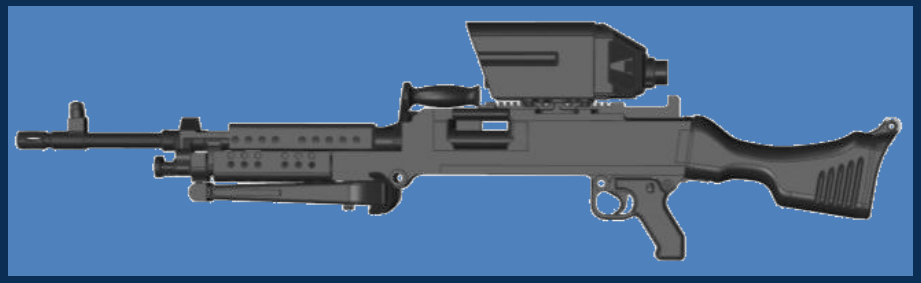

A NEXT GENERATION SMALL ARMS FIRE CONTROL SYSTEM

NDIA 2015 ARMAMENT SMALL ARMS FORUM

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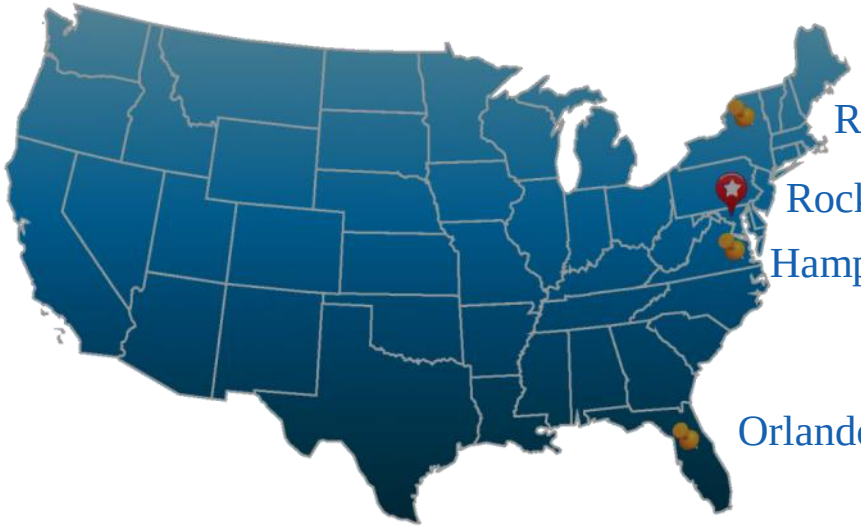
Intelligent Automation, Inc.

Company Overview

- Founded in 1987
- Woman-owned small business
- Headquartered in Rockville, MD
- 150+ Professional staff
- $31M+ revenue for 2014

Locations



IAI is focused on developing innovative technologies from concepts to fully-functional prototypes, and in transitioning our technology to products, government programs, and industry partners who have a strong marketplace position

VPR: Video-based Precision Ranging (JSSAP)

Develop and demonstrate technology that will a) improve first strike accuracy by providing integrated laser range finding and ballistic solution, b) decrease time to engagement.

MOTIVATION AND CONOPS

The Problem: Target Detection and Range Acquisition

Next generation fire control systems will be equipped with a ballistic computer to provide a ballistic reticle allowing for first shot accurate engagement. The ballistic computer relies on an integrated laser range finder (LRF) to obtain an accurate range to the target. **However, it will be up to the soldier to point and steady the LRF at the target**.

Soldiers engaging enemy targets with small arms face challenging conditions:

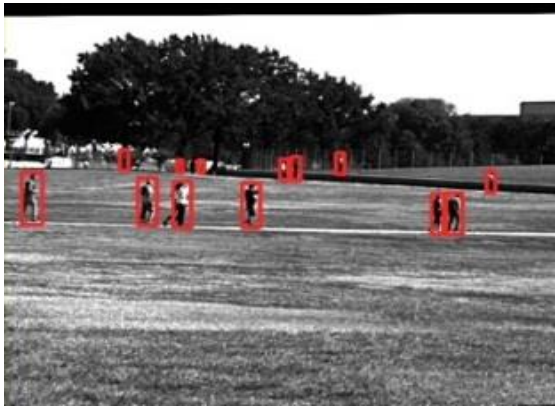
- Soldiers often engage targets **standing in an unsupported position** (~60% of the time)
- Targets are often in motion and seeking cover; which makes them **difficult to detect and track**
- In order to obtain a range to a target, soldiers must accurately **aim the weapon and keep it on the target** while acquiring a range
- Soldiers engage targets under considerable stress, where **elevated heart rate and fast breathing** make it difficult to maintain a range finder on target

All these conditions make it extremely difficult for a soldier to obtain an accurate range to target and an accurate ballistic solution.

