Application Solutions Case study:

Autonomous Vehicles

Product names -Eagle, Falcon, Harmonica

Elmo

Motion Control

www.elmomc.com

Machine Description:

Unmanned vehicles have made quite an evolution throughout the years. Today, unmanned vehicles are tasked to maneuver through harsher terrains and environments and serve for a multitude of functions or operations. Unmanned vehicles are used for a variety of operations such as hauling, transportation, disposing and/or disarming of explosives, surveillance, etc.

This particular high-speed vehicle is a ground-based unit for both industrial and military use capable of reaching speeds of 25+ MPH (40+ KPH). This robotic vehicle platform is unique in the sense that it is omni-directional. Basically, all wheels steer independently which allows the vehicle to move in any direction. It is also equipped with a manipulator arm allowing for 5° of freedom. The manipulator arm is also capable to lifting 100+ lbs (45+ kg) at full extension.

The Challenge:

- Provide a capable and compact drive package for a wide range of power levels
- Provide a way to implement a distributed motion network
- Upgrade from competitors' lower power & capability solutions.

The initial implementation fell short on power for the wheels and also did not provide genuine velocity control for the wheels. As a result, the vehicle had limited drive capability on an incline. And when coming to a stop, a final corrective move would occur… as an effect of the servos closing any position error present.

Additionally, the vehicle's control system was originally based on the CANopen DSP402 protocol, a device profile for motion drives. Direct compatibility of this protocol and knowledge of the implementation was required for a simple upgrade from one manufacturer to another.

Elmo's Solution

The compact nature of this vehicle required comparably compact electronics and a minimal bulk from cabling. Drives designed with high power density and for distributed control system are an optimal fit.

The **Eagle** digital drive was selected for the vehicle's drive system and provides encoder-only velocity control for the drive wheels. The Eagle model used for this application provides 60A continuous at a 46-195VDC bus. Weighing at less than 25oz, the Eagle is a truly unique Elmo offering high power in a relatively compact package.

Model number and description: EAG-R60/200 Eagle Digital drive, 60A cont / No peak, 46-195VDC equipped with incremental encoder feedback and CANopen communications.

Eagle Intelligent Digital Drive

The **Falcon** digital drives were chosen for the manipulator arm control, specifically on the higher (3) of the higher power arm joints. Encoder only velocity control is used in conjunction with absolute position feedback from an analog absolute encoder. The Falcon was selected for their power density.

Model number and description: FAL-15RMS/200 Falcon Digital drive, 15A RMS / 30A peak, 40-195VDC equipped with incremental encoder feedback and CANopen communications.

Falcon Intelligent Digital Drive

The **Harmonica** digital drives were also chosen for both the platform steering and the lower power manipulator arm joints. The Harmonica drives were selected for their compact size and ability to support up to a 200VDC bus. The platform steering is done in position m*de using only Hall effect sensors. As with the Falcons, the Harmonicas control the manipulator arm in encoder-only velocity mode.

Model number and description: HAR-6/200C Harmonica Digital drive, 6.6A cont / 13.2A peak, 40-195VDC equipped with incremental encoder feedback and CANopen communications.

Harmonica Intelligent Digital Drive

Connectivity

The Eagle and Falcon are industrial rated drives utilizing D-sub style connectors. The D-sub connectors are more ruggedized and can withstand the shock and vibration encountered while the vehicle travels through rough terrains.

Another key factor for utilizing the Elmo based solution was the support of the CANopen protocol. The CANopen implementation allowed the drives to be mounted very close to the electrical axis and reduce overall cabling. Supporting both CAN In and CAN Out terminals, allows daisy-chaining of the CANopen communication lines from drive to drive.

Motor connections

- Control Architecture & Feedback Interface
- Velocity control with only an encoder
- Hall only feedback for position control
- Analog, absolute position sensor interface
- CANopen DSP402
- Profile Velocity
- Profile Position

Why Elmo:

- High reliability EEC
- Military "ready to use"
- High power density
- Versatile servo architecture
- CANopen DSP402
- High efficiency
- High linearity and accuracy