US ARMY RDECOM

U.S. Army Research, Development and Engineering Command

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

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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

Joint Armaments Conference, Exhibition and Firing Demonstration

20 May 2010

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?*
  - Science of offsetting the direction of weapon fire from the line of sight to the target in order to hit the target

- *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.

- *Categorized as either tactical or technical.*

- *Small Arms Fire Control*
  - Advanced Fire Control for Small Arms ATO focus is technical fire control.
  - Provides the computational and mechanical operations required for the weapon system to hit a specific target with a specific munition.
  - Augment the soldier's capability, enabling the soldier to fire on more targets both more quickly and more accurately

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Advanced Fire Control Technology for Small Arms (ATO)

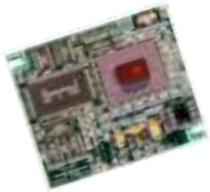
Purpose

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

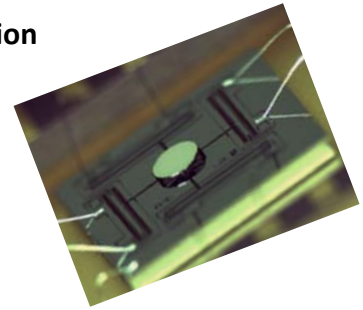
Challenges

- 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 in 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

Subset

Measure	Current	Threshold (T)	Objective (O)	Technology Maturity Level
Volume Reduction	Extrapolate from current capability	Reduce by 20%	Greater than 20%	Start: TRL 2 End: TRL 5
Power Distribution/Sourcing	Multiple batteries and cables	Remove Cables/Reduce Battery Load	Advanced Power Management/Distribution	Start: TRL 2 End: TRL 5
Energy Recovery/Harvesting	None	Reduce Power Cost by 5%	Reduce Power Cost >20%	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
Laser Steering and Automated Target Tracking	L3/Brashear	X	X	X
Multi-Spectrum Sensor System	Stevens Institute of Tech	X	X	X
Target Tracking Laser Range Finder for Small Arms TA/FC	IAI	X	X	
Covert RF sensor for location and tracking of defiladed human targets	Penn-State University	X	X	X
Advanced Fire Control	Award Pending **			
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	
Concept & Numerically Modeling for Energy Harvesting	LOS ALAMOS			X
Microsight Technology	IDAHO NATIONAL LAB		X	

New for FY09

New for FY10

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

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Industry Status

✓ 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 completed, TRL 2 achieved, Phase II in-process (working to TRL 3)

✓ L-3 Brashear Corp.

- **Project Title:** "Steering and Automated Target Tracking
- **Status:** Phase 1A, 1B completed, TRL 2 achieved, Phase II in-process (working to TRL 3)

✓ Penn-State University

- **Project Title:** "Covert RF Sensor"
- **Status:** FY09 award, characterization of components, materials, for initial concept underway

✓ Intelligent Automation Associates (IAI)

- **Project Title:** "Automated Target Tracking Laser Range Finder for Small Arms TA/FC
- **Status:** FY09 award, Target tracking concepts /component integration initiated, 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, RF Sensor technology
- 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

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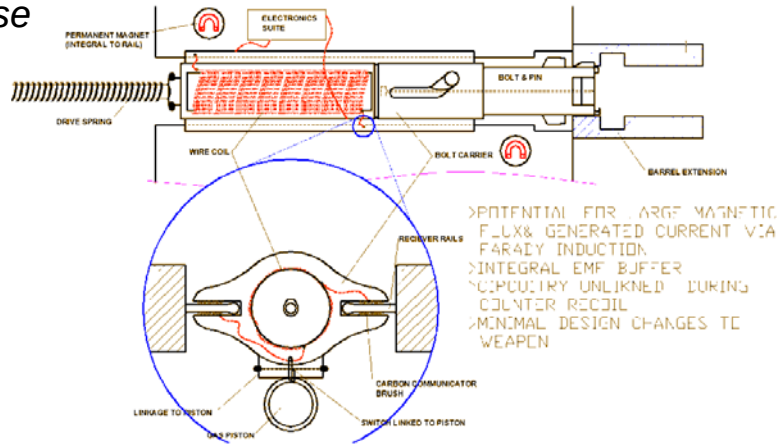
Armament Research Development & Engineering Center (ARDEC)

- ***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)*
  - ✓*First iteration layout formulated for incorporation into small cal.*
  - ✓*First order power output estimation analysis conducted*
  - ✓*Los Alamos Labs providing numerical modeling expertise*



Enabling Technology Updates (Department of Energy)

Oak Ridge National Lab (Optical Fiber-based Barrel reference sensor)

- **Objective:** Implement a barrel deflection reference sensor on weapon.
- **Status:**
  - Measurement & characterizing barrel oscillations completed
  - Bore sight laser calibration system established and tested
  - Breadboard fiber optic interference system built

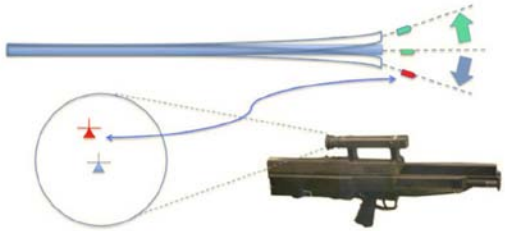


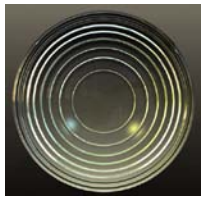
Figure 0. Barrel position sensor and reticle compensation system.

Sandia National Lab (Adaptive Optical Zoom for Combat Rifles)

- **Objective:** Provide a variable power magnifying optic over a much wider range with a button
- **Status:**
  - Polymer lens fabrication & characterization established
  - Lens core actuation modification in progress
  - Temperature compensator sensor initiated

Idaho National Lab (Microsight Lens technology)

- **Objective:** Dual focus lens capability for simultaneous focus on both the front sight and target.
- **Status:**
  - Three (3) designs with under development to address sight radius for M4/LSAT.SAT.



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Summary & Path Forward

- **Awaiting confirmation to extend Advanced Fire Control ATO one (1) additional year.**
  - Full maturation of technology will be achieved (TRL 4)
  - Enhances transition to follow-on effort (PM, ATO's)

- **One (1) new effort to be awarded in FY10**

- **Enabling Technology Efforts on-going**
  - Idaho National Labs
  - Los Alamos National Labs

Path Forward?

- *We are getting answers from industry academia, and government.*
- *ATO components technology is maturing*
- *Take best component technology and start integrating onto weapons platform to support multiple missions!!*