The Solution : Target Detection and Range Acquisition

An ideal solution would:

- Assist the soldier in the **detection and tracking of difficult moving targets**
- Assist the soldier in compensating for weapon wobble and target motion (i.e. **stabilizing and pointing the LRF** at the target automatically)
- **Continuously acquire the range to multiple targets**, without the need for user intervention (unless desired)
- Predict the range and position of the target at the time the weapon is fired based on target tracking and ranging history (thus providing the ballistic computer the most accurate information possible; **generating an accurate ballistic reticle**)

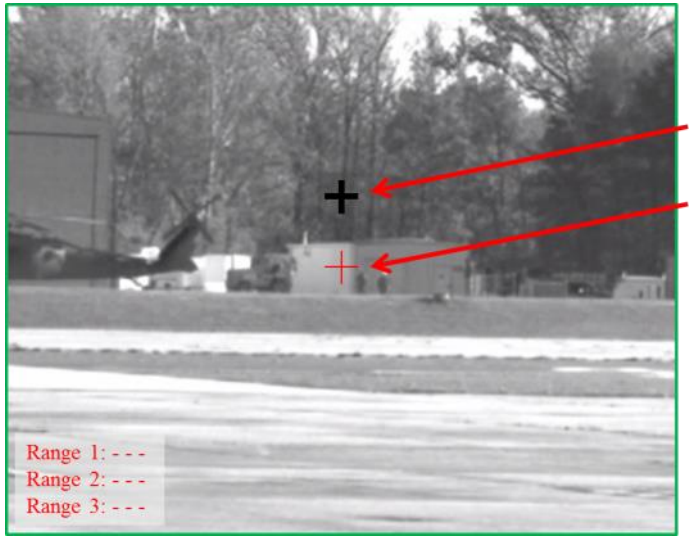


The Video-based Precision Ranging (VPR) small arms fire control system implements all these capabilities by:

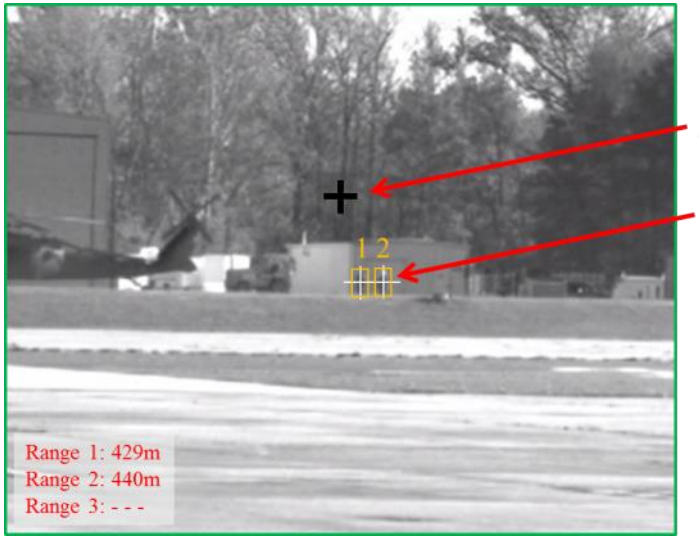
- Using machine vision, multiple targets are simultaneously and automatically detected and tracked.
- A steerable laser range finder automatically obtains an accurate range for each target

