

# THE USE OF DRONES IN VERIFICATION OF IRREGULAR BUILDINGS

**Amanda Eloise Machado**  
Assis Gurgacz University Center

**Cezar Rabel**  
Assis Gurgacz University Center

## Abstract

**The article fits into urban planning and has as its theme gauging irregular buildings in urban centers, using drones. Currently, there are several reasons for the existence of these irregularities, which end up hurting the urban scenario and government tax management. Given this, it is extremely difficult to prevent illegal urban advances, either by insufficient staff or by the disorderly growth of cities. So, in order to find possible solutions to this, the research problem in this article questions the possibility of measuring irregular buildings using drones. In view of the conditions of financial viability and practicality of operation, it is hypothesized that the use of drones for mapping may be a strategy with the potential to facilitate the supervision of works. Therefore, in this research the methodology is based on a bibliographic review, which aims to synthesize procedural concepts related to the use of the drone. In addition, some important items are addressed in order to generate reflections and discussions on the topic.**

## INTRODUCTION

The research will address the subject of geoprocessing, with the theme: gauging irregular buildings using drones, and the same is justified in view of the harmful conditions in which urban landscapes are found. In view of this, the general objective becomes to answer the research problem, which is: "Is it possible to measure irregular buildings using drones?", and it is hypothesized that it is possible to hold this conference, however, the effectiveness of these measurements depends on other factors to be

considered, such as the programs and software used; models and types of drones; and the current legislation.

It is intended to reach this conclusion from the specific objectives: a) Cite what are the possible reasons for the current irregular occupations in cities; b) Synthesize procedural concepts related to drone use, such as photogrammetry, software and applications used, drone models and legislation, and c) Present reflections on the possibilities of such measurements based on existing cases of inspections in Brazil.

Based on authors such as Neto (2015 and 2017), Feital (2017), Loturco (2019) among others, we sought to present the current context of applicability of aerophotogrammetry in the identification of irregular buildings. It is worth emphasizing that research aimed at the use of drones is developing more and more in many countries and this scenario, coming from accessible technologies, provides horizons for several applications in the most varied research themes (Pegoraro 2013).

As a choice of methodology, the bibliographic review is used, starting with a brief approach on the possible reasons for the current irregular occupations in the cities, as well as seeking to present real situations that this measurement method has already been applied in Brazil.

This systematic review of the literature aims to select, analyze and synthesize the relevant evidence available, dealing with academic research, such as these, dissertations and scientific articles, as well as articles from the press. Thus, as mentioned in the specific objectives, it was necessary to carry out an approach to elucidate concepts related to the use of drones, to then present reflections on the feasibility possibilities of this inspection instrument.

## CONCEPTUAL FOUNDATION

### *Irregular Buildings*

There are several reasons for the existence of irregular buildings in urban centers, which can be both financial and lack of knowledge and interest of civilians. In the world labor market, there are specific professionals for construction and renovations, aware of the rules and norms of each space, thus avoiding future irregularities and inconveniences.

According to Pioli and Rossin (2006), it can be said that irregular buildings are reflections of economic cycles in disordered urban growth, as well as the concentration of income and the absence of the State. Furthermore, they point out that the accelerated urbanization that occurred in Brazil, and the disparity between social classes, generated cities with peripheral human settlements that reflect and perpetuate social and economic inequalities. Some consequences of the concentration of wealth, such as: social exclusion, environmental degradation, urban violence, unemployment, and the inability of the State to intervene in the implementation of effective public policies in environmental protection, generate a vicious cycle that is difficult to break.

In addition, Magnani (2019) clarifies that the most privileged sectors also use urban illegality when it is convenient, because irregular works are those built without the necessary licenses and documentation, whether in high or low construction standards, presenting in their most of them the absence of architects or engineers in their design and execution, not complying with basic urban laws.

