# *Update on Picatinny High Speed Turret*


**Presented to 2005 NDIA Guns and Ammunition Conference**
**New Orleans, LA**
**25-28 April 2005**

***Richard A. Ciekurs, P.E.***
***RDECOM-ARDEC***
***Picatinny, NJ***

# *Industry Partners*

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

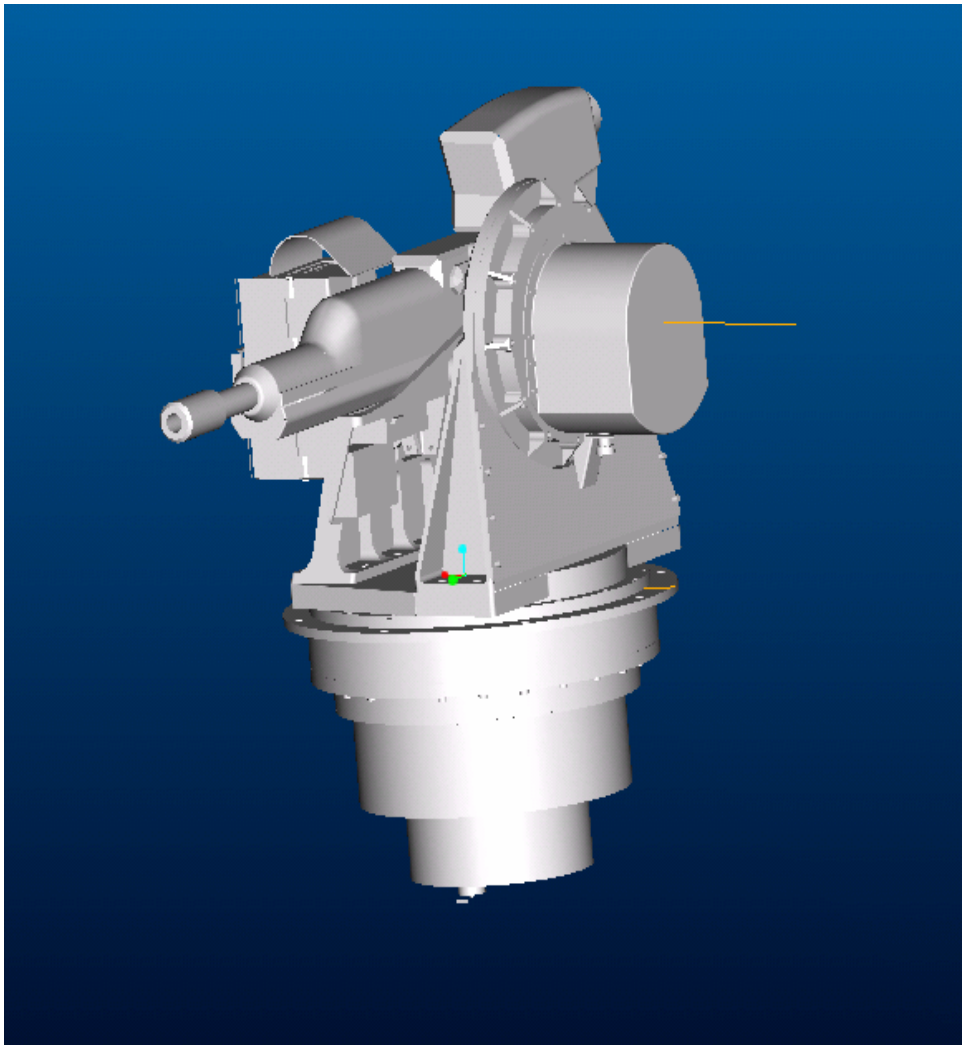
**HARDWARE:**

- 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

**PERFORMANCE:**

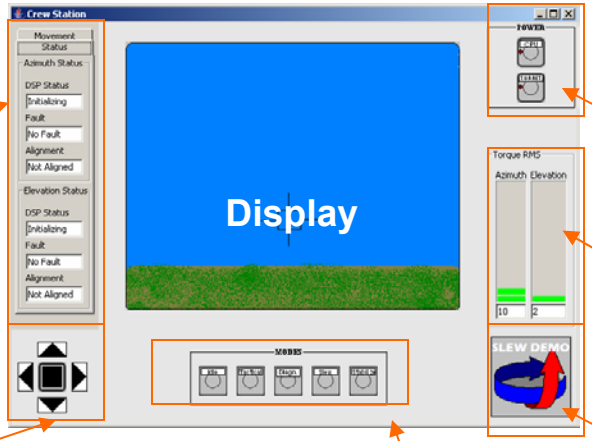
- Full 360 degree azimuth
- +55 to -20 deg elevation
- Peak slew rates:
  - 1000 deg/s Az
  - 480 deg/s El
- Stabilization:
  - Feed-forward/feed-back loops
  - min 20db disturbance rejection @ 10Hz
- Weight:
  - Turret: 325 lb
  - ECU&cables: 75 lb
  - XM307 Wpn, FC, ammo: 49 lb
- Size:
  - 22 in diameter footprint
  - <25in above mounting interface
  - 14.5 in intrusion
- Power: 28/270 VDC