Target Detection and Range Acquisition

Conventional Approach



VPR Approach

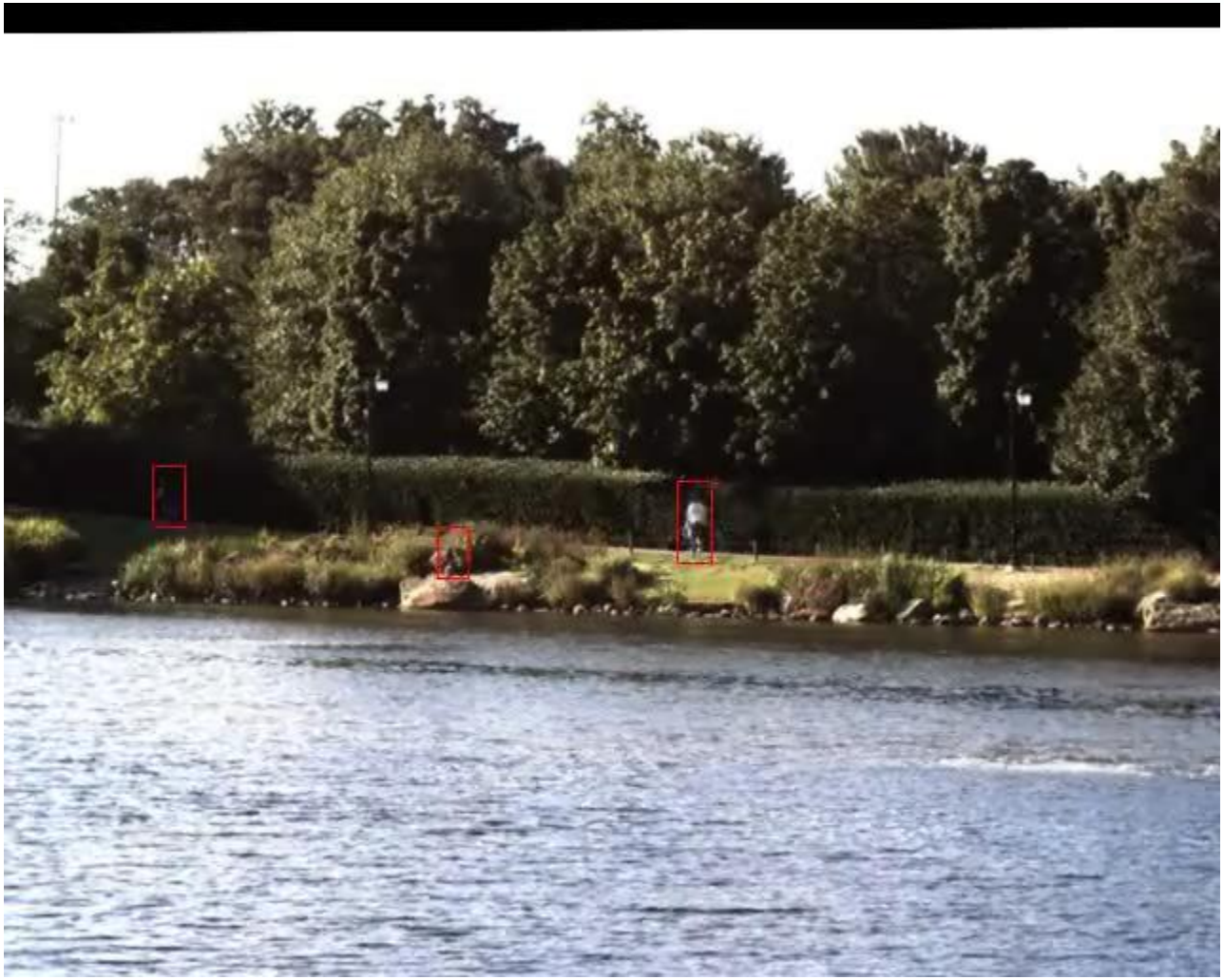


Conventional	VPR
User must **detect** targets	Targets are **automatically** detected via machine vision algorithms
User must **aim weapon** at targets (LRF reticle)	Ranges are **automatically** acquired by steerable LRF
User must **hold LRF reticle** on target	
User **requests range** to target	

HOW WE DO IT

Target Detection and Tracking

Example 1: Target Detection and Tracking



Example 2: Target Detection and Tracking (panning)

Example 3: Target Detection and Tracking (panning)

