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 Small Unit Small Arms Technology Research (ASUSAT) Program

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Agenda

- *ASUSAT Background*
- *What is Active Stabilization?*
- *Why Active Stabilization?*
- *Development Path*
- *Project Evolvement*
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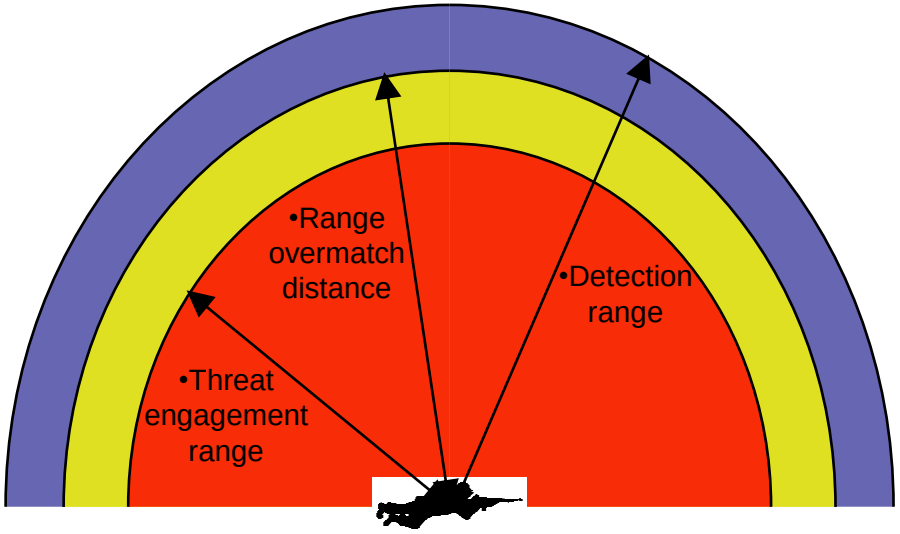
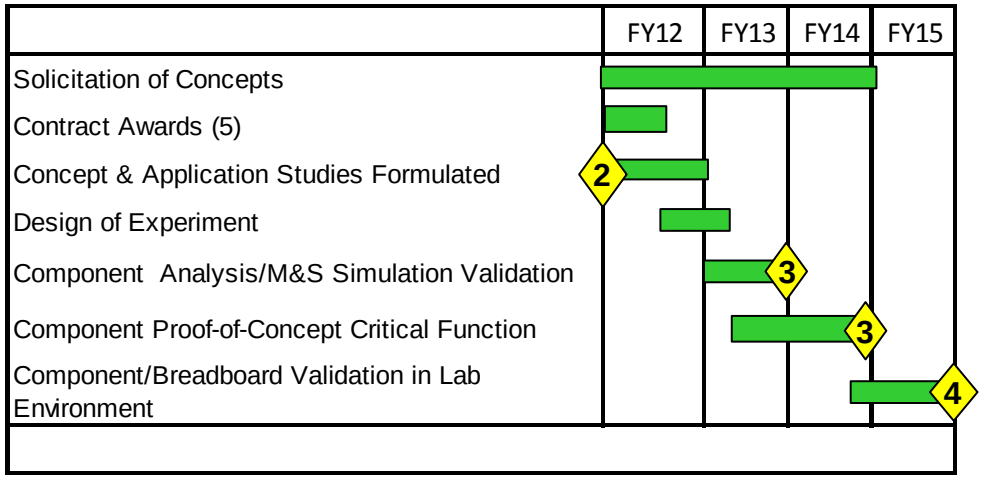
- *Acknowledgements*
- *Summary & Final Thoughts*

Advanced Small Unit Small Arms (ASUSAT) Technology Research Programs



Schedule & Cost



Purpose:

- Identify and advance technologies leading to the ability to improve Small Unit Level effectiveness.
- Utilize new small arms technological concepts to improve range overmatch capability against like-sized threat elements.

Capability:

- Increase Probability of Hit (P_{hit}) for rifles from 0-600m

Technology:

