Moog Developing Azimuth & Vertical Angle Measurement System for Man-Portable Targeting Systems

Moog, under Night Vision and Electronics Directorate (NVESD) sponsorship, is developing a high accuracy, compact, Azimuth & Vertical Angle Measurement System (AVAM) for man-portable targeting systems. The program was designed to enable the accurate delivery of precision guided munitions and thus reduce friendly fire and collateral damage. The AVAM, referred to as ‘North Finder’ or ‘Gyrocompass’, provides all-weather, 24 hour targeting capability, and is immune to ferromagnetic field distortions. Moog’s AVAM uses advanced MEMS-based gyroscope and accelerometer technology to provide fast, high accuracy heading and vertical angle determination, as well as motion tracking without GPS. The system overcomes the primary weakness of the magnetic compass by measuring the Earth’s rotation rate to determine true north. The Moog AVAM is a proprietary and patented (pending) design.

Third Generation Stores Management System for Agile Militaries

Moog unveils its third generation stores management system (SMS) for weapons delivery. The SMS is comprised of the stores management computer, stores control panel and stores interface units. This proven, rugged system is an affordable solution to stores management on both rotary and fixed wing platforms. The SMS leverages Moog’s extensive experience in sub-system integration, weapons and fire control solutions. The flexible modular design of the SMS enables fast delivery, rapid integration and future upgrades to the sensors, avionics and weapons, insuring the SMS’s value for future mission requirements and weapons expansion.
Supplier of V-22 Primary Flight Control Actuation

Moog is providing the design, manufacture and integration of 19 primary flight control actuators including the main rotor swashplate, flaperon, rudder and elevator.

In addition, Moog is providing the active vibration control system, blade fold actuation, nose wheel steering servovalves, main prop rotor slip ring, hydraulic fluid compensation module and engine fuel control servovalves. Key attributes of the flight control system include a 5000 psi operating pressure, duplex hydraulic – triplex electrical redundancy on the Swashplate actuators and ballistic tolerant elevator and swashplate actuators.

Ballistically Tolerant Fly-by-Wire Flight Control Actuators

Moog is the market leader with more than 30 years experience designing, testing and manufacturing ballistically tolerant flight control actuators. Our extensive heritage includes dual-tandem and dual-parallel configurations with designed operating pressures up to 5000 psi. Our product breadth includes swashplate and tail rotor actuators for conventional rotorcraft as well as fixed wing flight controls for tilt-rotor aircraft.

Advanced Electronic Controls for Aerospace and Defense

Moog is a leading supplier of electronic controls for mission critical applications in the aerospace and defense industry. Our state-of-the-art systems are used wherever precision control is required, including aircraft flight control, launch vehicle thrust vector control, aiming and stabilization, and missile steering. Our expertise includes advanced digital control, distributed system architectures, high power drives, redundancy management and designs for harsh environments. We have designed, qualified and provided certification support to civil and military level A standards. Our products are well-suited for both OEM and product upgrade programs.

Active Vibration Control Systems for Military and Civil Rotorcraft

Moog is supplying its active vibration controls for Sikorsky’s UH-60M Black Hawk helicopter. Moog’s Vibration Suppression Actuation System (VSAS) includes a DSP-based Controller and a pair of counter-rotating Force Generators per channel. Vibration levels within the air vehicle are monitored and the Force Generators inject cancellation forces at discrete locations throughout the airframe, dynamically adapting to changes in the vibration environment. By eliminating the need for heavy passive vibration absorbers, the system offers weight savings while providing a number of secondary benefits including enhanced situational awareness, passenger comfort and increased aircraft component life. The system is currently flying aboard the Sikorsky S-92, Bell/Boeing V-22, UH-60 Blackhawk and SH-60 Seahawk rotorcraft.
CRITICAL CONTROL SOLUTIONS FOR MILITARY AIRCRAFT

Connectors with Integrated Fiber Optic Components

Moog now has a line of high performance fiber optic transmitter and receiver components that are integrated with an optic plug connector. The Sabre series is a multimode optical fiber interface that supports applications where copper cable link distance, bandwidth, weight or bulk make the use of twisted pair, twinax or quadax copper conductors unacceptable. The Sabre series allows for high speed network communications over long distances in harsh environments.

