

THE USAGE OF UAV IN THE TRANSPORT OF OVERSIZED CARGOES

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Abstract

The article deals with the usage of UAV in the transport of oversized cargoes on roads in the Czech Republic and abroad. By using the UAV technology, the transports during passage via critical points of transport routes (intersections, roundabouts, bridges) were monitored. The technology was also used for verification of swept paths of vehicles, analysis of construction elements of intersection and geometric elements of intersection. On the basis of obtained data, the parameters of roads are suggested. These parameters enable transport of such cargoes. At the end of the article there are examples of further usage of UAV for the realization of research projects in the area of transport constructions and traffic engineering.

Keywords: UAV, oversized cargo, intersection, roundabout, swept paths

INTRODUCTION

The heavy industry, iron and engineering production and the subsequent transport of excessive cargoes have a long history in Europe. Traditionally, ironworks and engineering works produced custom products of oversized dimension and weight. Their transport is done by rail, waterways and on roads. It is very difficult to transport products by rail with respect to the clearance gauge and radii of arcs. Water transport also cannot be used fully in our conditions, or it is restricted by navigability of watercourses. It is necessary to carry out the transport on chosen routes of road infrastructure with the assistance of special vehicles. The road network not only in the Czech Republic but also in other European countries is not dimensioned for these transports. The backbone routes which would ensure the spatial requirements for the passage of transport are missing completely.

On the basis of these aspects, research has been conducted for a long time at the Department of Transport Constructions. For example, within the project TA ČR ZÉTA “Determination of parameters of backbone routes for transport of oversized and excessive cargoes”. The aim of the research is to determine technical recommendations, a map of backbone routes in the Czech Republic and the creation of models of vehicles for software verification of swept paths. The transport of oversized cargoes on roads and critical points of transport routes (intersections, roundabouts, bridges) are monitored. For the measurement the newest technological equipment for subsequent analysis and data processing is used. It includes special types of cameras and cameras with wide shot image, 360° video cameras and cameras, cameras with slow motion function, thermal cameras and also various types of UAV. Without the UAV technology it would be very difficult to obtain necessary data for subsequent evaluations. Fig. 1 shows the used types of UAV.



Fig. 1. Used types of UAV

ANALYSIS OF THE IMAGES OF QUADCOPTER DJI F450

Several types of UAV were used for monitoring the transport of oversized cargoes. This technology has been used since 2013 when the quadcopter DJI F450 was purchased. The quadcopter was fitted with mechanical hitch with a camera GoPro Hero3. Further, it was also equipped with Spironet antenna, telemetry unit Graunper, DJI NAZA-M unit for receiving GPS, DJI iOSD Mini unit and Li-po battery for power.

An illustration of usage of DJI F450 in transport of oversized cargo is shown in Fig. 2. It was very important to record the passage and the overall behaviour of the set during the transport. It was a set using bearing structure of load, which is distributed between two independently controlled 16-axle low-loading trailers. In such a type of transport it is very difficult to monitor its course from cameras located in terrain.



Fig. 2. Usage of UAV in transport of oversized cargo

Acquired materials from quadcopter DJI F450 were further analysed. There was an analysis of the image done, unwanted curvature was removed (sc. fisheye) – the image was verified and smoothed for subtraction of

distance from solid obstacles. The speed of transport, the turning of wheels on the trailer and the behaviour of the trailer were analysed. The obtained materials were supplemented by video and photo documentation from the country.

On the basis of technical information from the manufacturers of the low-loading trailers the model of the vehicle including the transported cargo could be done in the AutoTURN program (program for verification of swept paths). This model was subsequently verified with the data obtained during the transport of the cargo. GNSS technology is also used for more complex types of vehicles. Fig. 3 shows an example of created vehicle in AutoTURN program on the basis of the verification from UAV.

