

# Civil Applications For Mini VTOL UAS

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Infotron, a French based company, has developed a vertical take-off and landing (VTOL) mini unmanned aircraft system (UAS) for civil operations. This UAS is based on a contra-rotating system powered either by a 2 stroke engine, or a brushless electrical engine. The commercial objective is not only to sell the product, but also to supply flight services with it when customers wish to have specific non-recurrent operations carried out in any domain. Infotron will then act as a flight service company. This paper describes three different types of applications for which the mini UAV (models IT 180-5 EL and IT 180-5 TH) has been used.



In France, companies such as railway transportation companies (SNCF) or power distributing companies (EDF) are the owners of multiple civil engineering works, such as overpasses and dams. Legal safety regulations force them to make recurrent inspections of such structures, in order

to detect, early on, any potential future problems (cracks, etc). Up to now, classical means were used to conduct such inspections. This was mainly accomplished by inspectors in winched nacelles or by specialized climbers. Such types of inspection are conducted «manually» and the result is a set of reports where disorders or cracks are localized on a map. A few months ago, a French civil engineering consultant office<sup>1</sup> proposed the use of an UAS in order to take multiple high quality pictures of civil construction. Those pictures were then downloaded into a dedicated software<sup>2</sup>, which reassembles them showing the complete structure and pointing out all cracks with accuracy of down to 0.3 mm. The advantage of this solution is to have a perfect repeatability between measurement campaigns. Principle is to lock the hovering unmanned aircraft in position towards the civil construction using multiple sensors (Ultrasonic & Laser). The system then automatically takes pictures when the unmanned aircraft is moving along the structure. Generally, one picture is taken every two meters in order to get enough overlap between adjacent pictures and allow the software to complete the assembly more easily.

The mini UAS has been used to install high voltage lines. In a normal environment, there is no need for specific tools in order to pull the cable from one pylon to the next one. Either, the cable is pulled by workers (going on foot from pylon to pylon) or it is positioned by means of a four wheel drive vehicle equipped with a winch. However, in certain conditions, there is no possibility to use these methods. For example, when the high voltage line crosses a river, or when there is a need to cross an abyss, or even in mountainous areas.... In those situations, companies used to make use of helicopters. In this case, the helicopter directly deploys the cable over multiple pylons. But due to multiple restrictions (flight authorization, weather conditions, availability of a helicopter

and qualified pilot), this can turn into a complex situation, which can delay the planning of high voltage line installations. A private company working for RTE (a subsidiary of EDF, France dedicated to energy transport & distribution) had had the idea of using a mini UAS capable to carry up to 3 to 4 kilograms of light wire (Kevlar type) in order to realize the first link between the two consecutive pylons. Some specific developments were carried out on the unmanned aircraft in order to carry the small cable with enough protection (fuse) in case of blocking obstacles. Also a system has been designed (patent pending) to launch the cable once the unmanned aircraft has passed the second pylon. Multiple field tests have been undertaken and the results were very positive. Commercial and technical discussions are still in early phase, and as soon as the contract is signed, the system will be used by multiple working teams in France.

Classical aerial photography is usually done using a helicopter<sup>3</sup>. But this is still a costly way of working as you need a combination of factors (good weather condition, availability of both a Helicopter and qualified pilot with flight authorization) to be able to start a set of shots. In comparison the use of mini UAS is much more flexible as you can start the mission even with a very small window of good weather condition, no need to wait for the helicopter coming from its base. At the end of the day the total cost of use can be drastically reduced. In addition there is a limitation when using such helicopter as you cannot fly below 150 m. Moreover some interesting places are not located in area where commercial or touristic flights are allowed (e.g. Chantilly castle close to Paris). Certain professional photographers have thought of using the UAS as a tool to realize new and more interesting shots. Infotron has worked with a professional photographer to design and develop a specific stabilized platform that can be used with most high end professional digital still cameras. The still camera is thus stabilized and can compensate for any movement of the aircraft generated by external conditions (e.g. wind gusts) on the UAV. A miniature CCD camera has been adapted to the camera's viewfinder to send the still camera images down to the Ground Control Station. A remote system allows the operator to take pictures at any time. The first test field has been done using a Nikon D200 & Canon EOS D1s Mark III and produced very good results. By using an electrical noiseless engine, we can expand this system for wild animals' photography.



<sup>1</sup> HELIOS S.A.R.L. based in France is the owner of multiple patents concerning this approach for civil art diagnostic.

<sup>2</sup> Mosaïque® has been developed by Hélios S.A.R.L.

<sup>3</sup> Famous French photographer Yann-Arthus Bertrand has used this means to produced a wide number of books i.e.: Earth seen from the Sky