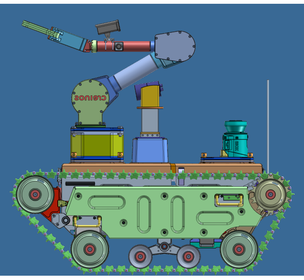
Robot for search of human beings in incrushes and avalanches



Introduction

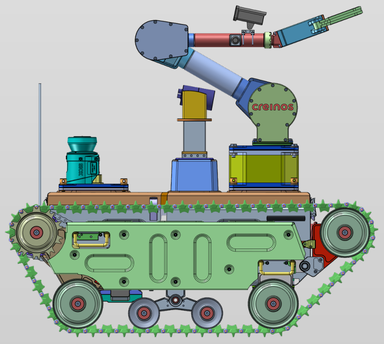
This project is devoted to the problematic of research and development of technologies for rescue robots. The result of this project will be utility and industrial model of rescue robot, which will be used for search of human beings in incrushes and avalanches. Intelligent sensory and navigation systems will be able to optimally navigate the robot on the incrush or avalanche and to avoid dangerous places if possible. It will be able to detect human beings under the incrush or avalanche. Main aim of this robot is to systematically search in critical areas where it is not possible or is dangerous to dispatch human rescuers.

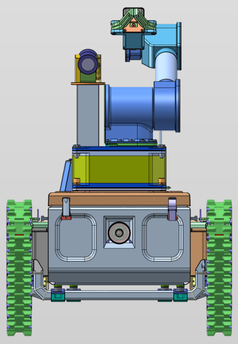
Mechanical design

The robot is designed with two tracks where each track has active drive. This option has proven to be the best compromise in terms of low difficulty and for good possibility for passing of the terrain. The chassis has a removable track's (for caving and snow). Surface of the entire robot is also decontaminable, it is designed for operation in chemically contaminated areas.

a) The body of the robot

Basic idea of the body structure is simple shape and modularity, so the possibility of some connection of optional components. The body therefore allows modular connection of other functional units. The modules are removable and stackable.

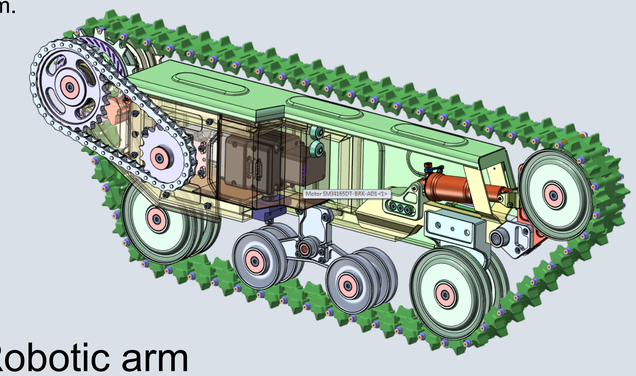




b) Track module

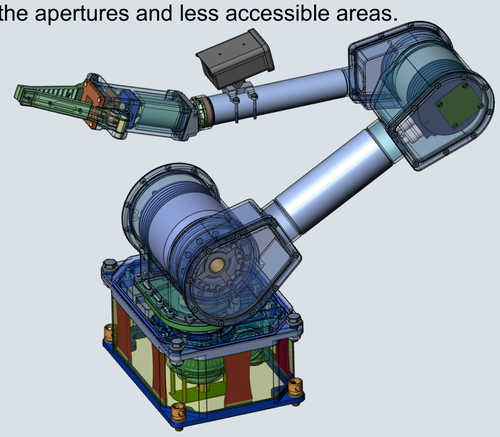
The following picture shows the concept of track module. It is a independent element of the robot which includes wheel suspension belt, belt tensioning mechanism, dynamic break, engine and one driven wheel. Due to the expected size of the whole robot the diameter of the drive wheel was chosen 200mm.

Drive of the robot is solved by two independent motors SM34165DT from Animatics company, which also contains static break. Dynamic break is ensured only by own motors. They have a power up to 615W with torque 3,39Nm.



c) Robotic arm

Robotic arm allows manipulation with small objects e.g. obstacles. It is able to work in 360 degrees horizontal angle and has maximal accessibility of 950 mm. Manipulation head is able to catch object up to 100 mm large and 2 kg heavy. Another aim is to explore neighbourhood. On the manipulation head are placed a camera, thermal camera and microphone which are able to take a look to the apertures and less accessible areas.



Sensoric system

a) Localization and navigation of robot

We are using typical sensors for this field. It includes stereo camera, LIDAR, ultra sonic range finder, 3-axis accelerometer, 3-axis gyroscope and differential GPS. Virtually all information are sent to the operator. Fully autonomous mode is not planned.

b) Active systems for searching people

These systems consist of two devices. One is carried by person, which needs to be found. The second is used for searching.

Well known devices specialized for avalanche rescue are avalanche transceivers. These devices are carried by skiers and skialpinists. Normally the device is in transmit mode at frequency 457 kHz. In case of avalanche, the rest of group switches the devices to the searching mode and tries to find for buried people. We are using avalanche transceiver BCA Tracker2 (see image). It has good results and its user interface can be processed easily.

There are other systems for avalanche rescue, like system RECCO. It consist of reflector, which is part of outerwear. Rescue teams have special detector, which is searching for reflected signals.

There are also other active systems, which are using devices carried by “modern” people. We are able to locate person using GSM, BlueTooth or even Wi-Fi technologies. Our plan is to use GSM and BlueTooth localization.

c) Passive systems for searching people

These systems are directly searching for person. The results are typically slower and less accurate, but person don't need to have any special device.

Basic methods use camera or microphone. Infrared cameras can be also used. The potential region is found by infrared camera and output of standard camera is masked. We are using all of these sensors.

For searching of people behind the obstacles, we are using special through wall radar technologies. We are using ReTWis, which is based on Ultra Wide Band technology. Small movements of human body are detected (breathing, heart throbs). Depending on configuration, it can detect buried person at a distance up to 20 meters.

We are also in phase of testing Ground Penetrating Radars. These radars are used to image the subsurface. As they are also used in archaeology research, there is probably chance to find buried people.

Acknowledgement

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