THE POWER OF UAVS

UAVS HAVE MANY STRENGTHS, BUT HOW WOULD THEY FARE WHEN TRYING TO INSPECT POWERLINES IN HEAVILY FORESTED AREAS ON THE CZECH-GERMAN BORDER? JAKUB KARAS EXPLAINS HOW NOT ONE BUT THREE DIFFERENT TYPES OF UAV ARE NEEDED

UAVs have great potential in the energy sector for technical aerial inspection, mapping and monitoring. In the Czech Republic, Upvision has carried out various kinds of testing of UAVs, including inspecting insulated power lines for the largest Czech electricity provider CEZ.

Very often, damage occurs to the insulation of isolated power lines in difficult, inaccessible terrain, primarily in forests from falling branches. It has been impossible until now to check and identify the sites of damage, because it must be done from above the power line.

Upvision tested various UAVs and techniques of aerial inspections along a more than 4km stretch of power lines in the forested area on the border of the Czech Republic and Germany.

The site selected for inspection meant that only three different types of professional UAV with various outputs could be used, but the UAVs that offered the best options for moving in heavily accessible terrain when flying in visual range of the pilot were used.

The following outputs of aerial inspection were tested:

- Orthogonal photos with overlaps at low altitude (about 10-15m) over the power line
- Aerial video documentation
- Mapping (orthophoto and digital surface model)

To map the power lines in millimetre resolution, we used the medium-sized Geodrone 6 to map smaller areas or line structures. This was designed for the inspections based on the German Mikrokopter platform, with our own modifications. The camera mounted on the UAV was a professional SLR Canon EOS 700D with interchangeable lenses (four different focuses).

This UAV can image the required area automatically using a flight plan, which can be activated after take-off. Alternatively, mapping can be done manually, with photos manually taken from the UAVs or using an auto-exposure time series determined by the airspeed and the overlap needed between photos.

The creation of aerial images with overlaps over power lines from a UAV is one of the best possible outcomes with respect to the use of professional cameras with interchangeable lenses of various focuses for zooming the resulting images. At the same time, this is the best possible method to accurately synchronise the GPS positions of the

photos taken. Professional UAVs are designed to record the GPS location mapping centres of each photograph; it is therefore then easy to trace the position of possibly damage.

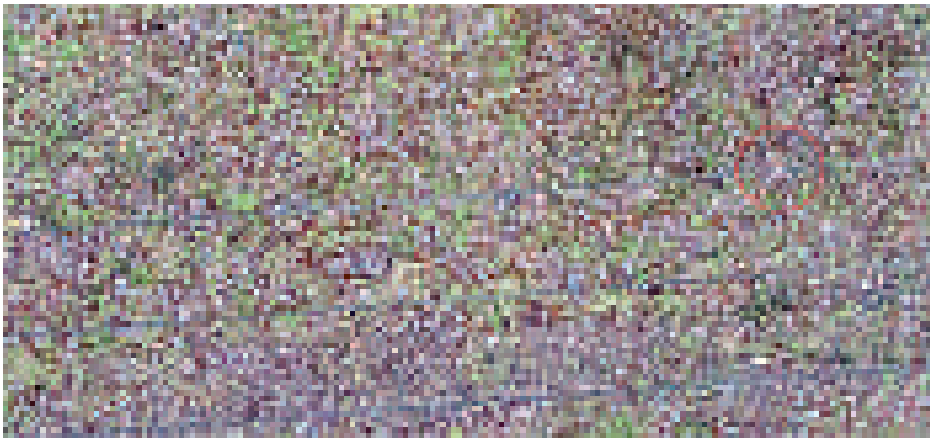
The output of this method are the original aerial images overlaid on each other and coordinate centres (external orientation) for all the images. For the best quality aerial images, the RAW format is used, which can be further improved during post-processing to deal with bad weather conditions, eliminate shadows, improve sharpness, increased brightness and so on.

In addition, the UAV can be piloted by one person while another controls the recording of images and the degree to which they overlap. The method is also appropriate for the challenging terrain, as all UAVs in the Czech Republic and the rest of the EU must be operated within sight of the pilot.

Video documentation

We also tested aerial video documentation of the power lines using a bigger UAV: the DJI S1000, with a camera and special lens for recording in 4K resolution. This provides both high resolution and detail, although the quality is inferior to photos taken using a professional SLR camera. In addition, while the recorded video can be exported to individual photos, these images suffer more from motion blur so are more suitable for use on open exterior sections and for monitoring at a lower altitude over power lines.

Digital surface model as textured point cloud (© Upvision)



A damaged power line – the red circle indicates where the insulation has been damaged by a falling tree branch (© Upvision)

Narrow slits in the forest with power lines where the UAV identified damage (© Upvision)

Image of a power line taken from a UAV (© Upvision)

Aerial monitoring from a UAV of a high voltage pylon (© Upvision)

The inaccessible terrain makes controlling a UAV harder, because of its size and the need for two people – one to fly the UAV, the other to capture the video. There are other, smaller UAVs that offer professional 4K video, but most of them assume one person will be controlling the UAV and capturing the video, which is too difficult in this kind of terrain and risks greater blurring of the photos from the videos – biggest problem in the case of identifying damage is determining from the video the GPS location of the damage.

Aerial video documentation is therefore suited better to monitoring power lines in the open field or electric poles.

Orthophotos and mapping

To create orthophotos in high resolution, we used a professional UAV, Topcon's MaVinci Sirius, with a Panasonic GX1 camera located in its 'belly'. The Sirius can take off from the hand, rather than a launch pad, which offers considerable advantages in handling and transport, as well as ease and the space required for take-off. Among the Sirius' unique features are that it can fly both automatically and manually by remote control, which is convenient for landing in a relatively small area of about 50m or on the road and in less accessible terrain.

The whole 4km-long area was mapped in two flights of the UAV in less than an hour. On the ground after landing, it was possible to check the condition of the forest and power lines and identify the most problematic places where branches extended over power lines.

Identification of small damages does not require extremely high resolution, so an orthophoto resolution of 2cm/px is still sufficient. Such orthophotos can then be used to control sections of power line and imported as a current layer into a GIS, as well as serving as the basis for new projects or maintenance, whether for GIS developers or administrators and as the current raster position basis. Moreover, they can be used to generate digital surface models (DSMs) or 3D model environment. DSMs can serve as a basis for designing altimetry, route-planning for reconstruction, contour maps, terrain profiles and various analyses, including visibility and signal.

In addition to checking the status of power lines, it is very convenient to use UAVs for aerial inspection of large pylons, as it makes climbing inspections much rarer, greatly reducing costs.

UAVs have a great future in the energy market, increasing the efficiency of checks and inspections and making previously impossible outcomes possible.

UAVS HAVE A GREAT FUTURE IN THE ENERGY MARKET

Jakub Karas is co-owner of Upvision (www.upvision.cz)