Drives for high-mobility robot

The Chaos mobile robot from Autonomous Solutions is an autonomous tracked robotic platform designed for high-mobility in areas with challenging terrain. It can carry a wide range of sensors and payloads. The high-mobility is a result of four tracked arms that provide both high speed and strength. A real-time distributed control system controls each tracked arm independently, allowing agility and versatility in steep, uneven, and loose terrain.

The Chaos robot’s four tracked arms use each two Whistle digital servo drive motors by Elmo: One for rotating the arm and another for track locomotion. The arm’s rotation allows the robot to change its posture, climb over obstacles, elevate its body, etc. and the tracks provide the locomotion and steering. The matchbox-sized servos provide CANopen connectivity. The drive’s 1,6-kW continuous power output (20 A at 80 VDC) provides high arm torque and rapid changes of arm position to allow high agility under heavy loads. While moving across terrain the Whistle’s high power allows the robot to move at speed both on flat terrain and steep inclines. The robot is controlled via CANopen in a distributed control system.

The CiA 402 profile is used for motion control in addition to Elmo’s CiA 301 binary interpreter. This allows the Whistle’s proprietary command set to be used to enhance the motion control modes via the CiA 402 profile.

Autonomous solutions’ main aims for the chaos mobile robot were:

- Increase the speed and strength of the platform for traversing terrain, carrying high payloads, and climbing over obstacles.
- Maintain the existing control architecture and communication protocol.
- Minimize the footprint of the design to reduce the weight and size of the enclosure where the drive sits.

The Whistle digital drive was chosen for this application due to its extreme power density and CANopen compatibility. The Whistle measures 55 mm × 46,5 mm × 15 mm and weighs 50 g.

The Whistle is a member of the SimplIQ product family, designed especially for applications, where compact size, high-power density, and robustly implemented standard communication protocols matter the most. Robust implementation of the CANopen protocol, adhering to the standard communication and motion control protocols while allowing extensions due to the rich command set. The drives are installed at the juncture between the tracked arms and the robot body. Each tracked arm uses two servos, which are both mounted on a PCB designed by the customer.

The Whistle drives provide closed loop motion control, feedback inputs, and communication support. Compliance with CANopen, the CiA 301 communication protocol and the CiA 402 motion device protocol allow the customer’s pre-existing robot controller to provide high-level motion commands to the drive. Additional, manufacturer-specific CANopen implementations also allow for control and monitoring above and beyond what the standard protocols provide, without affecting compliance to standards.

The Whistle is the only digital servo drive on the market that can handle both the extreme power requirements and the tight spaces of the high-performance chaos robot. It allowed us to take full advantage of the design, giving chaos a carrying capacity of well over 45 kg and a top speed that rivals any robot in its class, a significant improvement over the previous implementation.