

UNNAMED VEHICLES, CONSTRUCTION AND THEIR USAGE

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Abstract:

This article deals with construction of drones and materials for manufacturing of them. In next part is focused on possibilities of their usage in thermo diagnosis. This deals about technical aspects, law and from that resulted terminology, restrictions for operation and necessary permissions. In consideration of growing availability of UAV, technical and software equipment we could expect that we are on the beginning of new trend – deployment of UAV in field of technical diagnosis.

1 Introduction

Nevertheless, the field of unnamed systems is still quite young and his commercial deployment is on the market since 2015, these systems are more and more established in field of technical diagnosis.

Body, chassis, hood, cover, each people name this with another word, but it's still the same. This is the part which is on the drone the most visible. This part has very high influence on properties and useful value. This is the topic which is good to know before purchase of vehicle or by maintenance or reconstruction.

With suitable sensors are these systems used for inspections in large and hard accessible technological and another units. Today usual available sensors for UAV are RGP, LWIR and MWIR thermo cameras. The exception aren't SWIR or multispectral systems. By deployment is not only using in non-accessible objects. Using of thermo cameras in connection with UAV brings to field technical diagnosis especially overview which is for a lot of diagnosis systems very important.

Decentralized or centralized systems for thermal supply include interconnected thermal sources, thermal structures and consumer devices. Under this we could imagine heating and supply of heated water for houses and industry companies.

Flying inspection of components has two major advantages: components above the ground are often located in hard accessible terrain and for localization of components which are located under the ground

(in case for localization of medium leakage from these components) is very important overview from aerial images. The thermal changes could be very small to be able to observe them from the ground. This situation is shown in the picture n.1, where we can see leakage of hot water from underground pipeline. Thermal changes on the surface with the dimensions are much bigger than men (see red circle) and this failure isn't possible to detect from the ground.[1], [2]

1.1 Construction of multicopters

In comparison with planes with hard wing isn't needed to have aerodynamic surface for the chassis of multicopters. Basically, it's very simple construction which the main task is hold the all the stuff. That means electronics, engines, camera and next equipment during the whole flight, in the best scenario during critical situation as well. Just this last-mentioned requirement shows that construction of chassis for drone requires a bit of knowledge and thinking. So basically, with enough power isn't problem to fly with almost everything, but only with good construction is possible to land and start again. In such case is possible to use this drone for useful tasks as well.[3]

1.2 The shape – advantages and shortages of solutions

The base selection of copters comes from number of engines, respective from propeller. Their number is the most often from three to eight (threecopter, quadrocopter, hexacopter or octocopter). Quadrocopters are the most common solution. For imaginations of functionality is good example as well. For another types it's not such easy to understand their functionality.

Overwhelming major of sale quadrocopters have chassis like a cross, where in the arms are usually build in drivers and on the end are engines. Electronics, batteries and next equipment are in the middle of chassis, basically in the middle of the cross. This is look of for example DJI Phantom.

The biggest advantage of this solution is simple and save of the weight. But for sure this solution has shortages as well. It's mainly relative easy damage of long arms by shock. Broken or cracked arm is the most often reason of failed landing or crash. Due to such crash could be damaged driver and engine as well. In case of one block is basically whole vehicle for scrap.

Chassis of commercial drones are in the most cases pressed from plastic – nevertheless of statement that plastic is fragile. Before construction requirements are here commercial view – serial production with huge amount and cheap material. Especially for cheaper vehicles is valid that their durability and endurance isn't on high level. Expensive solutions therefore using another materials, mainly light alloy, carbon or different sandwich construction. In the last days we can see using of 3D print. Information about materials are interesting for people which would like to build their own construction, or for people which would like to use old electronics and another stuff from old or crashed drone to the new one.

Carbon

Material which is in construction praxis and sculpture named carbon, is basically composite of carbon fibers and mineral resin. This material is extremely light and strong, due to this fact is used in flying or cosmic industry, in sport cars etc. This material has the shortage as well: expensive, fragile, strong only in few directions. His usage requires technical knowledge. Beside this manufacturing require special devices and procedures. In sculpture markets is possible to buy carbon boards, pipes and profiles. Is good to know that work with this material is risky

from health point of view and this material shielding of electromagnetic field. So we have to keep in mind this fact during proposal of antennas for communication.

This material is retailed for race copters, where every single saved gram good or for big professional copters. For rest of copter's portfolio isn't relevant due to more shortages.

Fiberglass

The same as in case of carbon, the fiberglass is composite. In this material is instead of carbon fibers glass fibers. Resin could be more expensive – epoxide resin or cheaper polyester resin. Fiberglass has little bit higher weight than carbon but is still lighter and stronger than another material. To this fiberglass offer next advantages: is resistant against adverse conditions, relative cheap and easily available. In simple conditions is possible to make almost any shapes. In case of good molds is possible very easy produce spare parts.