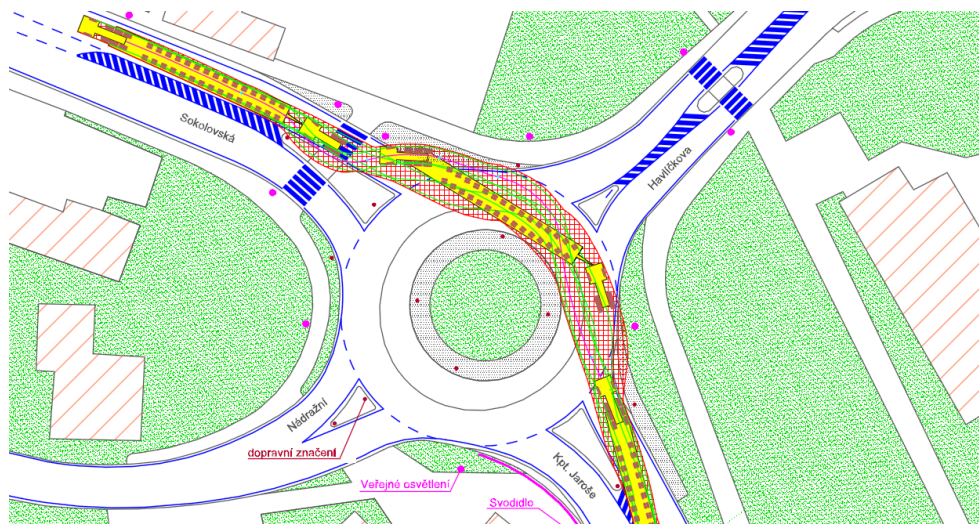


Fig. 3. Swept paths of vehicle in AutoTURN program, paths were verified on the basis of the data with UAV

MEASUREMENT ABROAD

Currently, the newest types of “drones” are used in the realized research. For the measurements the drones from company DJI (MATRICE 210 RTK, Phantom, MAVIC - ZOOM, ENTERPISE, AIR) are used.

The measurements, which were realized abroad, were focused on the passage of oversized cargoes carrying blades of wind power plants. Critical points on the route of the transport were monitored. These were mainly roundabouts, where special modifications for ensuring the passage were made. Because there is not currently any regulation in the Czech Republic, which would determine geometric and technical parameters of intersection for ensuring a passage of oversized cargoes, the technology UAV was used for obtaining necessary data. The intersection was surveyed with the help of UAV and then analysed on the basis of photogrammetry of processed orthophotographs, but also from photos and videos taken during the passage of the cargoes.



Fig. 4. Modification for passage of the cargo on the roundabout in Poland and roundabout in Denmark

Data obtained from the measurements abroad are necessary for the determination of parameters of roads and for ensuring the passage of oversized transports.

CONCLUSION, FURTHER USAGE OF UAV TECHNOLOGY IN TRANSPORT CONSTRUCTIONS

The method that has been applied to the transport of oversized and oversized cargoes has applications in other areas. The main area is the use in traffic construction and transport engineering. Using this method, it is possible to map and detect fault points on the road (building elements). This is interesting for communications managers. Furthermore, it is possible to use the proposed procedures in police work. These are traffic monitoring, conflict analysis, risk detection. It is also used for road safety auditors in their traffic surveys. Cooperation was also established for image analysis, where it is possible to apply the gained experience from the method to the automotive industry. It is an analysis of the passage of cars at roundabouts. These UAV measurements will then be analysed in the DATA FROM SKY program.

The UAV technology is widely used for realization of research projects in the area of transport construction and traffic engineering. In the field of traffic engineering it is used for video analysis of conflict situations (intersections, roundabouts and turbo roundabouts), acquisition of continuous records for traffic-engineering analysis (intensity, speed, distance, etc.), or for the usage of the output for analysis of image in special programs and monitoring the traffic. In the field of transport constructions it is used for photogrammetry, analysis of building elements and geometry of the intersection, etc. Fig. 5 shows conflict situations, analysis of image and traffic-engineering research on roundabout in England.



Fig. 5. Conflict situation of lorries, analysis of image of turbo roundabouts and traffic-engineering research on atypical roundabout in England.

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