US ARMY RDECOM

U.S. Army Research, Development and Engineering Command

J·S·S·A·P JOINT SERVICE SMALL ARMS PROGRAM

Malcolm Baldrige National Quality Award 2007 Award Recipient

ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER PICATINNY ARSENAL, NJ

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Advanced Fire Control Technology for Small Arms

Terence F. Rice
US ARMY ARDEC
Joint Services Small Arms Program Office(JSSAP)
RDAR-EIJ
terence.f.rice@us.army.mil

Agenda

- *Introduction*
- *Advanced Fire Control Technology for Small Arms ATO*
- *Technical Approach (Metrics & Objectives)*
- *Project Portfolio*
- *Industry Status*
- *Enabling Technology Status*
- *Summary & Path Forward*

Introduction

What is Fire Control?

- Fundamentally, fire control are variations of the same basic situation
  - Launching a projectile from a weapon station to hit a selected target.
  - Target or the weapon station or both may be moving.

- **Small Arms Fire Control**
  - Used in a Direct fire control situation
  - Weapon fired at a target that can be observed by:
    - Optical or electro-optical instruments or
    - From the weapon itself or from nearby elements

Advanced Fire Control Technology for Small Arms (ATO)

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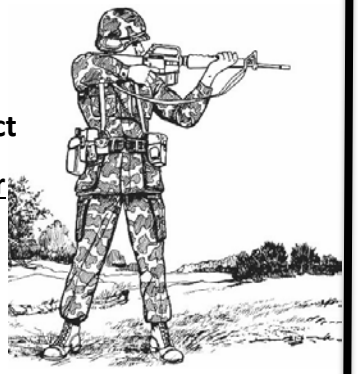
Purpose

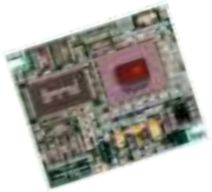
To demonstrate advanced fire control component technology determining correct range to moving targets and further power sharing within weapon for current and future warfighters.



Challenges

- Moving targets prior to their seeking cover
- Unsupported firing position.
- Inaccurate ranging limits precision
- Weight near muzzle leads to poor aiming
- Multiple batteries reduces accessory availability

How do we solve this problem



- Technologies for automatic target detection
- Laser steering to increase the soldier's ability to accurately determine range to non cooperative moving targets.
- Improved lethality for unsupported firing positions
- Develop range determination to overcoming wobble associated in an unsupported firing position

Payoff

- TRL 4 (Breadboard) component technologies integrated to establish that they will work together
- This is relatively "low fidelity" but shows we are getting there!!

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Technical Approach
(Metrics and Objectives)

Measure	Current	Program Objective	Army Objective	Technology Maturity Level
Unsupported Range Determination	4+% to 15% of range	3 meters to targets in cover	2 meters to targets in cover	Start: TRL 2 End: TRL 4
Missed moving targets	60%	20%	<20%	Start: TRL 2 End: TRL 4
Shared Power Weight reduction	Batteries (multi) & cables	Reduce weight & one battery	Reduce weight & one battery	Start: TRL 2 End: TRL 5

TRL 2: Technology concept and/or application formulated
TRL 4: Component and/or breadboard validation in laboratory environment
TRL 5: Component and/or breadboard validation in relevant environment

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Project Portfolio

Project Name	Technology Partner	Metrics		
		1	2	3
Automatic Fire Control - Phase One	AAI	X	X	X
Laser Steering and Automated Target Tracking	L3/Brashear	X	X	X
Tracking and Fire Control	Stevens Institute of Tech	X	X	X
Small Arms Electrical Energy Harvesting by Linear Induction	ARDEC			X
Optical Fiber Based Barrel Reference Sensor	ORNL	X	X	
Adaptive Optical Zoom for Combat Rifles	SANDIA	X	X	
Target Tracking Laser Range Finder for Small Arms TA/FC*	Award Pending*	X	X	
Target Tracking Laser Range Finder for Small Arms TA/FC*	Award Pending*	X	X	X

Metrics (Advanced Fire Control ATO)	
1	Unsupported Range Determination
2	Missed moving targets
3	Shared Power Weight reduction

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Industry Status

Three (3) contracts awarded through National Small Arms Center

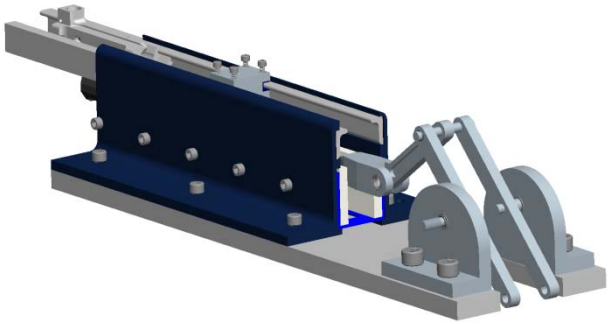
- **Stevens Institute of Technology**
  - **Project Title:** "A Standalone/Networked, Compact, Low Power, Image-fused Multi-Spectrum Sensor System for Target Acquisition, Tracking and Fire Control"
  - **Status:** Phase I complete, TRL 2 achieved
- **L-3 Brashear Corp.**
  - **Project Title:** "Steering and Automated Target Tracking
  - **Status:** Phase I complete, TRL 2 achieved
- **AAI Corp**
  - **Project Title:** "Automatic fire control -- phase one"
  - **Status:** Phase I complete, TRL 2 achieved