3D print

The possibility to propose complete chassis or single parts on computer and then "print" it with simple push of button is very seductive. The same is about production of damaged parts. This option is realistic only in case, if you have access to such 3D printer and knowledge about this process. Moreover, materials which are available for 3D printers today have no such good properties like alloys of aluminum or composite materials. This shortage of 3D print is solved with bigger thickness or complicated profiles. Again, is necessary to have knowledge from mechanical engineering, Of course 3D print is very perspective technology and is good to follow this technology.[5], [6], [7], [8]

2 Technical spectrs of aerial thermal diagnosis

The field of aerial thermal diagnosis brings few specifics and technical restrictions.

The first restriction is that no every single UAV is able to carry thermo camera. For example the most popular model in this category DJI Phantom has not enough carrying capacity and due to this fact isn't suitable for thermo camera. So is needed choose bigger vehicles with higher carrying capacity and with option of using tilting mechanism (gimbal). Flying time of such

vehicles is about 20 – 35 minutes, it depends on weight of thermo camera, conditions of battery, weather conditions, etc. For large aerial works is necessary to calculate with higher amount of batteries, which are important alternate and in case to charge.

Second restriction is about thermo camera. Thermo camera is good known device, which is very often used for maintenance and operation of industry companies. Usually are used hand cameras, which are used in case of preventive check or prediction maintenance or static systems used like the sensors for quality system and check of assembly line or for example in research applications.

In field of aerial thermal diagnosis is necessary to calculate with fact that in present days (by comparison with wide offer hand or stationary devices) is quite limited offer of thermo cameras which are compatible with some commercial UAVs and with software for postprocessing of aerial data.

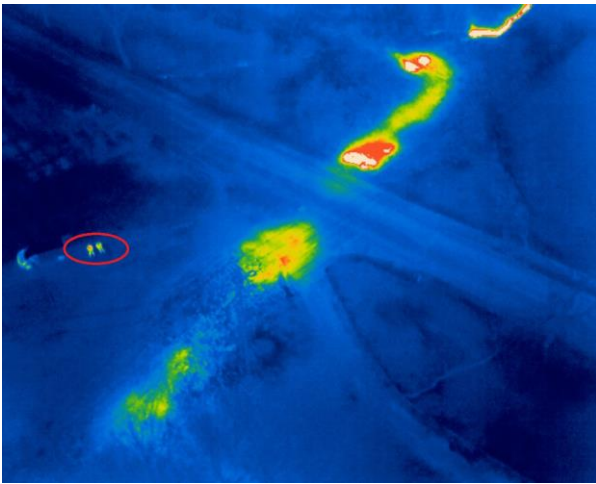


Fig. 1 The leakage of warm water from underground pipe line

Although these are classic thermo cameras with micro bolometric sensors, in case of usage with UAV they have to have communication interface due to remote control through the interface of UAV (bus PWM, S-BUS, CAN). These cameras have to be able store pictures with GPS coordinates as well. In ideal case it could be possible to control this camera with the same remote control. Unless is thermo camera equipped with corresponding communica-

tion bus, is possible shooting according GPS coordinates, altitude, etc. Good functionality is start of recording of radiometric video and automatic transfer of images according GPS coordinates. With this functionality is possible automatic choose of pictures from radiometric video according fly trajectory with defined distance. Of course, there is possible to setup single parameters and next functionalities during fly.

For illustration of technical devices, you can see on the Fig. 2 an example UAV DJI M600 with thermo camera Workswell WIRIS with resolution 640 x 512 px, lens 13 mm a thermal sensitivity 30mK.

3 Inspection of parts of heat supply systems

In case of inspection heat supply systems, we are focusing mainly on parts which could be located under or above the ground. In this application is using of thermo diagnosis matter of course. The steam or water with high temperature are carried by single components of heat supply system. Medium is insulated from external environment because of waste of heat and pressure. Damages on insulation have impact on the surface temperature and there are exist thermal bridges. Due to this fact we have quite huge thermal losses. On the picture n. 3 is possible to see higher amount of thermal bridges on the pipelines. Similar observations are quite often mainly on the older systems and this is caused by degradation of thermal insulation or not good finalization during the building.

UAV is possible to use very effective for localization parts of thermal supply system which are located under the ground. Is surprising that good insulated parts are visible by aerial checking as well. For this aerial checking have to be fulfilled few requirements: low temperature of air and ground and absence of sunshine. Such situation is possible to see on picture n. 4. Here was localization successful. In case of underground pipelines is aerial checking in comparison with hand thermo camera much more successful. Thermal changes are evaluated from higher perspective and this is not possible to do from the ground.[4]

The right question is maximal depth of installation of systems when is possible to sense thermal leakage. Answer on this question is not simply because it depends on amount of leak water, temperature of medium, temperature of the ground, influence of sun, etc. Common installation depth is 1 – 2 meters.