HOW WE DO IT

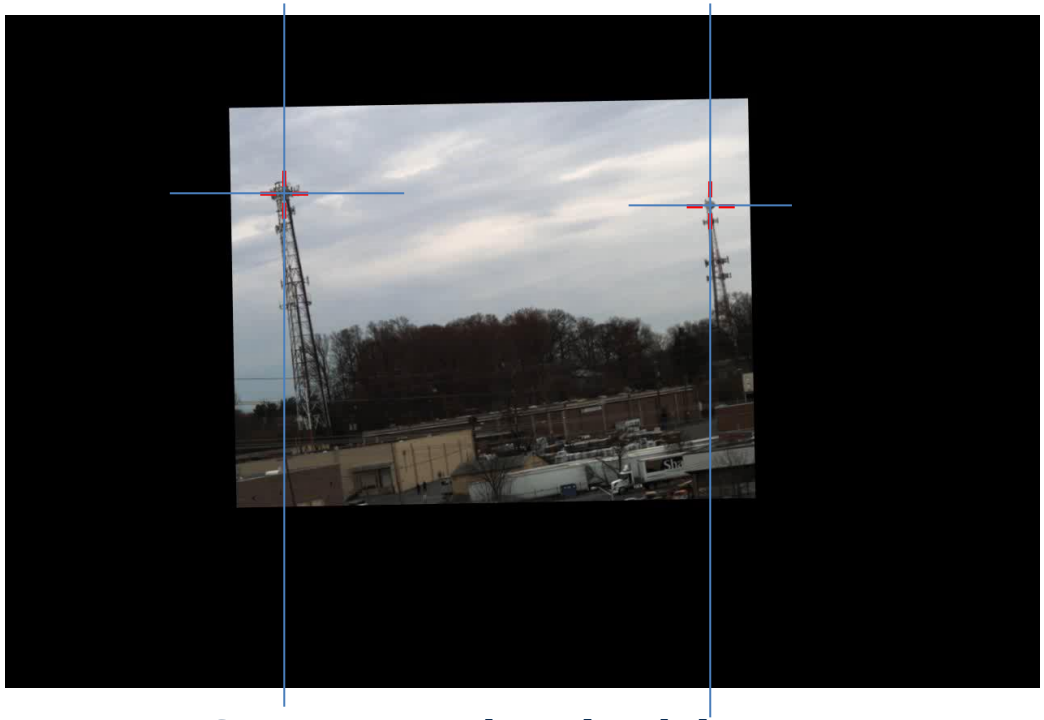
Robust Image Stabilization

Inertial + Vision-based Stabilization

Robust stabilization with respect to inertial reference frame

Crosshairs are not stabilized!!

Raw footage
Fov: 12.4 deg x 9.9 deg
Resolution: 640 x 480
30 fps



Gyro + vision-based stabilization
Real time processing

Inertial + Vision-based Stabilization

Robust stabilization with respect to inertial reference frame

Raw footage
Fov: 12.4 deg x 9.9 deg
Resolution: 640 x 480
30 fps

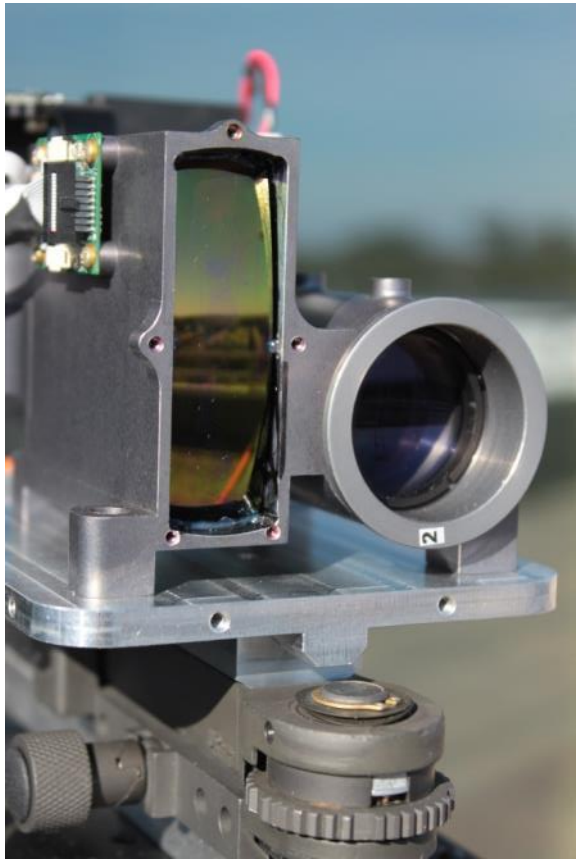
Crosshairs are not stabilized!!