- Active Stabilization Technology

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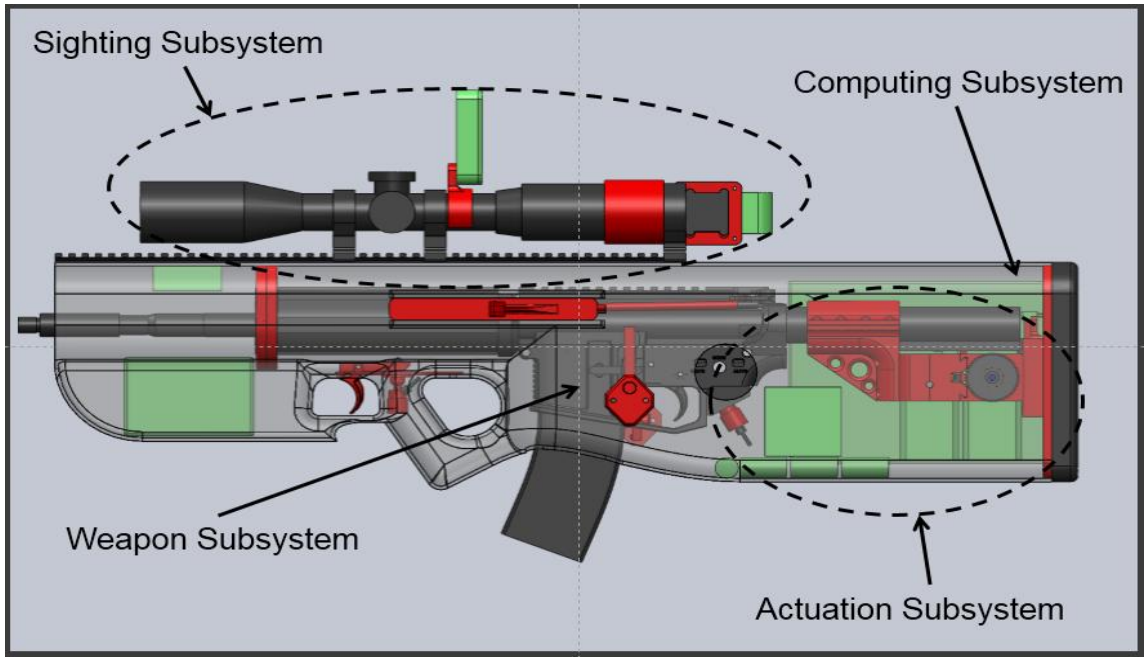
What is Active Stabilization 'AimLock'

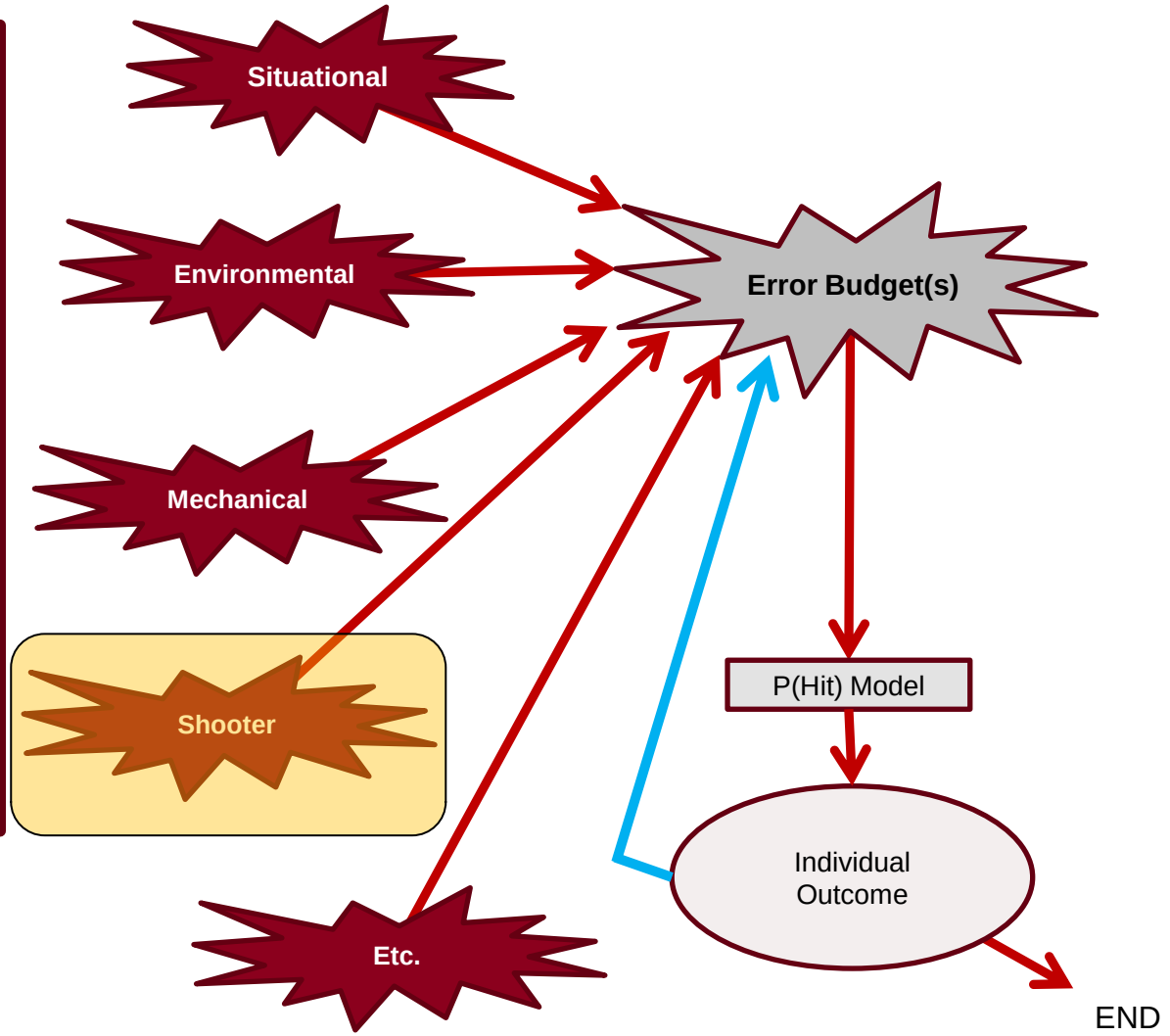
- **Barrel and receiver are articulated independently from the shooter-interface components of the system**
  - Grips, stocks, and optics, each of which are mounted to a "carriage" that envelops the moving parts of the weapon system.
  - Separation of the projectile-launching components of the weapon system from the user-interface components is controlled via target tracking software and embedded mobile processing hardware that optically monitor target position relative to point of aim.
  - Electromechanical actuators are activated to rapidly redirect the LOS of the barrel and receiver, separately from the standard LOS of the carriage, to actively stabilize the weapon-direction relative to the target.