# *From Design Concept …*



# … to Hardware






Fault/Status Messages

Power

Torque RMS

High Speed Slew Demo

FC Controls

Modes

# *Real-time*

# *Half-speed*

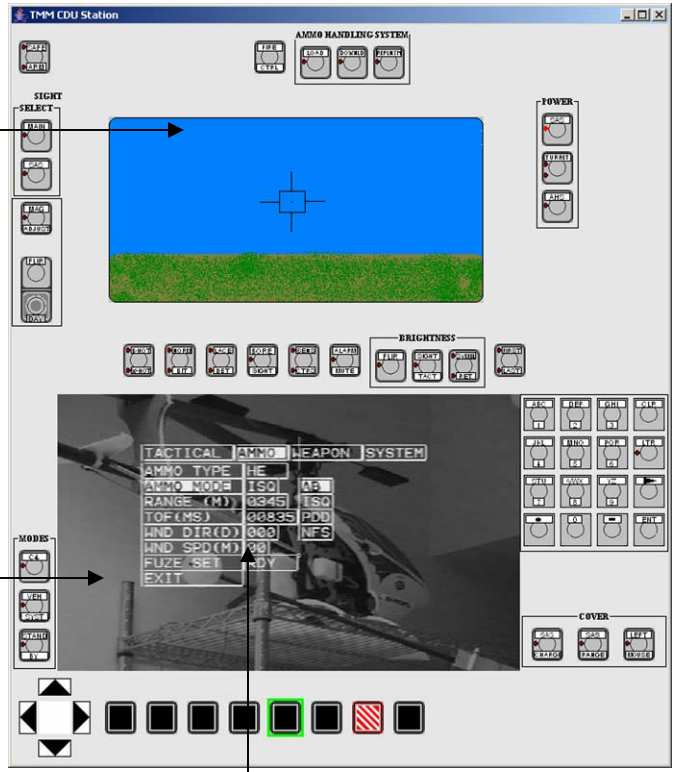
# *Validated Emulator with ACSW Fire Control Emulator*