Gyro + vision-based stabilization
Real time processing

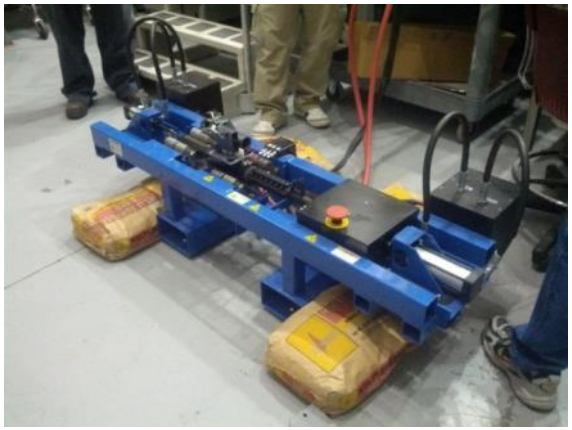
HOW WE DO IT

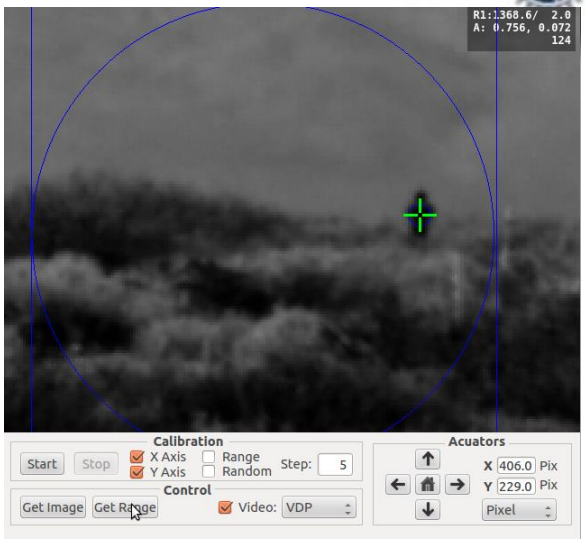
Laser Range Finder/Marker Beam Steering and Stabilization

VPR Phase I Steerable LRF Module



Steerable Laser Range Finder Optical Module

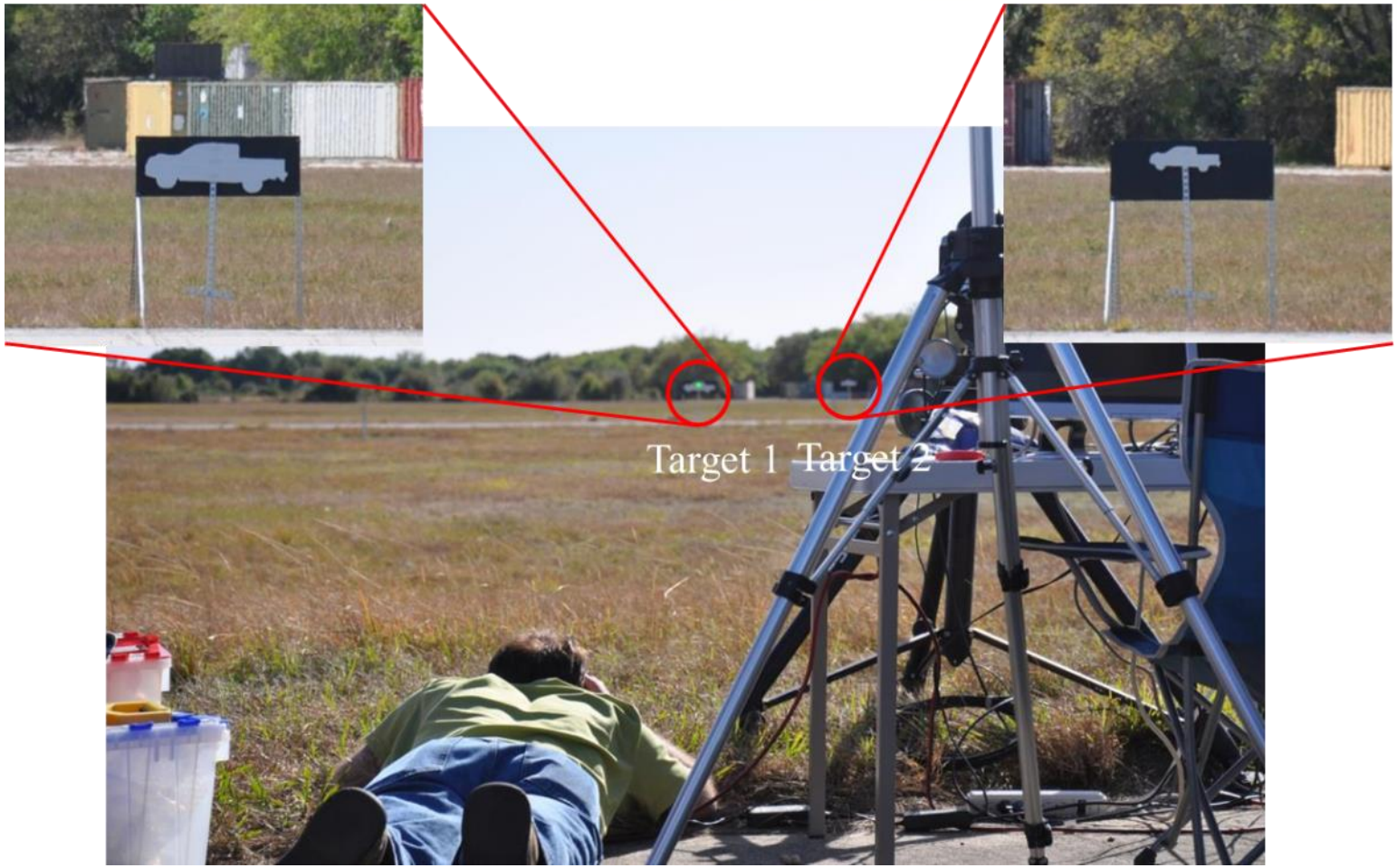




Evaluations performed at WSMR:

