ being valid for three years. According to Federal Aviation Administration press release on January 22<sup>nd</sup> 2016, nearly 300,000 owners have registered their small unmanned aircraft in the first 30 days after the Federal Aviation Administration's (FAA) online registration system went live. There is no special permit necessary for taking images or video with UAV in the USA. Similar regulations have been introduced in New Zealand and Australia.

In Europe, the European Union (EU) is trying to enforce civilian usage of UAV's promoting liberal regulation. However, since there is no EU regulation on this subject, final effect depends on national solution. Having same legal heritage on civil administration and aerial shooting, Croatia and Serbia have so far developed similar regulations regarding usage of UAV's. Croatia introduced the Ordinance on UAV's [2] in June 2015 that regulates general, technical and operational requirements for safe usage of UAV's and the requirements to be fulfilled by the persons operating those UAV's. Serbia introduced the Ordinance on UAV's [3] in December 2015 that entered into force partly on January 1<sup>st</sup> and partly on May 1<sup>st</sup> 2016. Croatian and Serbian Ordinances are quite similar, however, the Serbian Ordinance is more detailed. Both Ordinances are on the track of regulation mainstream for this topic in Europe, and similar Ordinances have been adopted in Scandinavian countries, Austria, etc. (see <http://thedroneinfo.com/the-current-state-of-global-drone-regulations/>).

Additionally, if anybody wants to execute aerial shooting with UAV for any purpose, especially for surveying and other commercial purposes, he/she has to obtain a permit for aerial shooting. In Croatia, this permit can be issued in accordance with the governmental Decree on aerial shooting. Respective permit in Croatia is issued by the State Geodetic Administration and it is applied both for shooting and usage of images or movies. The usage



implies the obligation to submit the **images or movies** taken for audit after the shooting. The mentioned Decree was released by the Government of the **Republic of Croatia** in November 2012 [4]. This Decree covers also the usage of UAV's treating them equally **as all other aircrafts**. New Decree that should simplify the administrative procedures has been prepared by **State Geodetic Administration**, but has not been adopted yet by the Government.

In Serbia, the legal framework for aerial shooting is different. The issuance of the permit for aerial shooting needed in state survey is regulated by the **Law on State Survey and Cadastre** [5] and issued by **Republic Geodetic Authority**. The issuance of permit for aerial shooting of military objects was regulated by the Decree on procedure for issuing allowances for aerial shooting of SRY territory and for publishing cartographic and other publications [6] that has not been in force since January 1<sup>st</sup> 2010. The new **Law on Defence** [7] bans any aerial shooting of military objects for civilians. Therefore, there is certain legal vacuum regarding aerial shooting in Serbia, and the usage of UAV's for motion pictures, books, magazines, other publications, and events, if no military objects are involved, is not regulated

Like in most other countries, no official figures are available about the number of UAV's in Croatia and Serbia. Only rough estimates used here only as indication have been given by specialized or daily newspapers. In March 2016, the number of UAV's in Croatia was roughly estimated to 5.000 with only 134 UAV operators being registered in the register conducted by the **Croatian Civil Aviation Agency** [8]. In Serbia, according to rough estimation, there are some 15.000 UAV's, out of which up to 1.000 are multi-copters [9]. Regardless of the present uncertainty about the number of UAV's in Croatia and Serbia, there is no uncertainty that this number will grow fast in forthcoming years increasing the security risks but also boosting the economy.

### **3. THE NEW PARADIGM**

As mentioned above, the usage of UAV's is worldwide in the gap between commercial and security aspects of use. Both confronted aspects of use have strong arguments advocating necessity to act in a certain manner. Commercial interests are the following:

- there is a potentially great market for usage of UAV's capable to contribute to the growth of national economies,
- the growth of production of UAV's depends on regulations that will enable or disable simple and efficient use of UAV's,
- the production and commercial usage of UAV's have global character and are therefore a global business. The backwardness in implementation of UAV's will not contribute to the growth of national economy, it may even decelerate it.

In today's world, security considerations are numerous and serious:

- simplicity in use and technical capabilities of UAV's can easily transfer any UAV from a useful tool to a deadly weapon for terrorists and other evil people,
- low price makes them easily accessible, and huge production is in principle uncontrollable,
- additionally, technical simplicity and accessibility of components enables easy assembling of UAV's by persons with moderate technical knowledge,
- despite all efforts, there are still no efficient protection measures and systems against misuse of UAV's.

Speaking about usage of UAV's, we have to be aware that most of the UAV's presently in use are used for hobby or recreational purposes. Taking the expected increase in the number of UAV's into consideration, it is reasonable to expect, that countries will have to adopt the legislation related to private and recreational use of UAV's that would not require permissions or approvals for operation, but expect from operators to follow safety guidelines in order to prevent persons or objects from being endangered [1]. Many countries, like the USA, UK or Canada, have already implemented campaigns to educate the public about using UAV's safely and responsibly.

