Pipeline inspection with thermal diagnostics

Pipeline – this is defined as a "special form of transport used to transport liquids (i.e. liquids and gases), or liquid mixtures with solid particles". The issue of thermographic pipeline inspection applies to long-distance piping systems supplying variable media with a temperature different from the temperature of the surrounding atmosphere. By using thermographic systems, it is possible to determine and localize defects to pipeline insulation and leaks of the transferred media. In some cases, leaks can even be determined and localized in underground pipelines.

Introduction to the issue

In practice, this can concern water piping (hot water piping, water mains), steam piping, product piping (crude oil or gas piping), piping in chemical operating units, the food industry, agriculture, power plants, mines, etc. Moreover, in most cases, the pipeline not only transports material but is used to supply the heated energy related to the transferred medium. This is related to the issue of heat insulation on pipelines and determining pressure losses in pipelines. The whole transport system must be completely sealed because leaks of media are not only mass, energy and economic losses, but often ecological losses.

A pipeline is technological equipment that transfers heat used to heat residential and public buildings or whole towns.

For more information about thermal imaging systems for drones or about this application please visit:

www.drone-thermal-camera.com

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The reliability of the piping can suffer through poor design, improperly selected material or a defective construction of the whole transport system or from unexpected conditions when in the operation. This text deals with external piping systems that are permanently affected by atmospheric influences and are threatened by unpermitted interventions (mechanical damage due to lack of knowledge, accidents or intentional actions). The damage can be reflected as weakening of the cladding on the external insulation and leaks of heating energy, as well as breaks in the piping and the loss of the transported medium. At the same time, there is the risk of the wear on the thickness of the piping through internal corrosion (during the transport of aggressive liquids) or mechanical stressing (in the case of the transport of non-homogeneous materials with solid particles).

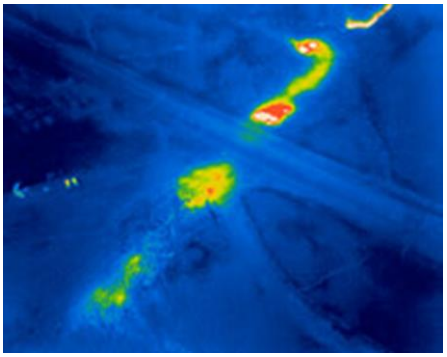
Aviation inspection of pipelines

Due to the risk of losses caused by defects in the piping system, it must be regularly and carefully checked. Unfortunately, it is usually in practice that there is a higher probability of damage to the pipeline; it is more difficult to check it. Pipeline systems are often located underground or run for many kilometres where access roads are restricted, the surrounding nature is not attained and access to pipelines is incredibly difficult or impossible. It is not humanly possible to visually check everything and fitting built-in measuring systems (pressure meters, flow meters) is financially demanding and not too reliable because it does not cover all risky places.

This hot-water pipeline appears to be fine during visual inspections. As we will mention later, there are many thermal bridges on this pipeline that reduce the efficiency of the transport of thermal energy. Traditional cameras do not detect defects on internal heat insulation and leaks below the surface of the ground.

To resolve the problem of inspecting long-distance pipelines, an elegant and simple solution is available at first sight. Application of UAV with a camera that can fly above the whole length of the pipeline while recording and displaying the monitored scene in real time.

The operator controlling the drone from a safe place has an immediate overview of the condition of the pipeline and if identifying a defect, can focus in detail and personally check the area. However, a traditional camera for the visible spectrum discovers only a fraction of the defects, or records only areas with visible damage or leaks.



A hot-water pipeline heats the surface of the ground and, therefore, can be detected by a thermal camera located on the drone. Using this camera, areas can be detected where the pipeline is broken or where the penetration of hot water heats up the affected earth.