Why Active Stabilization?

P(Hit)

- Mathematical function which conveys the likelihood of an impact within a designated area under specified conditions
- Dependent upon a number of other considerations and assumptions. These are conveyed via an **error budget**. This budget identifies and quantifies the impact of various **situational, environmental, mechanical, and psychological factors** that ultimately determine and ground the P(Hit) function with the specified firing event.



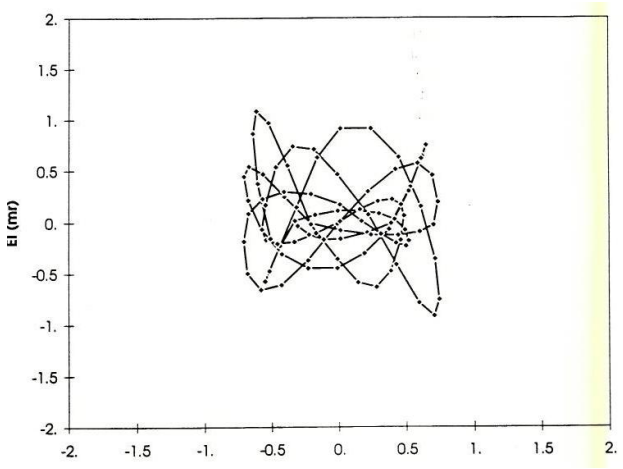
Active Stabilization-'AimLock' Development Path

Requirement:

- Development of a technology to mitigate the 1.5 Hz "Shooter Wobble" associated with the firing of a weapon from an un-supported position.

Goal:

- Reduce unsupported dispersion of small arms fire attributed to shooter wobble in order to increase Probability of hit (P_{hit})
  - Threshold: Reduce baseline dispersion by 10%
  - Objective: Reduce baselines dispersion by 25%



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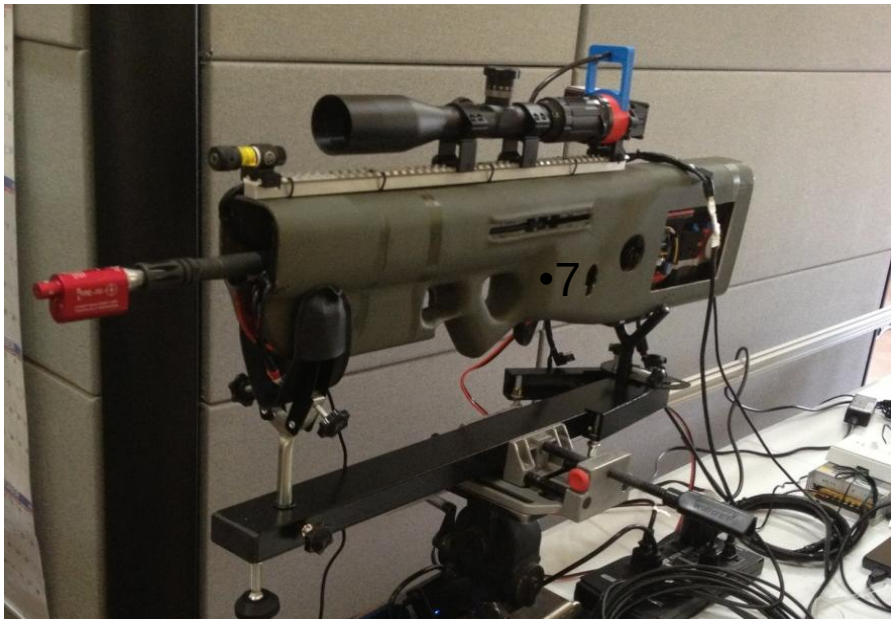
Active Stabilization – Phase I

