The obtained mathematical model allows to evaluate the reaction of the trolleybus steering system to the control effect created by the driver of the vehicle, as well as the speed of the steering drive.

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FULLY AUTOMATED SHOTCRETE ROBOT FOR ROCK SUPPORT

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1 Shotcrete application on site

Shotcrete is used worldwide as temporary or final lining in tunnels or in building pits. The application of shotcrete is strenuous and, because of this, tiring if it is done manually by a nozzle operator. This holds especially for the use of wet shotcrete. The capacity that may be handled is less than 5 to 8 m3/h when spraying manually and normally up to 20 m3/h by using manipulators (30 m3/h were already applied).

Shotcrete application as the first step of rock support often has to be done in a zone of danger (rock fall). With use of the robot, the safety of the worker can be improved. The handling of the robot is easier and less strenuous than steering a manipulator. A basic difference between common manipulators and the new robot is that the user steers the movements of the nozzle directly. He or she does not have to take care of the different boom joints. In the manual and semi-automated mode, the nozzle operator judges the surface himself or herself to get the required application. In the fully automated mode, total control is by the robot.

2 Delimitation from industrial fabrication robots

The handling of the robot tool, the spraying nozzle, is robotized according to industrial fabrication. Different are the positioning of the carrier vehicle and the recording of the geometric dimensions. In a spraying cell, the manufacturing area is fenced off clearly. The carrier drives in corridors and always repeats the same pattern of motion. The dimension data are transmitted out of CAD drawings.

Blasted tunnel excavation means varying sections that are not constant not even in a round. The theoretical tunnel section is given, and the excavated sections have to be measured every round. While measuring a round, the self- positioning of the robot carrier is effected (these data are stored and available at any time). Any shotcrete application with a specified layer thickness (effective, theoretical) is a prototype. The path planning of the vehicle is no topic for the automation for safety reasons.

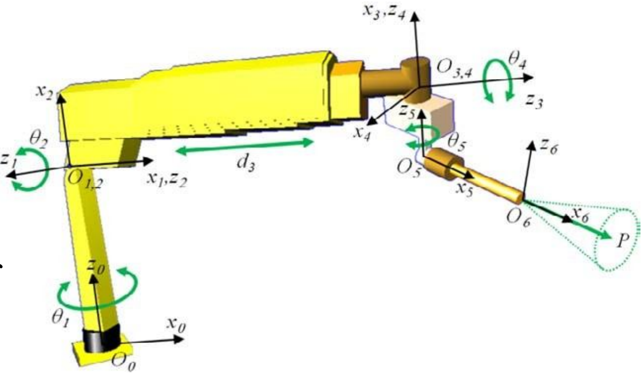
3 Process automation and control system of the shotcreting machine

In tunnelling, after the advancement (drilling and blasting) stage, shotcrete is used to cover the surface of the roadway to create a support on the working area inside the tunnel. The advancement stage is made by introducing explosives in the face of the tunnel and making a controlled blast. But, as controlled as the blasting can be, the dimensions of the resulting surface are completely unstructured and thus, one of the implicit difficulties involved in the shotcreting process that has avoided its automation.

Three steps have been defined for the automated shotcreting stage:

1. Pre 3D LADAR scan of the working area.
2. Automated shotcreting process.
3. Post 3D LADAR scan and layer quality evaluation.

The first step of the automated process is basically done by imaging the working surface of the tunnel with a 3D LADAR scanner (the LIDAC-16 developed by AITEMIN).



Picture 1 D-H configuration of the manipulator.

The information acquired from the first scan is then used by the main control system of the machine to generate the trajectories to shotcreting a layer. Finally a second scan is made in order to evaluate, subsequently, the quality of the layer and the amount of concrete used.

This information can also be used to optimise the control parameters of the automatic shotcreting system.

4 Robotization of the shotcreting machine

The shotcreting machines are based on manipulators that as an end tool they have a nozzle to spray the concrete fed by a concrete pump. It is to be noted that the best way to spray the starting mix into a wall is by keeping the spraying vector perpendicular to the surface of the selected area, at a certain distance that may vary between 1 and 1.5m. Furthermore this type of machinery hasn't been designed for automation purposes but for manually controlled labour. This implies that some additional factors like mechanical deformations, backlashes, or the control type of the actuators have to be taken into account in the control system of the machine for precise positioning.

The proposed control system has been designed to use the real-time layer thickness estimator and the roadway geometry information to feedback and adapt the trajectory control according to the conditions in order to produce high quality concrete layers.

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DEVELOPMENT OF THE DOCTOR APPOINTMENT BOOKING SYSTEM PROTOTYPE

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In the summer of 2017, the Ministry of Health Care of Ukraine announced the launch of the e-medical system for doctors and patients – that is the eHealth System. Some of the opportunities this system provides are making medical appointments and making arrangements for doctor house calls via the Internet. The switch to the electronic appointment system is not mandatory for medical institutions. But it is assumed that it will be more and more difficult to work without an electronic database in the future. You can make a medical appointment at different websites. The medical institution chooses on its own which of the developed information systems to connect to.

Now patients at public service bodies are making online appointments via such information systems as the Helsi Medics Polyclinic without queues, My Med Cabinet, Dr. Eleks, MedCard, Emsimed, medstar, eLife, and others. All the websites have quite a simple design and can even be used by those with little bit