CASE STUDY

Stabilized, modular, turret drive system for modern infantry fighting vehicles

CURTISS-WRIGHT

DEFENSE SOLUTIONS

Challenge

- Turret drive system for five vehicle variants
- High stabilization accuracy
- 25 year logistics support

Solution

- Modular turret drive system
- Stabilization analysis and optimization system
- Close collaboration resulting in high performance stabilization

Results

- Simplified logistics and Line Replaceable Unit (LRU) count
- Stabilization performance of 0.3 mrad
- Pre-production of two of the five variants

Challenge

When Denel Land Systems was awarded the contract to develop the new generation of Infantry Combat Vehicles (ICV), called the Badger, for the South African National Defence Force (SANDF), they contacted Curtiss-Wright. As a subsystem supplier, Curtiss-Wright provided technical support in the development of multiple system demonstrators. The system reliability and stability enabled Denel to secure the government contract for the Hoefyster program and therefore secured Curtiss-Wright's contract with Denel to provide the production turret aiming and stabilization drive systems.

The "Hoefyster" project includes the delivery of over 200 Infantry Fighting Vehicles (IFV) which will replace the 6x6 Ratel IFV used by the SANDF for the last 30 years.

Denel's challenge was to create five vehicle variants, with four different turret drive systems, two of which, the Section and Fire support variants, needed a highly stabilized turret drive system. Curtiss-Wright's challenge was to create a turret drive system with modular LRUs that could be interchangeable across the variants, thus reducing costs and simplifying logistical support.

Turret Drive System Components

Solution

Due to the unique specifications of each variant, each system was created for its variant. This meant that though the LRUs themselves were modular, each of the turret drive systems were designed specifically for a variant, taking into account the I/O, ergonomics and mechanical mounting specifications for the vehicle. The hand controller could be used across all variants and is connected to the motor controller. The Twin X DRUi motor controller was developed for this project to reduce LRU count. It combines the signal electronics and two power amplifiers, thus controlling both traverse (rotate turret 360 degrees) and elevation (lift up the turret) drives, in a single device. The gyroscopes on the Section variant detect vehicle disturbances and provide the information back to the drive system, forcing the turret to react accordingly to keep it in place, providing closed loop stabilization. The development of this system required significant collaboration between Denel and Curtiss-Wright due to the fact that an iterative process was required to determine the stabilization quality, taking into account the stiffness of the turret.

For this project, non-recurring costs (NRC) covered prototype design , this included the development of custom mechanical interfaces as well as CANBus interoperability. For ease of use and testing, the turret aiming and stabilization drive system has different levels of built-in-test(BIT). If a subsystem errors, operators will be notified as to which LRU is causing the problem, thus reducing risk and downtime.

Results

The stabilization performance determines the quality of the turret drive system. Without a high performing stabilization system, the other on-board systems are unable to adjust for the vehicles behavior and its probability of hitting the target. For example, if during design the center of gravity changes, Curtiss-Wright needed to be provided with this information in order to analyze how it affects the stabilization so a joint solution could be achieved. Therefore system performance is highly dependent on how well the vehicle design team and the turret design team work together. Curtiss-Wright was chosen for this project both because of their reputation as a leading supplier of drive systems and because they could demonstrate that, in collaboration with the customer, they could achieve high stabilization performance. With frequent on-site visits and the constant exchange of design data, Denel was able to capitalize on the expertise of Curtiss-Wright in order to achieve the levels of stabilization necessary to win the project.

In addition to developing the turret aiming and stabilization drive systems, Curtiss-Wright developed a custom service tool to measure and optimize the stabilization performance. This independent system included a laptop, custom software and gyroscopes, and enabled Denel to measure and analyze the stabilization performance and subsequently re-program the stabilization loop to increase the performance. Denel's team was provided training on both this optimization tool as well as mounting the drive system, getting it operational and how to measure stabilization performance. Due to the risks involved with operating this machinery, different levels of users/ groups were trained accordingly.

As of the time this was written, the different variants are at different phases of development. The prototype of the Section, Fire Support and Command variants are complete; the vehicles are in pre-production and are expected to be fielded in the end of 2016. The other two variants, Missile and Mortar, are in development and are expected to be in pre-production in 2018.

INFO: CURTISSWRIGHTDS.COM
EMAIL: DS@CURTISSWRIGHT.COM