Traffic monitoring UAV in the air just after take-off

HELP FROM ABOVE

MONITORING FROM ABOVE LITERALLY PRESENTS NEW PERSPECTIVES IN OPTIMISING ROAD SYSTEMS THAT ARE EXPERIENCING CONGESTION. RENÉ LUND HANSEN SHOWS HOW ONE DANISH FIRM IS USING AERIAL VEHICLES TO HELD THOSE ON THE GROUND

New challenges call for new solutions. This is also the case with an increasing level of traffic on the Danish roads. Expanding a traffic system by building new roads is expensive and therefore road authorities demand advanced solutions that can optimise existing traffic systems.

These advanced solutions however require comprehensive and detailed data inputs and analysis to point out the exact issues in a given area of congestion. Therefore, COWI has started using UAVs to monitor and analyse traffic flow. The use of UAVs as an alternative to manual inspections, as well as semi-automatic traffic-data collection methods placed on the ground, has many advantages including the ability to detect drivers who act inappropriately and determine why. It is also possible to analyse several traffic streams and their effects on each other at once. Finally, video recording using a UAV obviously secures a unique documentation of traffic observations that we cannot obtain when standing on the ground.

COWI has been using UAVs for various purposes for the past four years, including 3D mapping and modelling, high-resolution photography and visualisations. Last year, we began using UAVs for traffic monitoring, which has proven to be a valuable tool, especially after finding solutions to some of the built-in limitations that come with UAVs themselves.

Congestion at a roundabout in Randers

The municipality of Randers in Denmark has experienced high levels of congestion at one of the city's central roundabouts, and it is assessing different solutions. Before making a decision on which solution to implement, the municipality needed a thorough analysis of the level of congestion, as well as the reasons for the congestion, such as traffic backing up from other nearby intersections.

COWI organised a non-stop UAV-recording of two hours of traffic during the morning and afternoon peaks in June this year. We conducted the recordings from a flying height of approximately 60m and we recorded the video footage in full HD, allowing us to present videos on high-resolution screens so we could see even small details in the footage.

We determined the position of the UAV for the recordings based on two conditions. First, we needed to keep the necessary safety distance. Second, we wanted to be able to follow the traffic flow going south to and from the roundabout in the direction of the bridge crossing the river that runs through the city.

An in-depth analysis of the footage showed that a number of different conditions contributed to the congestion at the roundabout. It was also clear that the congestion caused traffic to back up on all roads

Roundabout in Randers, Denmark. Congestion allows no traffic to get through and causes traffic to back up all incoming road

leading to the roundabout, resulting in a classic gridlock spreading throughout the city. We conducted our analysis in several steps, starting with a vehicle count that documented the amount of traffic passing through the roundabout. We compared the count with the expected capacity of the roundabout and used the difference between the two as an expression of the level of congestion.

Combining this detailed knowledge with another of our key business areas, traffic management, enabled us to design a solution addressing the documented issues. Hence, using a UAV for collecting traffic data made the difference.

During the next couple of months, we expect the municipality to make a decision about how to improve the flow of traffic, based on our findings.

Lane changing on a motorway

The Danish Road Directorate has established a pilot project to replace the emergency lane with a parallel traffic lane, which drivers should consider as an extended entrance/exit road. This means that road users who enter the motorway should leave the parallel lane at the beginning of the stretch unless they plan to use the coming exit.

Motorway E45 outside Kolding, Denmark. Video footage allows us to detect unfortunate traffic behaviour in terms of lane changing

To evaluate whether drivers use the parallel lane as intended, COWI used a UAV to monitor traffic on a section of the motorway. On the recorded footage, it is possible to register whether drivers leave the parallel lane after entering the motorway or stay in it.

We conducted the recordings from a maximum height of roughly 65m, as we wanted to be able to analyse the longest possible stretch in one recording. In this case, the recording covers close to 500m of motorway – the longest distance we have analysed in one recording so far. We chose the position of the UAV by considering the legislative limitations, combined with a request to capture both the weaving sections of the motorway as well as the regular sections.

We have started the initial analysis of the footage. This involves registering the number of vehicles using the parallel traffic lane as intended and unintended respectively.

We conducted the recordings in June and have not yet concluded the results of the analysis. It is, however, clear that the use of UAVs allows us to evaluate the project, which simply could not have been carried out through a manual inspection on the ground or by car due to the large area we needed to monitor simultaneously.

Current challenges

The use of UAVs for traffic monitoring and analysis is not without challenges. The most important challenges in Denmark are in regards to legislation, which is very strict. Legislation prohibits flying closer than 150m to large public roads and densely populated areas, unless an exemption has been obtained. Even with an exemption, licensed pilots must never fly a UAV closer than 50m to public roads. Obviously, this limits the use of UAVs for traffic monitoring, as most roads are in urban areas. Also, not being able to record footage directly above intersections, for example, limits their use.

There are also technical challenges. COWI currently uses a specially designed UAV for our traffic monitoring assignments. The UAV weighs just less than 7kg, as we need a high degree of stability when flying in windy conditions. Consequently, the needed power is rather high. The known balancing of battery capacity versus weight gives us roughly 20 minutes of flying. However, this is just not enough when conducting proper traffic analysis. Flying and recording non-stop dictates powering the UAV using a ground-based power supply connected to the UAV using a power cable. But as cable weight increases proportionally with its length, this limits the flying height to approximately 65-70m.

The future

We expect the use of UAVs to increase dramatically over the coming years. Competition will grow, and we anticipate cheaper, low-quality solutions to flood the market.

For now, we have obtained a very good, balanced solution for using UAVs to obtain traffic data. However, the need for increasing usability and quality for traffic monitoring at the same time as reducing costs means that we are constantly on the look out for bettering overall performance.

We believe UAVs will allow us to monitor traffic while collecting traditional data such as counts. We are close to being able to conduct fully automated counts using specially designed software that detects all vehicles entering an intersection and registers their following exit. This allows us to both count the amount of traffic as well as work out an origin and destination analysis.

WE HAVE OBTAINED A VERY GOOD, BALANCED SOLUTION FOR USING UAVS TO OBTAIN TRAFFIC DATA

René Lund Hansen is a traffic planner at COWI (www.cowi.com)

Beta version of software automatically counting traffic at a large roundabout north of Aarhus, Denmark. The software detects, marks and follows every vehicle entering and exiting the roundabout