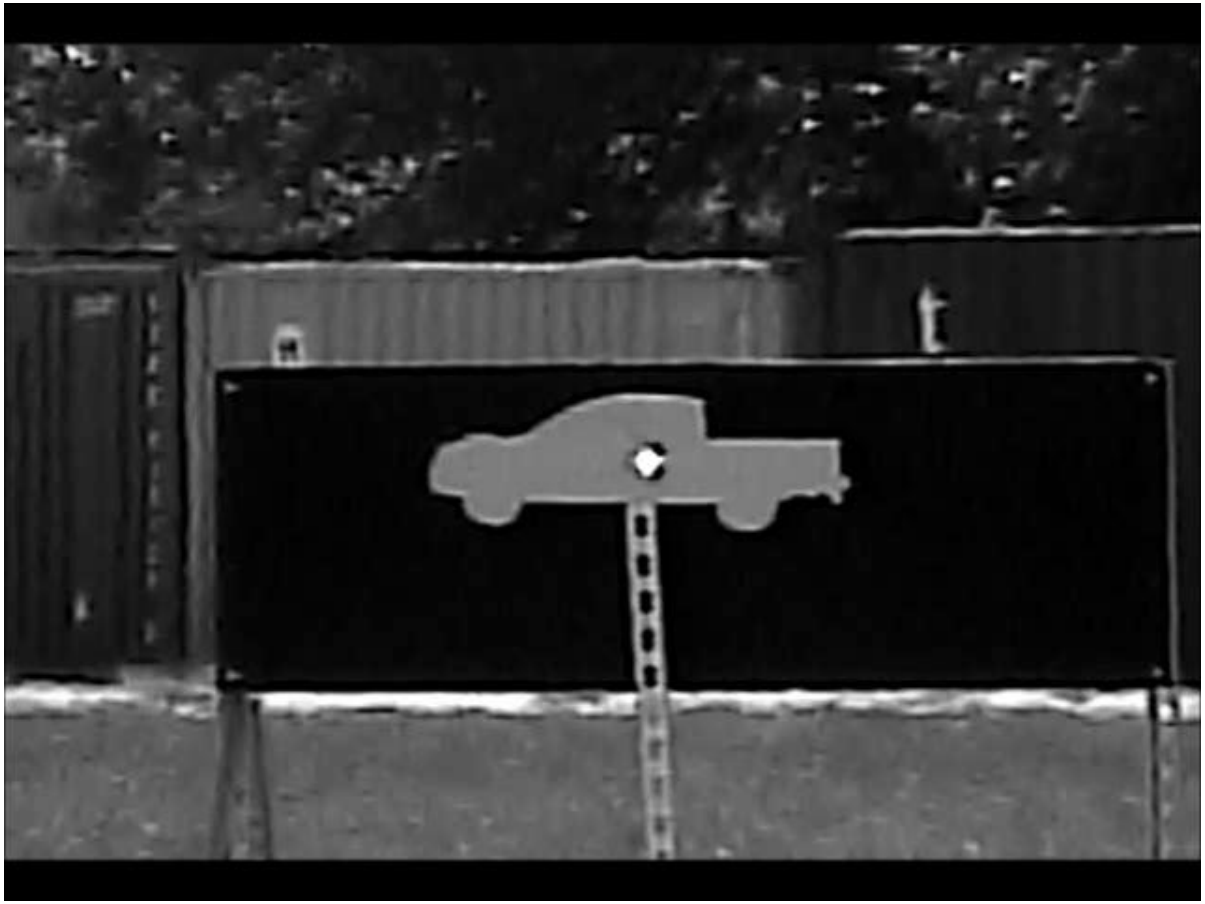
- Range Accuracy (human target at 1,200 meters),
- Ranging Repeatability
- Steering Accuracy,
- Steering Repeatability
- M4 Shock survivability