The second major usage concerns the official use for military, security, disaster and other related purposes that we shall exclude from further considerations because those usages are regulated separately or differently from commercial usage. Finally, the commercial usage of UAV's for aerial shooting of any kind can be categorized in three main categories:

- for shooting of temporal defined and limited events like sports or cultural events, social events, like weddings or anniversaries, and similar,

- for industrial purposes and for monitoring the structures like plants, high chimneys, dams, mines and quarries purchased mainly by the companies or owners, and
- for any kind of mapping purpose, purchased officially by mapping, cadastral or other authorities, or companies producing spatial products.

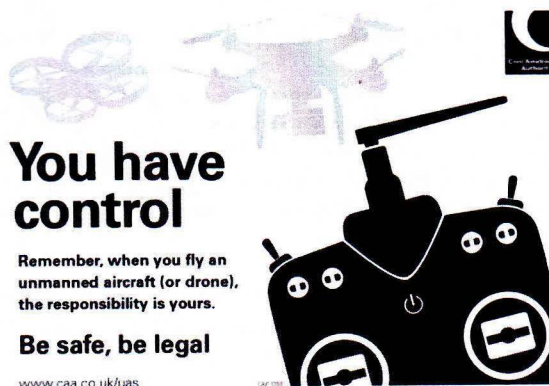


Figure 3: Educational campaign leaflet. Source CAA, UK

The variety of new usages, relative technical simplicity and short time from ordering the service until the delivery of final product (digital terrain model, orto-photo maps, 3D models, etc) create new paradigm of aerial shooting worldwide. From exclusive, restricted and highly specified and specialized branch of commercial activity focused on a limited number of customers, aerial shooting is tending to become daily routine commercial service procurable to anybody, either some authority, legal or physical person. The most important criteria for providing services involving aerial shooting are not any more related to the accuracy of the final product, but the time necessary for delivery of purchased service or product.

Furthermore, the insisting on the procedures that used to be implemented earlier for aerial shooting from airplanes and helicopters and required relatively a lot of time for issuing the permit and subsequent auditing of taken material (images and movies) is not in accordance with the expectations and understanding of the society, especially regarding the first, temporally defined category of usages. Additionally, these procedures have become obsolete in the modern digital world since they require physical transfer of material taken by UAV's, including the routines that are doubtful in their efficiency.

Finally, due to the fact that the number of providers of aerial shooting services has grown from a few in the past to several tens or hundreds today both in Croatia and Serbia and is expected to continue growing even faster, the present model of issuing the permits and of auditing the images/movies cannot cope with the development that will become everyday reality in near future. Therefore, the model of treating the usage UAV's and of commercial use of UAV's, especially aerial shooting, requires new and innovative approach based on acceptance of the reality around us. For example, images and movies taken by UAV's, airplanes or helicopters are subject to control and in some countries also to the modification of image content in order to cover military and other protected sites, and on the other hand, the same content is completely free and visible on satellite images and geo-portals based on them, like Google maps, and similar.

The authors think that a new paradigm of using aerial images and movies, regardless of how they are captured, but of course with the emphasis on UAV's, should be based on:

- UAV's and used sensors are part of present technological revolution and digital technology. Therefore everything related to UAV's should be based on the use of digital technology and fully digital communication between UAV operator and regulating authorities with near to immediately issuing permissions for first category of services (temporally defined) and much faster procedures for other two categories of services, and
- legislation that will regulate the use of UAV's is necessary and should cover all aspects of UAV's usage. The main leitmotiv of any legislation related to UAV's should not be the prohibition but the protection of general safety and possibility of simple and efficient use. To achieve these goals, it is important to continuously increase the awareness and build confidence among the users, citizens and authorities.



To sum up, it should be mentioned **that there** is more research necessary to be done before some final conclusions can be given, but it can be **suggested** to the regulators in Croatia and Serbia to consider the necessity of a breakthrough in thinking and **approaching** to the issue regarding the definition and designing of regulations related to all aspects of UAV usage. **Otherwise**, there will be a constant conflict between operators and UAV commercial services providers on the one hand and the governmental authorities on other hand.

#### 4. CONCLUSION

The development of UAV's equipped with digital sensors to advanced technical and efficient tools capable to deliver aerial images and movies at low cost has changed the paradigm of aerial shooting worldwide. Taking into account the perspective of the extreme growth of the number of purchased UAV's in the next five years, both UAV commercial service providers and regulating authorities seek new solutions to cope with the development. Currently, two major factors influencing the decisions about the framework in which UAV services are executed and provided are apparently confronted. In fact, it is the issue of paradigm change that has to be recognized, and new concept and set of postulates and patterns should be adopted accordingly.

The discussion on this topic given in this paper aims to emphasize this paradigm change. The necessary change of legislative framework cannot be achieved unless the paradigm change is accepted, and consequently, no contribution will be provided for the economic growth of society. The necessity to change the paradigm is clearly required in Croatia and Serbia, where the respective situations have been analyzed and the reasons for change elaborated.

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