This statement is in line with the result of a survey carried out in 2015, commissioned by the Brazilian Architecture and Urbanism Council (CAU/BR), which pointed out that 54% of the economically active population in Brazil has already built or renovated residential or commercial property. Of this portion, a region of great concern was the Midwest, where 89.5% of the works were carried out without adequate professional monitoring, making them irregular. In this regard, some cities that have a demographic density between 200 and 500 thousand inhabitants, with approximately 70 years of history, deserve special attention, as they already have worrying rates that will seriously worsen over the years.

### *Photogrammetry, Drones and Softwares*

According to Bosquilia (s.d.), photogrammetry is understood as an art, science and technology of obtaining information from real and reliable sources on various objects through the processes of recording, measuring and interpreting

photographic images. According to Feital (2017), with the evolution of construction techniques and abundant technologies in the global market, architecture and civil engineering needed to update themselves on the means of completing their work.

In this perspective, the conventional methodology for monitoring works, for example, has been replaced by inspection using drones. In addition, in large urban centers, it is already used to map the urban network, as shown in image 1.



Figure 1. Photogrammetry. Droneng 2015.

Despite being considered a new method, the proposal for the use of aerial vehicles has been worked on since 1898, when Nicolai Testa created a torpedo capable of being remotely controlled by radiofrequency to be used during the Spanish-American war. With this, in 1922, a new concept was developed, which approached what is now known as a drone (Feital 2017). Currently, the main benefit of using UAVs is security, however, Costanobre Engenharia (2018) maintains that there is less time spent on surveys and less cost to perform such action. In addition, there are other benefits: there is ease in places of difficult access - avoiding the exposure of workers to risk - location accuracy due to GPS, and the ability to make multiple inspections at the same time, considering that the mapping is done according to the need of the pilot.

Still, Loturco (2019) states that drones are able to capture images from different angles, until then, impossible to access. In this way, companies have been collecting strategic data, helping to improve the capacity and planning of each project.

For those interested in the specific use of these means, there is a need to study the various models available on the market, as well as appropriate software for them.

According to Neto (2015), image processing software is used so that from these, captured with drones or airplanes, a cartographic base of the terrain of interest is generated.

As for mapping, several programs assist in the process, with Agisoft Metashape, and Pix4D Mapper Pro, Russian and Swiss software, respectively, being the first on the list. In addition, for those who are new to this market, Drone Deploy is also used, as it is compatible with various aerial vehicles.

Also according to Neto (2015), there are some drones that are specific for aerial mapping, being directly connected to the engineering market when mentioned. Because of this, the models can have a higher added value, because when you buy a drone, you also buy the control station, which is the brain of the whole system.

#### *Government Licenses and Irregularity Affection*

Due to the fact that UAVs fly over great heights, there are criteria and rules, which must be followed, according to their classifications, size and weight. These categories include aircraft and helicopters, and another type of aircraft. In Brazil, the regulation is made by ANAC (National Civil Aviation Agency), and the vehicles in question were included in this management process due to the ease of locomotion and displacement, both vertically and horizontally (Feital 2017).

For a civil construction or urban planning professional to use a drone for mapping, several documents and approvals, involving public agencies, are required. According to Vasconcelos (2017), there is a need to carry out a homologation with ANATEL (National Telecommunications Agency) and request the authorizations provided for in ANAC. To register at the agency, you need: personal data (or legal entity) of who will fly, aircraft data, equipment identification number, and a photo of it; this complete process, once completed, generates a mandatory document in all future operations (Lis 2017).

After doing this process, you can start the mapping from the chosen area. The measurement of irregularities begins after all the photos taken are transferred to the software, making it possible to check the buildings on a mathematical basis. Another possible aspect to be carried out is the Building Inspection, which, according to NBR 5674 of 1999, identifies the state of the building as a whole, and understands it as a human body, requiring an occasional “medical check-up” (Coutinho et al 2017).

## **METHODOLOGY**

The general methodology of the work is developed through the literature review, which aims to elucidate the research problem, select possible technologies and cases of cities that have already applied the measurement methodology, analyze such scenarios and synthesize the relevant available evidence (Galvão and Pereira 2014).