Avon Park, FL, TNT-13.2



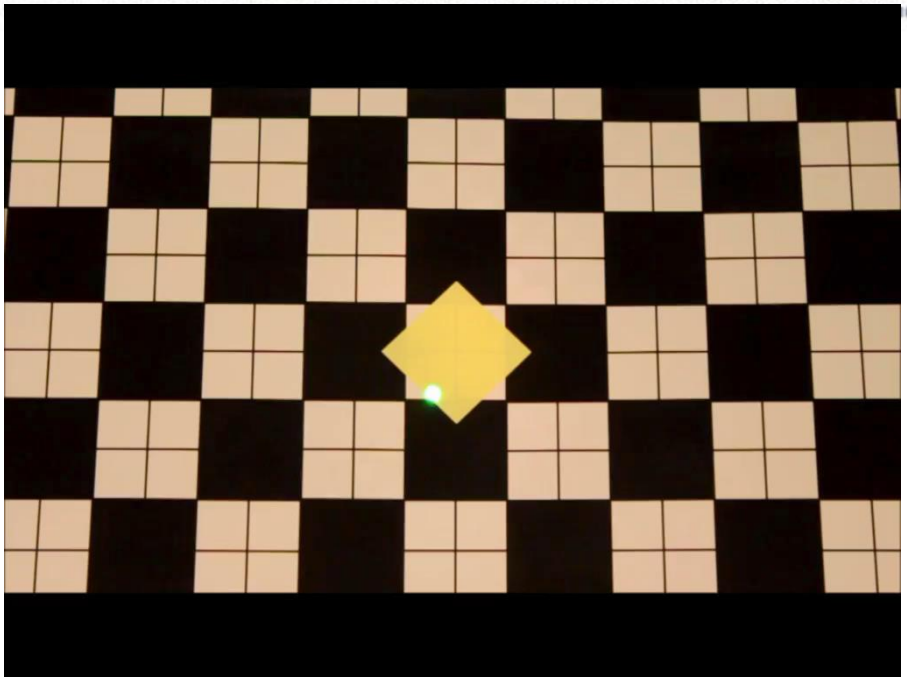
Target 1: Equivalent to Toyota pickup at 500 m
Target 2: Equivalent to Toyota pickup at 1,000 m

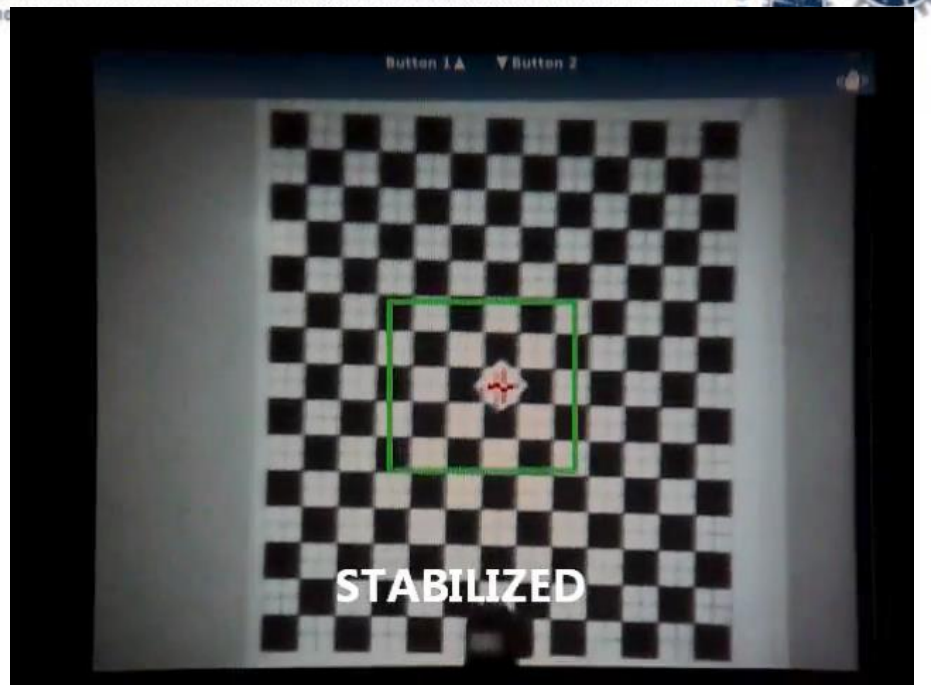
Outdoors: Avon Park, FL, TNT-13.2



- Target 2: Equivalent to Toyota pickup at 1,000 m
- Stabilization engaged; Operator in sitting, unsupported position.
- Un-stabilized not shown because beam would very rarely hit the target

Indoors: Stabilized Laser





View at the target **User's view (eyepiece)**

- Untrained user, unsupported
- Purposely aggressive jitter while stabilized, trying to lase the target when not stabilized
- **Stabilization is engaged** when a green square appears in the user's view video (see caption)
- The green square indicates the boundaries of achievable steering

VPR Status and Future Work

VPR Demonstrator Schedule:

- VPR final demonstration scheduled for December 2015.