Product Features:
- Operating temperatures from -55°C to +85°C
- Shock and vibration resistant
- Meets stringent corrosion performance specifications

Moog Crossbow Fiber Optic Vertical Gyro Supports Critical Aircraft Navigation and Guidance Applications

The VG700MB is a MIL-Qualified vertical gyro used for measuring roll, pitch and heading angles in dynamic environments. VG700MB applications include avionics, platform stabilization, land vehicle guidance, and control of sophisticated robotic systems. Moog Crossbow has fielded thousands of systems worldwide for use by the US DOD and Coalition Forces. Major customers include the IAI family of Searcher, Hunter, and Heron family of Unmanned Aircraft which utilize the VG700MB for primary navigation and control.

The VG700MB incorporates Moog Crossbow’s third generation Fiber Optic Rate Gyro technology providing superior performance, reliability, and long term stability.

Product Features:
- MIL-Qualified Vertical Gyro
- Fiber Optic Gyro Stability <20°/hr
- Stabilized Roll and Pitch Angle Outputs
- Optional Relative Heading Output (206 Model)
- Environmentally Sealed Enclosure
- MIL-STD-810E, MIL-STD-461D

Moog Crossbow Introduces New Card Level MEMS-Based Attitude Heading and Reference System

The ANC1000 is Moog Crossbow’s most compact, card-level MEMS GPS-aided AHRS for embedded use within integrated navigation and guidance systems.

The ANC1000 has a small footprint volume of only 2.5 cubic inches and weighs less than 25 grams. Example applications include UAV flight control, SATCOM on the move, land vehicle and missile guidance, platform stabilization and micro-robotics.

Product Features:
- Single card-level Attitude & Heading Solution
- High Reliability MEMS Sensors
- High range sensor option available
- High accuracy < 0.2°
- Small form factor < 2.5 in³
- Low power < 1.5W
- Lightweight < 25 grams
- External SAASM GPS and magnetometer interface
- High vibration immunity

Rotary and Linear Electromechanical Actuators and Controls

Moog leads the industry by designing and producing high-performance linear and rotary electromechanical actuators (EMA) for aerospace and defense applications. Our actuation products are used to control flight surfaces and position sensors on aircraft, missiles and space vehicles; provide stabilization and aiming for land and sea based gun turrets; steer antennas in high bandwidth communication systems; and provide control for various utility applications.

Moog is able to offer precision actuation solutions with rare earth brushless motors, planetary gears and smart servo controllers with integral position control or utility actuation solutions with DC motors, spur gears and analog amplifiers with external position control.

A technology initiative currently underway allows us to offer a fiber optic communication interface for our EMA’s. This technology provides many systems advantages, including EMI immunity and weight savings.
Moog Crossbow Offers High Performance Tilt Sensors

The CXTD02 is a family of high performance Tilt Sensors that offer outstanding resolution and accuracy in measuring tilt angles on an object with respect to gravity. The CXTD02 measures tilt using a triaxial MEMS accelerometer that is responsive to gravity. The triaxial accelerometer allows sensing over the entire 360° roll range and 180° pitch range. In addition, alignment, scale factor, and non-linearity compensation are computed internal to the sensor with the on-board DSP processor.

Product Features:
- Roll and Pitch Angle Measurement in Any Orientation
- 3-Axis Digital Acceleration Output
- High Accuracy
- Fully Temperature Calibrated
- ~80dB Signal to Noise Ratio

Moog Crossbow Offers Mili-Qualified Ground Vehicle INS/GPS System

Moog Crossbow’s GNAV540 integrates field proven MEMS-based inertial sensors with an embedded Military Grade SAASM GPS receiver to provide system integrators with a lower cost, high accuracy GPS/IMU system option for use in demanding military applications. The GNAV540 is designed to combine the functions of Attitude and Heading determination with GPS in a compact environmentally sealed enclosure. The GNAV540 improves performance with enhanced EMI protection and input power filtering.