ACSW FCS

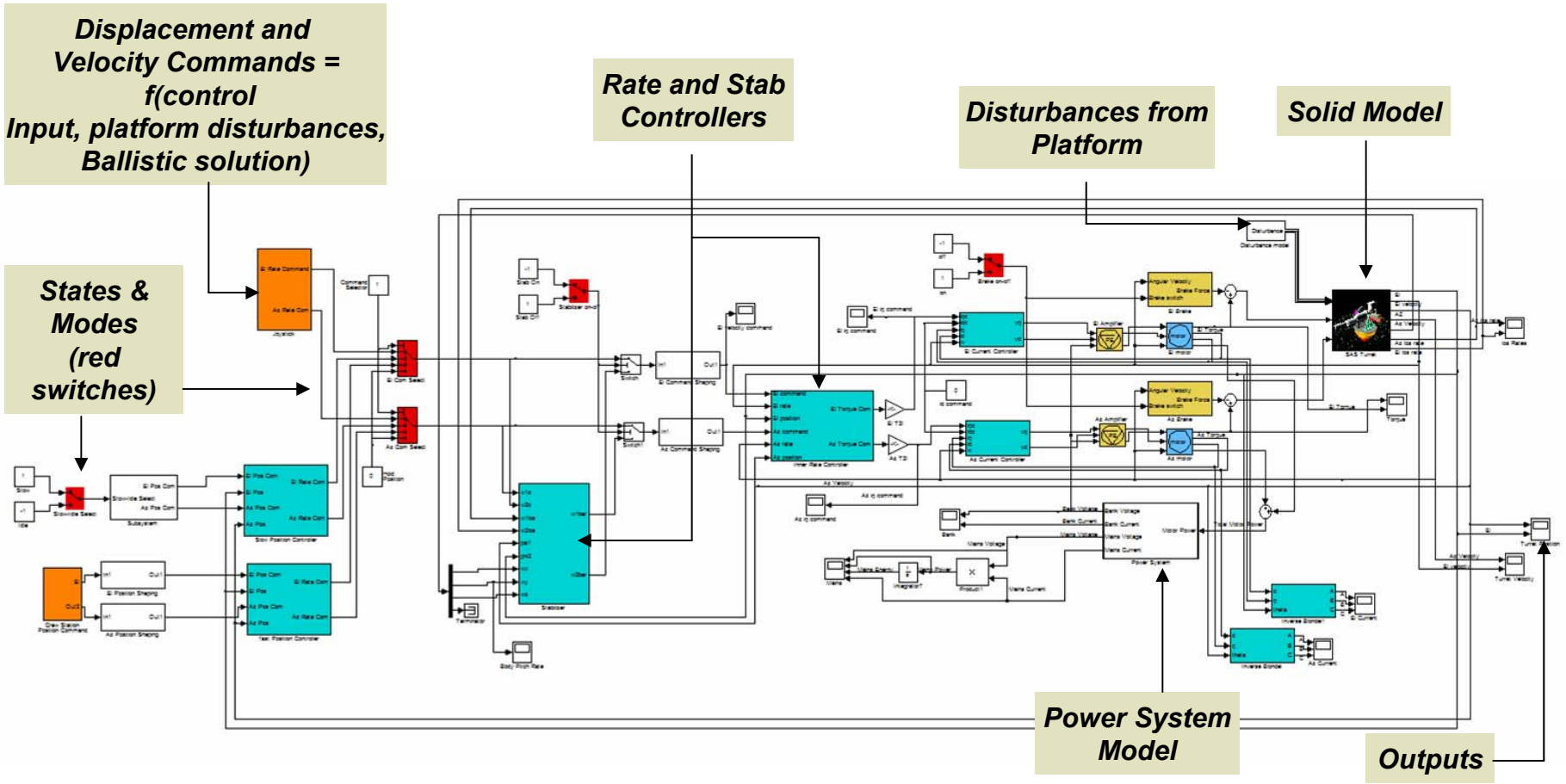
Visualization

Crew Station Display

ACSW Menu Display



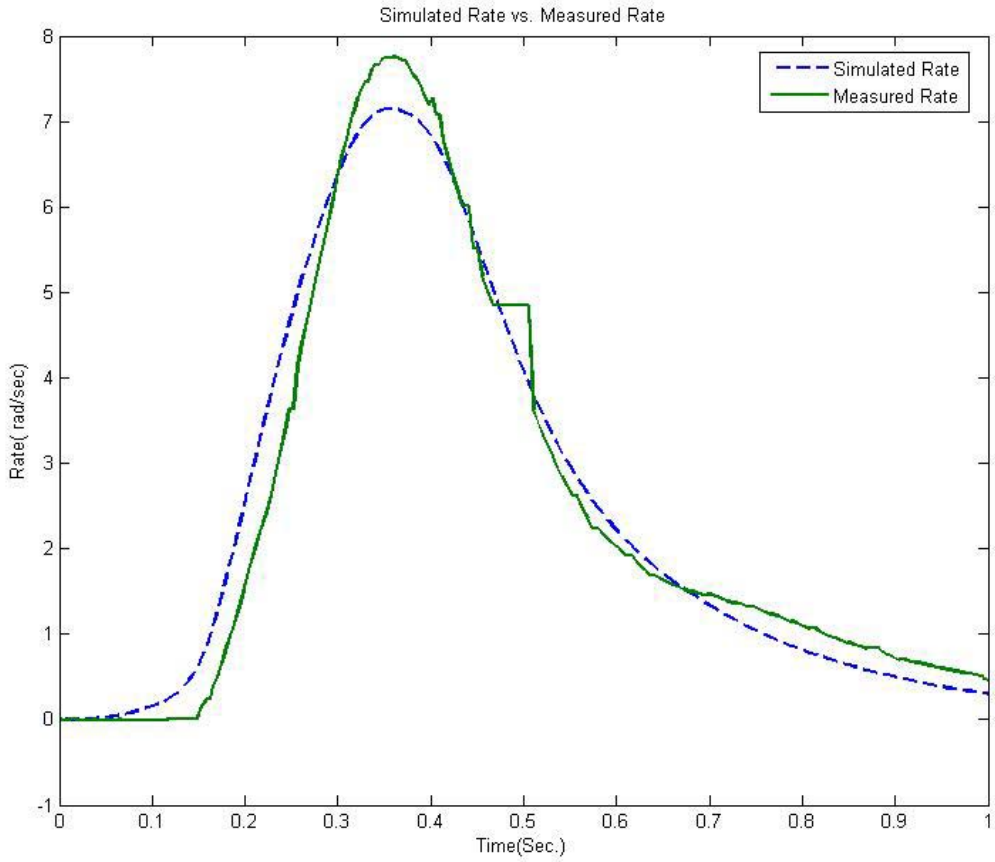
# SIMULINK / STATEFLOW Model




Source: Techno Sciences, Inc

# Measured vs. Simulated Case 1

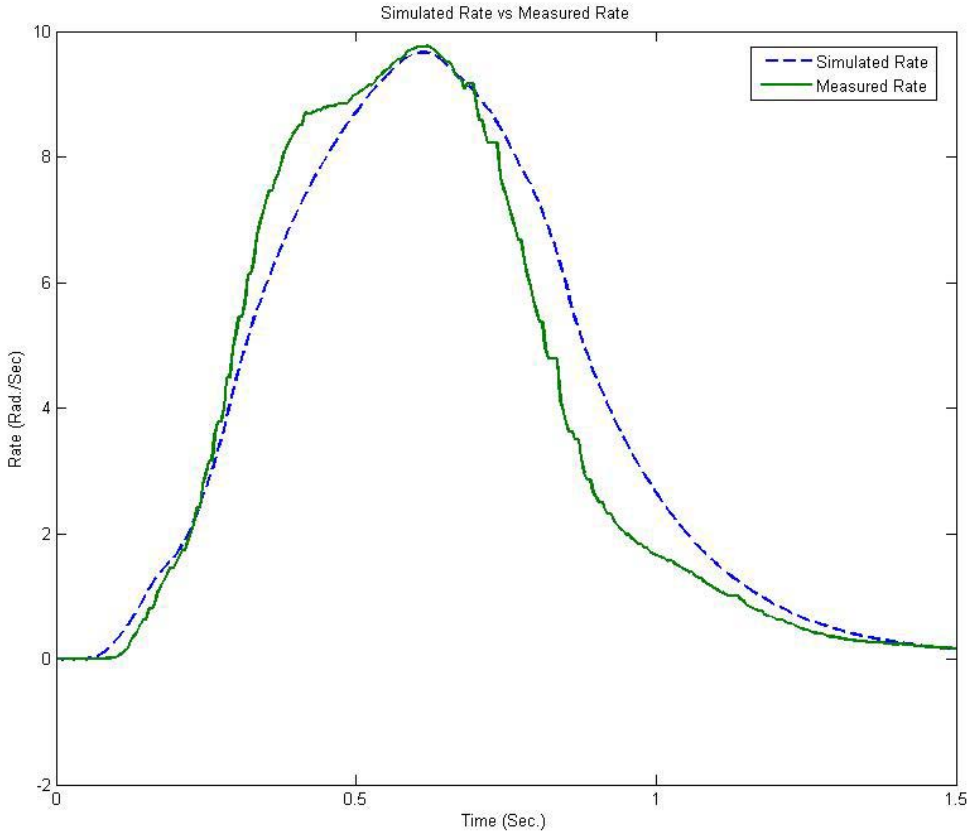
- Measured azimuth motion commanded using a series of rate commands selected to achieve a slow/fast/slow profile
