Update on Picatinny High Speed Turret

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TECHNO-SCIENCES

• Prime contractor
• System modeling
• Interfaces
• Control systems

GENERAL DYNAMICS
Robotic Systems

• Electrical and mechanical design
• Power systems
• Hardware fabrication

GENERAL DYNAMICS
Armament and Technical Products

• Weapon integration
• Fire control integration
• Mechanical design
Background

- Objective to develop and integrate a high performance secondary armament turret onto the Multi-Role Armaments and Ammunition (MRAAS) ATD Turret Mission Module (TMM)
  - Direct-drive motor technology
  - Use TMM controls
  - Ethernet based interface
  - TMM system integration lab (SIL)

- MRAAS was restructured and renamed 120mm Line of Sight/Beyond Line of Sight (LOS/BLOS) ATD
  - Stand alone demonstrator
  - Develop own controls and displays

- Renamed it the Picatinny High Speed Turret
Features/Specifications

WEAPONS:
- XM307/XM312
- Other similar weights/inertias

PERFORMANCE:
- Full 360 degree azimuth
- +55 to -20 deg elevation
- Peak slew rates:
  - 1000 deg/s Az
  - 480 deg/s El

HARDWARE:
- Segmented Array Motors
  - 500 ft-lb torque in Az
  - 208 ft-lb torque in El
- Encoders
  - 200K resolution/turn
- Stabilization sensors
  - 4 KVH-5000 FOGs
  - 2 on cradle
  - 2 on mount
- Az and elevation brakes
- CAN network interface

Stabilization:
- Feed-forward/feed-back loops
- min 20db disturbance rejection @ 10Hz

Weight:
- Turret: 325 lb
- ECU&cables: 75 lb
- XM307 Wpn, FC, ammo: 49 lb

Size:
- 22 in diameter footprint
- <25in above mounting interface
- 14.5 in intrusion

Power: 28/270 VDC
From Design Concept …
... to Hardware

- Weapon Station
- Electronic & Power Unit
- Display
- Joystick
- Fault/Status Messages
- Power
- Torque RMS
- FC Controls
- Modes
- High Speed Slew Demo
Real-time
Half-speed
Validated Emulator with ACSW
Fire Control Emulator

ACSW FCS

Visualization

Crew Station Display

ACSW Menu Display
Displacement and Velocity Commands = f(control Input, platform disturbances, Ballistic solution)

Rate and Stab Controllers

Disturbances from Platform

Solid Model

Power System Model

Outputs

Source: Techno Sciences, Inc
Measured vs. Simulated
Case 1

- Measured azimuth motion commanded using a series of rate commands selected to achieve a slow/fast/slow profile

- Discrete nature of rate changes reflected in measured data

- Resulting motion
  - 152 deg in 0.64 Sec
  - Avg rate = 238 deg/sec
  - Max rate = 447 deg/sec

Source: Techno Sciences, Inc
Measured vs Simulated Case 2

- Measured azimuth motion commanded using a series of rate commands selected to achieve a slow/fast/slow profile

- Discrete nature of rate changes reflected in measured data

- Resulting motion
  - 315 deg in 1.5 sec
  - Avg rate = 210 deg/sec
  - Max rate = 544 deg/sec

Source: Techno Sciences, Inc
Picatinny Lightweight Remote Weapon Station

- Leveraged system/emulator to develop control system and user interface
- In-house design with contractor support in metal parts fabrication and crew station development, and control software.
- System Capabilities:
  - Weight goal: <150 lbs above the roof including gun and 200 rounds
  - Slew rates: 90 deg/sec in Az and El
  - 2-Axis Stabilization, 5Hz, 20 Db goal
  - Continuous 360 Degree rotation
  - Elevation Range +45º to -15º
- Integrated Crew Station
- Electronics Control Unit

Mounts M240 and M249 machine guns
Summary

- **Weight w/o gun/ammo/fire control:**
  - 400 lb vs projected 451 lb

- **Slew rates meet objectives values**
  - 500 deg/s average in az
  - 240 deg/s average in elevation

- **Elevation range:**
  - +55 vs projected 60 deg max
  - -20 deg vs. projected -20 deg min

- **Network compatible**
  - Demo with ethernet
  - Fabricated with CAN

- **Demonstrated electrical integration with ACSW fire control**