Typical applications include navigation, control and stabilization in marine and land environments.

Product Features:
- Integrated SAASM or C/A Code GPS aiding
- Ethernet or RS-422 output
- MIL-C-38999 connector
- Internal or remote magnetometer
- Low Power < 4W
- High Reliability, MTBF > 25,000 hours
- Rugged & sealed enclosure meeting MIL-STD-810 and MIL-STD-461 EMI

Moog Crossbow Offers Affordable MEMS GPS/IMU Solutions

The Moog Crossbow NAV440 is an integrated GPS and Attitude & Heading Reference system (AHRS) that utilizes low drift MEMS-based inertial sensors with GPS aiding to provide an unmatched price and performance. Developed in response to years of extensive application experience in a wide variety of airborne, marine and land applications, the NAV440 also incorporates many new and enhanced design features. Typical applications include navigation, control and stabilization in marine and land environments.

Product Features:
- Complete GPS-Aided AHRS Solution
- Accuracy < 0.2 deg
- Output Data Rate > 100Hz
- WAAS and EGNOS Enabled GPS
- Low Power < 4W
- Rugged Sealed Enclosure

Moog Unveils ProtectIR

Moog recently debuted the ProtectIR ISR Targeting (T) pod, which is a fully integrated, rapidly deployable COTS ISR (T) pod for use on existing fixed and heavy rotary wing aircraft. It is a valuable capability for allied air forces that want to conduct ISR operations using a flexibly-mounted ProtectIR kit.

The ProtectIR allows allied military forces to have ISR (T) dominance without significant expense. The ProtectIR is a 5th generation high-definition electro-optical infra-red (FLIR) system with a tightly integrated moving map, stores management computer, GEO location, and state of the art data links. Optional payloads can be configured to include Ground Moving Target Indication (GMTI)/Synthetic aperture radar or a mobile phone tracking in a sub-136 kg (300 lb) package.

Moog can install the ProtectIR at the customer site within nine months along with aircrew training and mission planning. Moog offers this product and service capability for less than half of what other OEM’s charge for their basic ISR configuration alone.
Motion Control Technology for Defense and Security

Moog designs, manufactures and integrates motion control systems and components for military vehicle platforms. Moog’s expertise in stabilization, fire control, weapons integration, power distribution and management, data acquisition and management, and C4I systems can be found on more than 30 of the world’s leading military vehicle platforms.

Moog builds its systems from heritage components designed and manufactured in-house. Key components include:
- Gun controllers
- Electromechanical and electrohydraulic actuators
- Single to multiple axis controllers
- Fire control computers
- Power management units
- Slip rings
- Fiber optic multiplexers

Moog Develops Non-Lethal Grenade Launcher for Rapid Deployment

Moog debuted and demonstrated its new EAGLS (Electrically Articulated Grenade Launcher System) non-lethal grenade launcher at Eurosatory 2012. This unit has been developed to support the military’s need for rapidly deployable, escalation of force, mission ready equipment. The applique system gives troops the ability to accurately target and disperse a crowd without using lethal force.

EAGLS is designed to accommodate the 66mm family of non-lethal grenades, including both smoke and anti-riot. The system is comprised of an electromechanically controlled, dual-axis positioner supporting two grenade discharge racks and a wide angle day sight camera. Each discharge rack has the capacity for six grenades and allows troops to individually position and deploy grenades up to 100 meters. The launcher is continuously adjustable in azimuth and discretely adjustable in elevation for range select. It also features an optional surveillance suite for 360° situational awareness and active stabilization for low bandwidth, shoot on the move capability.

Situational Awareness and Surveillance Operations

Moog QuickSet is demonstrating the Commander’s Gimbal surveillance system at the AUSA 2012. This new surveillance system greatly increases situational awareness for the warfighter. The system has been tested by the US Army on a modified Stryker vehicle.