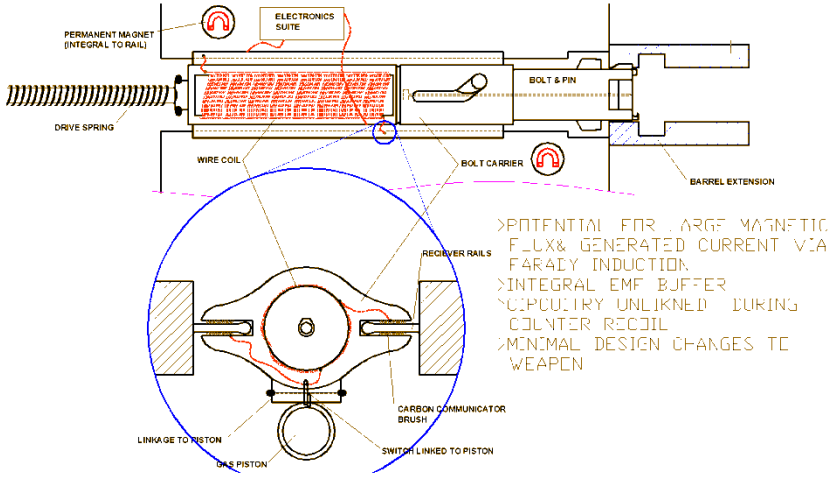
Fire Control Technology Areas Addressed

- Multi-wavelength imaging target acquisition system comprised of a dual laser radar system (LIDAR)
- Acoustic SONAR and forward looking infrared (FLIR) image acquisition technologies.
- Transmit/receive optics for DVO, night vision, and range-finding
- Integrated technologies for Laser Rangefinder, Micro-Display, Thermal Imager, and control electronics
- Low light level TV/IR camera, Software target recognition, Software trackers
- Laser transmitter, Laser beam steering, Laser receiver, Laser signal processing, Advanced optics
- Minimization of weight, volume, and power consumption parameters

Armament Research Development & Engineering Center (ARDEC)

- ***Title:*** *Weapons Electrical Energy Harvesting (WEEH)*
- ***Objective:*** *Investigate novel ways by using the cyclic motion in small caliber machine guns to generate electricity*
- ***Status***
  - ✓*Magnetic circuit design and bolt wiring scheme optimization (wire loop dimensions, orientation, magnet selection, mounting)*
  - ✓*Prototype under construction*

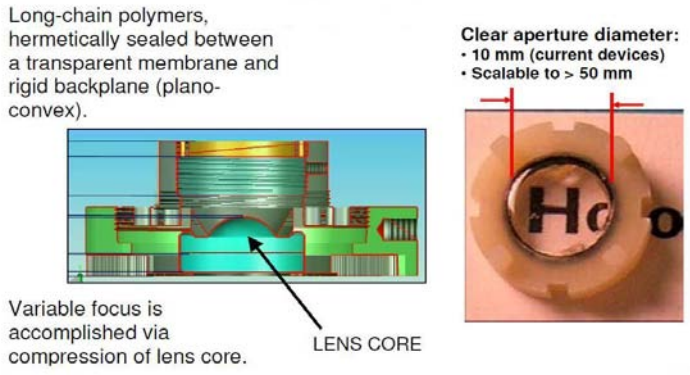




Enabling Technology Updates (Department of Energy)

Sandia National Lab

- **Title:** *Adaptive Optical Zoom for Combat Rifles*
- **Objective:** *Provide a variable power magnifying optic which would enable the soldier to discretely adjust magnification over a much wider range*
- **Status:**
  - *Polymer lens aberrations & power to actuate lens addressed*
  - *Prototype underdevelopment*



Oak Ridge National Lab

- **Title:** *Optical Fiber based Barrel reference sensor*
- **Objective:** *Implement a barrel reference sensor on weapon barrel to sense barrel deflection.*
- **Status:**
  - *Barrel reference sensor implemented*
  - *Measuring & characterizing barrel oscillations as projectiles are fired*

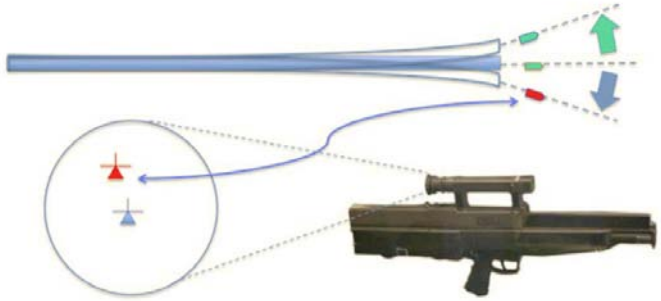


Figure 0. Barrel position sensor and reticle compensation system.

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Summary & Path Forward

- *Three (3) year R&D effort for Advanced Fire Control component technology*
- *TRL 2 achieved on efforts contracted through NSAC*
- *Enabling Technology Efforts on-going*
- *Two (2) new efforts to be awarded in FY09*

Path Forward for Fire Control?

We are getting answers from industry, academia, and government.

We are still looking for good ideas

Highlighted Technology Areas of Specific Interest

1. Power Distribution/Sourcing
2. Volume Reduction
3. Use of Enabling Technologies