Phase I

- Static Detection
- Integrate optical target detection and tracking
- Integrate active electro-mechanical stabilization
- Demonstrated TRL 3 Proof of Concept on an M4 type weapon platform



Active Stabilization – Phase II

Phase II

- Conduct Live Fire Test
- Trade-Study
  - –Optics, Computing, Actuators
- Live Fire Test Results
  - –Improved (P_{hit}) for both skilled and unskilled shooters with decreased engagement time in both stationary and moving targets

Test Stats						
Iteration	Shooter	Position	Stabilization	Target	Firing Sequence	Environmental
1	Skilled	Standing	Off	Stationary	8 groups/10 shots	Temp: 72-76° F Winds: 2.5-12 mph
2	Unskilled	Standing	Off	Stationary	8 groups/10 shots	Temp: 78° F Winds: 4-11 mph
3	Skilled	Standing	On	Stationary	8 groups/10 shots	Temp: 77° F Winds: 2-8 mph
4	Unskilled	Standing	On	Stationary	8 groups/10 shots	Temp: 76-77° F Winds: 4.5-8 mph
5a	Skilled(RMSL)	Prone	Off	Stationary	8 groups/10 shots	Temp: 64.8-65° F Winds: 0-1.5 mph
5b	Skilled	Prone	Off	Stationary	4 groups/10 shots	Temp: 71-76° F Winds: 0 mph
6	Skilled	Prone	On	Stationary	10 groups/10 shots	Temp: 71-77° F Winds: 0-10 mph
7	Skilled	Standing	Off	Moving	1 groups/10 shots 5 groups/5 shots	Temp: 63-69° F Winds: 2-10 mph
8	Unskilled	Standing	Off	Moving	4 groups/5 shots	
9	Skilled	Standing	On	Moving	4 groups/5 shots	
10	Unskilled	Standing	On	Moving	4 groups/5 shots	
Baseline Comparison (AR Platform not in Stabilization Shell)						
1B	Skilled	Prone	--	Stationary	1 group/10 shots	Temp: 73° F Winds: 5-6 mph
2B	Unskilled	Standing	--	Stationary	1 group/10 shots	
3B	Skilled	Standing	--	Stationary	1 group/10 shots	
4B	Skilled	Standing	--	Stationary	1 group/10 shots	
Active Stabilization Test Results Dates: 6/12/14 - 6/19/14 Location: Private Test Range in Conifer, CO Elevation: 8800 ft. All Units: INCHES						

Active Stabilization – Phase III

Phase III (In-Progress)

- Development in a more dynamic environment
  - Shooting from a moving platform at stationary and moving target from extended ranges
- Integrate Improved Controls, Drives, and Servo motors
- Integrate IMU and sensors, rangefinder, barometric sensors, ballistics engines, wind sensors
- Demonstration, Live-Fire Testing
  - Aug/Sep ‘15

Live Fire Demonstration Videos

- Location: Las Vegas Metro Police Dept. Range
- Range: ~ 100yds
- Target: 12” Circular (1/4” Steel Plate)
- Shooter: Craig LaMudge (JSSAP)
- Weapons Fired:
  - 5.56 Stabilized Platform (Demonstrator)
  - 7.62 Stabilized Platform (Beta Configuration)

Summary & Final Thoughts

Payoff

- **Increased in Probability of Hit P(Hit)**
- **Significantly reduce target acquisition time by offering shooters an effective 'snap-to-target' capability**

- Minimizes almost all shooter errors
- Mitigates gap of moving target engagement
- Ability to engage while moving in vehicle or advancing on foot
- Decreased training time to same level of skill
  - Less costs and more time to teach advanced TTPs
- Improved $P_{(hit)}$ on stationary targets for both skilled and unskilled shooters with decreased engagement times
- Increased effectiveness of system in standing unsupported position to almost match prone supported system results.
  - NOTE: Shooter in loop standing nearly matched system accuracy in bench rest on multiple occasions.
- Can execute with a "hot" trigger and/or a tag and mark fire mission
- Can receive/use multiple inputs = wind, facial recognition, prioritized targets
- Can be optimized within purpose built weapon system for form/function/SWAP

Acknowledgements

Contract Partner

- Rocky Mountain Scientific Lab (RMSL)
- Mr. Bryan Bockmon, President
- Littleton, CO 80127
- www.rmsl.net

Government Team

- Craig LaMudge: JSSAP Special Projects Officer
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