VPR Demonstrator provides a flexible platform for evaluation of capabilities such as:

- Small Arms Cooperative engagement
- Identification of Friend or Foe
- Long Range Facial Recognition
- Closed loop fire control
- Etc.

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Vice President
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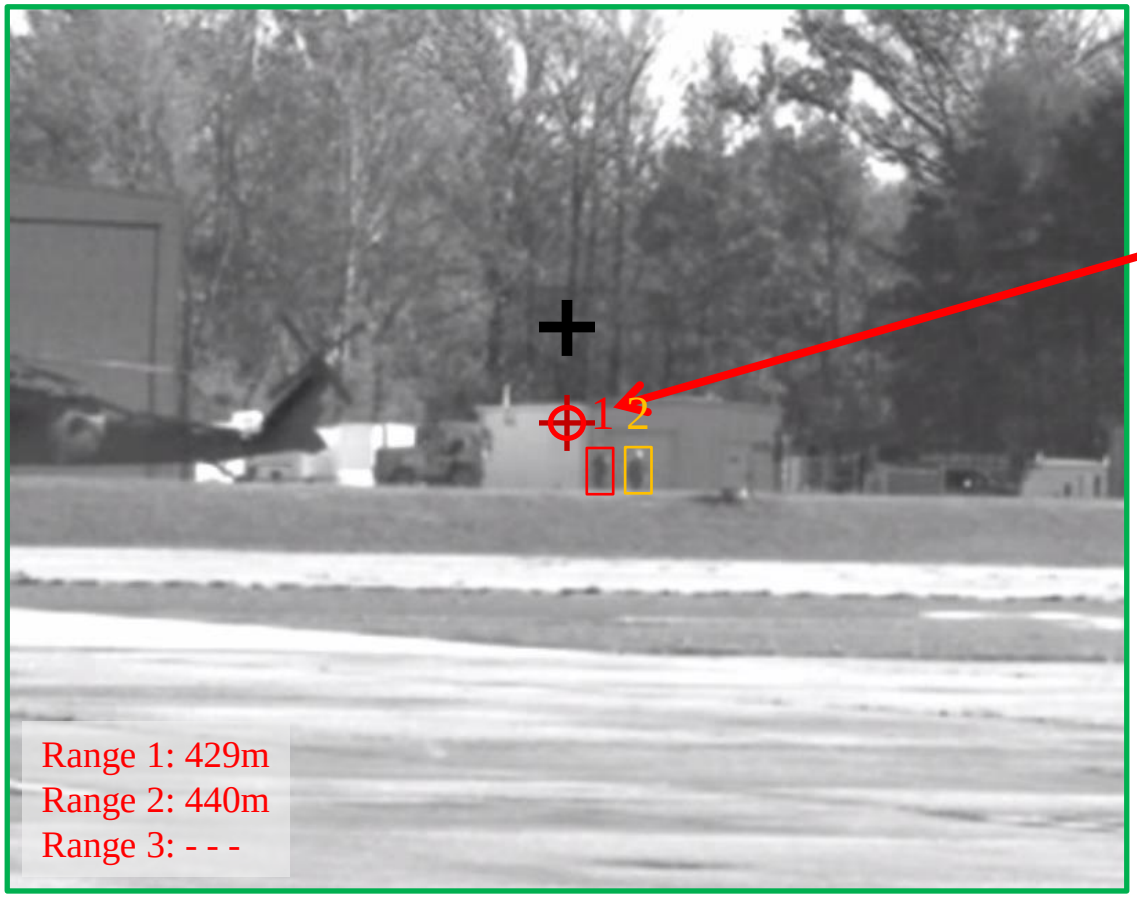
CONOPS (VPR approach)

- Ballistic reticle automatically computed,
- Ballistic reticle displayed.

Elapsed time < 1 sec



Ballistic Reticle for active target displayed.

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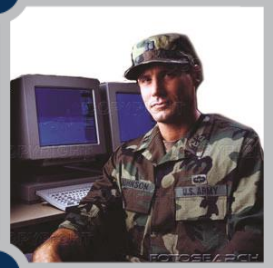

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