Fig. 2 UAV DJI M600 with thermo camera
Workswell WIRIS

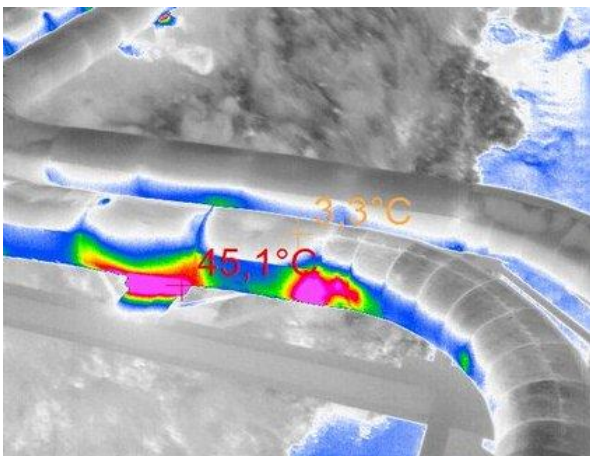
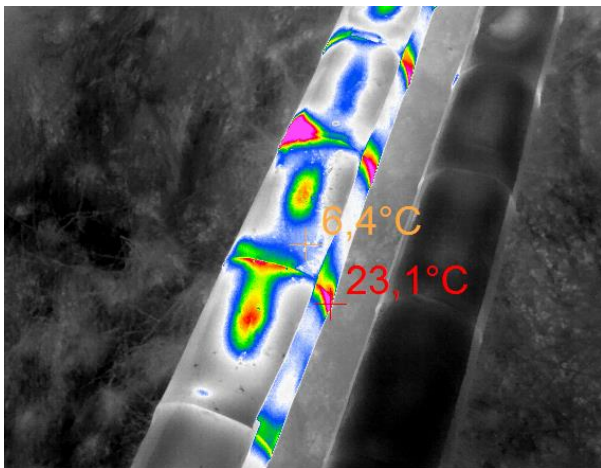


Fig. 3 Thermal bridges on thermal pipe lines

4 The law about unnamed aerial vehicles

This article wouldn't be complete unless we are not mentioned the law and few restrictions which are results of this law. Supervision for operation, certi-

fication of UAVs and pilot's licenses in Slovak Republic performs Civil Aviation Authority. Operations of UAV is in category civil aerial operation and therefore we have to keep valid legislative rules. According to law the flights are possible to carry out only for distance of direct visual contact with UAV (without any additional equipment it's about 200 – 500m). This rule is due to correct evaluation of situation around the UAV – some obstacles, etc. The flight with AUV could be carried out only in case of no damages on human health, property, environment and safe of flight. The flight with UAV isn't possible to everywhere. In general, the flights aren't possible to do above dense occupied areas, above persons without their approval, above roads and trails or in near of airport. Only Civil Aviation Authority could make an exception from mentioned rules.

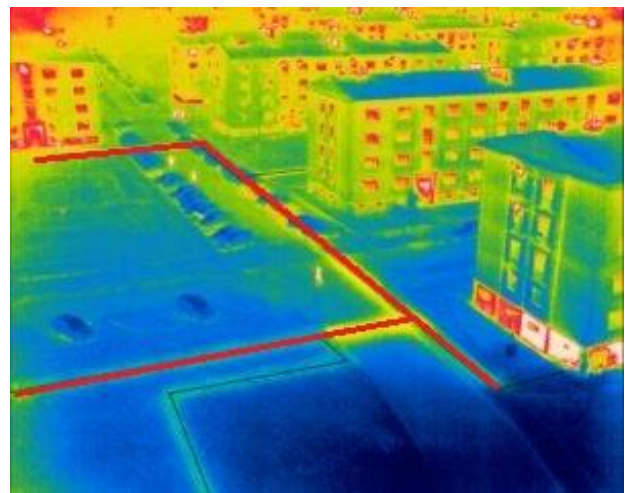


Fig. 4 Localization of underground pipelines with
aerial thermo diagnosis

The flight of plane could be carried out with two options: like a service for payment or aerial activity for your own need. In both cases in necessary to have permission from Civil Aviation Authority. For this you have to make theoretical and practical exams.

5 Conclusion

In the face of law and technical restrictions is aerial thermo diagnosis field with good perspective, in field of technical inspection of thermal supply systems as well. Deployment of this technique isn't only about measurement in hard accessible places, this brings to the field of technical diagnosis mainly the overview, which is in the lot of situation very

needed. In consideration of growing availability of UAV, technical and software equipment we could expect that we are on the beginning of new trend – deployment of UAV in field of technical diagnosis.

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