## **ANALYSIS AND DISCUSSION**

### *Technologies: Drones and Softwares*

The use of drone technology for mapping urban areas is feasible. With the DJI Phantom 4 (image 02), for example, it is possible to make flights with an average range of 2 kilometers. Such equipment generates orthophotos, which design maps in 2D and 3D, offering dimensions and valuable details.



Figure 2. DJI Phantom 4. MR1Drones.

DroneDeploy, on the other hand, among other mapping software such as PIX4D, presents itself as an adequate tool to carry out the analysis of urban territory. Its functions allow the realization of a flight plan, with options such as: selection of the flight area, height, speed, image quality and options for 2D or 3D mapping. With the aid of the software, it is possible to compare dimensions of buildings constructed with what is in the government register, through information in the public domain. Thus, there is a need to redo the calculations to confirm the irregularity.



Figure 3. DroneDeploy’s interface. DroneDeploy.

### Application Models

The collection of geographic information through three-dimensional mappings has generated advances in topographic studies, citing the varied spatial transformations, environmental phenomena, deforestation and irregular occupations. As seen, the drone can assist in urban planning studies and more actions, such as analysis of the traffic system standards, for example (Pereira 2017). In view of this discourse, some cities have decided to adopt this new measurement strategy, as discussed below.

### Florianopolis, Santa Catarina State, Brazil

According to the Brazilian Institute of Municipal Administration (IBAM 2015), in Florianópolis-SC, there are 1.8 million m in areas susceptible to high and medium risk landslides, with approximately 120 thousand people living in these places, as shown in the figure below.



Figure 4. Aerial image of buildings in an irregular situation. DroneDeploy.

Faced with this scenario, the City Hall, through the Municipal Secretariat for the Environment, Planning and Urban Development, began, with the help of drones, the inspection of these areas. This monitoring methodology will provide a scan of the city's land area, in order to compile information and compare it with the city's current records, in order to forward it to the municipal inspection (Stroisch 2019).

### FINAL CONSIDERATIONS

The surveys showed relevant results for urban management, regarding irregular buildings. It was noted that these, in most cases, are built without the necessary licenses and documentation, thus presenting the absence of architects or engineers in their design and execution. Because of these inaccuracies, government revenue becomes flawed, making it difficult, or even impossible, to invest resources in improving the urban environment. In addition, the more irregularities, the more prone to natural disasters the urban environment will be.

In view of this varied range of conditions, it is concluded that the measurement of these irregularities through drones, can become beneficial to society as a whole, as such action will allow the public authorities, among other benefits, to regulate the proper growth of the environment and balance fiscal collection.

In short, it is understood that the viability of inspection with such instruments is thus proven, thus having the freedom to suggest that the next works carried out on the subject, address the issues of gauging with drones at a deeper level, creating more theoretical references about that content.