The Commander’s Gimbal can be assembled into a variety of operational configurations tailored to support specific mission needs. The modularity of design allows the customer to define the configuration to maximize performance while minimizing cost. In its simplest form the CG is a positioning device that moves a camera in azimuth and elevation via simple joystick movements. In its full feature configuration the CG positions two high definition cameras, ranging, and non-lethal deterrents with precise high speed movement. It is also stabilized for applications where input disturbance is < 1Hz. It is extremely rugged and was designed to meet HMMWV shock and vibration profiles.
Moog Supports Ongoing Public-Private Partnerships

Moog is committed to supporting its customers through the use of Public-Private Partnerships. Moog currently has several partnerships in place, covering multiple platforms and applications. These partnerships provide significant value by leveraging the specialized expertise, equipment and facilities of each organization.

Since March of 2008, Moog has been under a Public-Private Partnership with Ogden Air Logistics Center for the overhaul and upgrade of the F-15 pitch and roll channel assembly. Moog has also been under a Public-Private Partnership since August of 2007 with the Fleet Readiness Center Southeast for the F/A-18 leading edge flap system. In November of 2011, Moog also entered into a commercial service agreement with the Fleet Readiness Center East for the V-22 Osprey. Moog Military Product Support is actively engaged in discussion for future commercial service agreements with the Tinker Air Force Base for the B-2, and with the Fleet Readiness Center Southwest for the F/A-18 E/F and F-35.
Moog Signs Umbrella Corporate Contract with DLA

Moog has recently signed an Umbrella Contract with DLA - Defense Supply Center Richmond. The Corporate Contract covers critical component parts and sub-assemblies required to support depot repair activity for all Moog Aircraft Group products. This new contract benefits DLA, the USAF depots and Moog by streamlining the procurement process and providing more cost effective and timely access to parts required to support legacy aircraft systems.

Defense Supply Center Richmond is the aviation supply and demand chain manager for the Defense Logistics Agency and serves within the Defense Department as the primary source of supply for more than 1.2 million repair parts and operating supply items. DLA recently assumed responsibility for procurement management and related support functions for depot-level repairables at the Oklahoma City, Ogden and Warner Robins Air Logistics Centers. DLA’s mission is to provide best value aviation weapon systems and logistics support to America’s armed forces—on land, at sea and in the air.

Moog Expands H-60/S-70 Flight Control Overhaul and Upgrade Services

Moog developed the capabilities to provide overhaul services for the entire family of integrated Trim/Boost Servoactuator Assemblies on the H-60/S-70, including the Pitch Trim, Roll Trim and Yaw Boost Servoactuator configurations. Moog inspects and disassembles the integrated assembly, overhauls and tests the individual LRU’s, and reassembles and tests the integrated assembly before delivery to the customer. Moog has recently won its second consecutive 5-year contract with the US Coast Guard (USCG) to provide overhaul services for their HH-60J/T flight controls, previously demonstrating a 50% improvement on turnaround time while significantly lowering the USCG’s total overhaul cost.

Advanced Surface Repair Solutions for Corrosion and Manufacturing Defects

For decades, both new part manufacturers and end users have tried to find repair solutions for corroded and damaged parts. Replacement parts are expensive and usually have long lead times. Many processes have been developed to repair damaged parts including grinding and welding, but these may induce thermal stresses that can result in premature failure.

Moog has been working with industry experts on a repair process called Cold Spray – an additive manufacturing process that restores original substrates without inducing thermal stresses. It is being widely used in the automotive and industrial marketplaces and is ideal for aerospace materials like magnesium and titanium, as well as alloys. Moog, through its Mid-America Aviation subsidiary, is performing these various Cold Spray repair activities today for military and civil aircraft operators.

Cold Spray is ideal for many situations, including:
- Repairing manufacturing defects
- Restoring material from wear
- Restoring material from corrosion
- Product surface build up
- Corrosion protection
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