A traditional camera does not detect defects to internal heat insulation and the escapes of media below the surface of ground. With the timely discovery of areas where the insulation is thinner or where the cladding on the tube is damaged, major accidents can be prevented that would result in economic losses and a threat to the health and lives of the public. A thermal camera can detect such defects and record the thermal radiation of objects. On the basis of the difference to the surface of the pipeline and the experience of the operator, hidden defects can be found. It is easy to identify where the insulation is damaged and heat losses occur (during the transport of heating media). In the case of underground pipelines, any penetration of hot water causes the affected earth to heat up so it is possible to discover where the pipeline is broken underground. This means that, it is no longer necessary to excavate kilometres of pipelines due to the discovery of the place of escape. The different temperature of the background and thin areas mean there is a risk of the pipe breaking so timely intervention may prevent fatal consequences.

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Why choose a Workswell WIRIS system?

Workswell WIRIS can be fully controlled using a traditional RC controller from which all functions of the system are accessible. In addition to all functions, the monitor displays images from the thermal camera as well as the colour camera.

The Workswell WIRIS thermal imaging system for drones is designed for assembly on the drone (UAV). **The set is light, mobile and fully controlled using a standard RC controller**. The system combines two camera systems - **a camera for visible spectrum (for inspection of visible defects on the piping) and a thermal camera (for detecting hidden defects). The servicing software enables to remotely switch camera regimes, to record radiometric videos and to make static images in the visible, as well as the infra-red spectrum.** The operator sees objects under the drone in real time or can analyse records to identify damaged areas.

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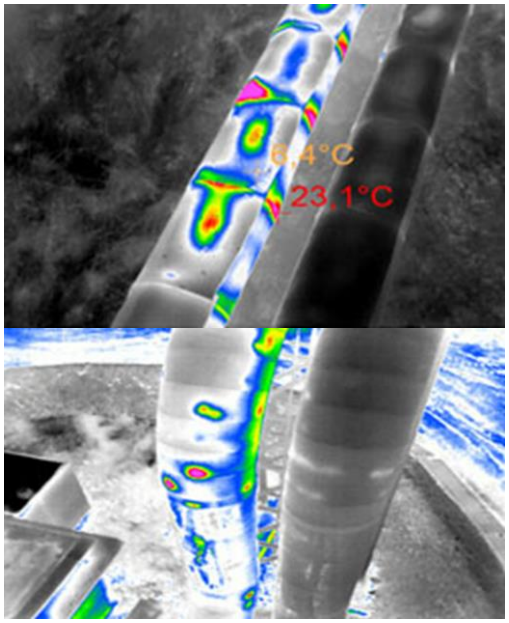
Moreover, Workswell WIRIS, unlike similar systems, enables to manually set the range of temperatures, e.g. in the interval 15 °C to 25 °C. Even this range of temperatures can be changed during the flight. Without landing, the actual situation can be set in the system to easily achieve the thermal sensitivity setting, **which is required for the localization of minor hot water leaks below the surface of the ground** or for the most precise localization of large defects. Moreover, the system can be fitted with a **GPS sensor** for storing information on the position of the drone when producing a record.

The system can measure temperature in the central point, as well as in the local minimum and maximum. The minimum and maximum are localized by blue (minimum) and red (maximum) crosses. This function can be used to navigate drones because the system automatically shows where the largest potential problem is located.

However, Workswell AIRvision also offers further functions suitable for this application: **for example, continuous ZOOM** (up to 14x for a thermal camera and 16x for a colour camera) for exact localization of the problem or to control NUC calibration so it is done at the right time.

Moreover, the Workswell WIRIS system is fully calibrated. During production, the exactness of measurement is checked and delivery of the system includes a calibration sheet with the stated precision of the measurement. The measurement results are then detectable.



Although in the visible spectrum this hot-water pipeline is completely without defects, the measurement of thermal camera shows that on the left hot-water pipeline there are a series of thermal bridges resulting in thermal losses.

Summary

The combination of visual and thermographed inspection using drones can discover a series of potentially hazardous problems before they become dangerous or financially demanding. Moreover, the whole system is universal and can also be used in a series of other industrial applications, not only during the inspection of pipelines.

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