## Endnotes

1. Aaker, David D *et al.* Marketing Research. New York: John Wiley & Sons, Inc, 2001. 768 pages.
2. Bosquilia, Raoni W. D. Concepts and Classification of Photogrametry. S.d. <http://1-Concepts%20e%20Classification%20of%20Photogrametry.pdf>.
3. Conselho de Arquitetura e Urbanismo (CAU/BR). Research shows that 90% does work without an architect. 2015. <https://www.caugo.gov.br/o-maior-diagnostico-sobre-arquitetura-e-urbanismo-ja-feito-no-brasil/>.
4. Costanaro Engenharia. Drones: use in surveys and inspections in civil construction. 2018. <https://costanobreengenharia.com.br/o-uso-de-drones-na-construcao-civil/>.
5. Coutinho, Italo; Marcelo Rosa Feital; Shirlei Querubina Costa. Innovation in Quality Management: Use of UAVs in Inspections in Civil Projects. 2017. <https://singep.org.br/6singep/resultado/181.pdf>.
6. DroneDeploy. Supported drones. S.d. <https://support.dronedeploy.com/docs/supported-drones>.
7. Droneng Drones And Engineering. How does photogrammetry on board the UAV work? 2015. <http://blog.droneng.com.br/fotogrametria-a-bordo-do-vant/>.
8. Feital, Marcelo Rosa. Use of UAV (Unmanned Aerial Vehicle) for inspection of Civil Construction Projects. 2017. <https://pmkb.com.br/wp-content/uploads/2017/09/TCC-Marcelo-Rosa-Feital>.
9. Galvão, Taís Freire; Mauricio Gomes Pereira. Systematic reviews of the literature: steps for its elaboration. S.d. [http://scielo.iec.gov.br/scielo.php?script=sci\\_arttext&pid=S1679-49742014000100018](http://scielo.iec.gov.br/scielo.php?script=sci_arttext&pid=S1679-49742014000100018).
10. Instituto Brasileiro de Administração Municipal (IBAM). Florianópolis Sustainable Action Plan. 2015. [http://www.ibam.org.br/media/arquivos/estudos/pla\\_no\\_de\\_acao\\_florianopolis\\_sustentavel\\_bid\\_caixa.pdf](http://www.ibam.org.br/media/arquivos/estudos/pla_no_de_acao_florianopolis_sustentavel_bid_caixa.pdf).
11. Lis, Laís. ANAC sets rules for the use of drones and requires qualification for larger equipment. 2017. <https://g1.globo.com/economia/noticia/anac-libera-uso-de-drones-sera-preciso-habilitacao-para-equipamentos-maiores.ghtml>.
12. Loturco, Bruno. The Importance of Drones Grows In Civil Construction. 2019. <https://www.buildin.com.br/drones-na-construcao-civil/>.
13. Magnani, Juliana Mattos. Clandestine city, collateral damage of urban laws: the regularization of buildings and the impacts on the production and management of Belo Horizonte, 2019.
14. MR1 Drones e equipamentos fotográficos. S.d. <https://mr1drones.com.br/drones-dji/1762-drone-dji-phantom-4.html>
15. Neto, Manoel Silva. Which drone image processing software should I use? 2015. <http://blog.droneng.com.br/processamento-de-imagens-de-drones-qual-software-usar/>.
16. Pegoraro, Antoninho João. Study of the potential of an unmanned aerial vehicle / quadrotor, as a platform for obtaining cadastral data. 2013. <https://repositorio.ufsc.br/bitstream/handle/123456789/107440/318753.pdf?sequence=1>.
17. Pereira, Matheus. Como os drones têm contribuído à Arquitetura. 01 Dez 2017. ArchDaily Brasil. Disponível em: <https://www.archdaily.com.br/br/884704/como-os-drones-tem-contribuido-a-arquitetura>> ISSN 0719-8906.
18. Pereira, Matheus. How drones have contributed to architecture. 2017. <https://www.archdaily.com.br/br/884704/como-os-drones-tem-contribuido-a-arquitetura>> ISSN 0719-8906.
20. Pereira, Matheus. How drones have contributed to architecture. 2017. <https://www.archdaily.com.br/br/884704/como-os-drones-tem-contribuido-a-arquitetura>> ISSN 0719-8906.
21. Pioli, Maria Sulema M. de Budin; Antonio Carlos Rossin. The environment and irregular occupation in the urban space. Brazilian Journal of Environmental Sciences. 2016. [http://rbciamb.com.br/index.php/Publicacoes\\_RBCIAMB/article/view/481.pdf](http://rbciamb.com.br/index.php/Publicacoes_RBCIAMB/article/view/481.pdf).
22. Stroisch, Bruna. Inspection of irregular works by drones in Florianópolis will be done in real time. 2019. <<https://ndmais.com.br/noticias/fiscalizacao-de-obras-irregulares-por-drones-em-florianopolis-sera-feita-em-tempo-real/>>.
23. Vasconcelos, Meggie Lecioli. I have a drone, do I need authorization to fly? 2017. <https://meggielecioli.jusbrasil.com.br/artigos/420155806/got-a-drone-need-for-authorization>.