- Discrete nature of rate changes reflected in measured data
- Resulting motion
  - 152 deg in 0.64 Sec
  - Avg rate = 238 deg/sec
  - Max rate = 447 deg/sec




*Source: Techno Sciences, Inc*

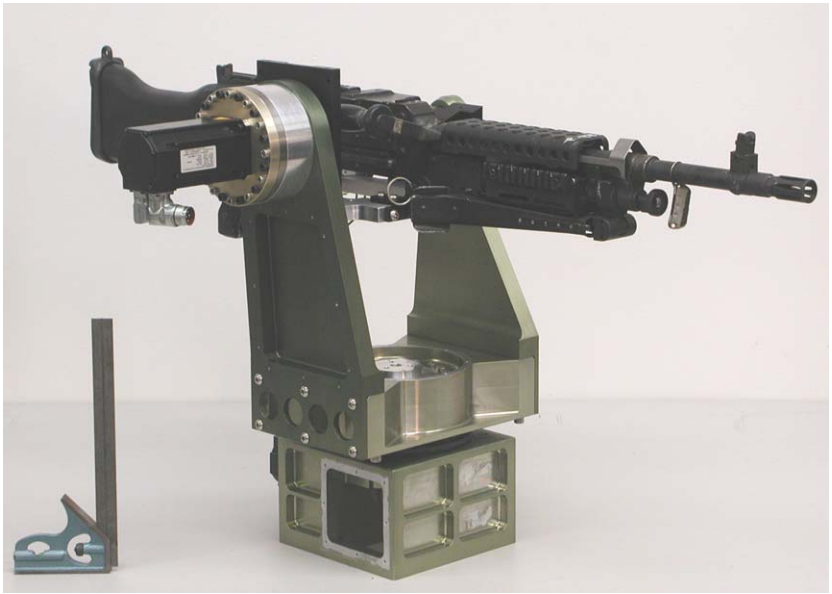
# *Measured vs Simulated Case 2*

- **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**

**Met critical design parameters**