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Development of Standardized Test Methods for Quantitative Small Arms Thermal Signature Characterization

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Project Objective

- Capability Gap: No internationally standardized test methods currently exist for quantification of small arms thermal signature
  - Inexpensive long-wavelength infrared (LWIR) imagers are readily available
  - Suppressors are of high concern

FLIR ONE, $275

- Objective: Develop and evaluate quantitative small arms thermal signature measurement methods—emphasis on suppressed weapons
  - Utilize IR/RF Countermeasures Division imaging expertise
  - Effort part of NATO Army Armaments Group (NAAG), Land Capability Group Dismounted Soldier Systems, Suppressor Team of Experts

FLIR VUE, $1499

Proposed Signature Evaluation Method

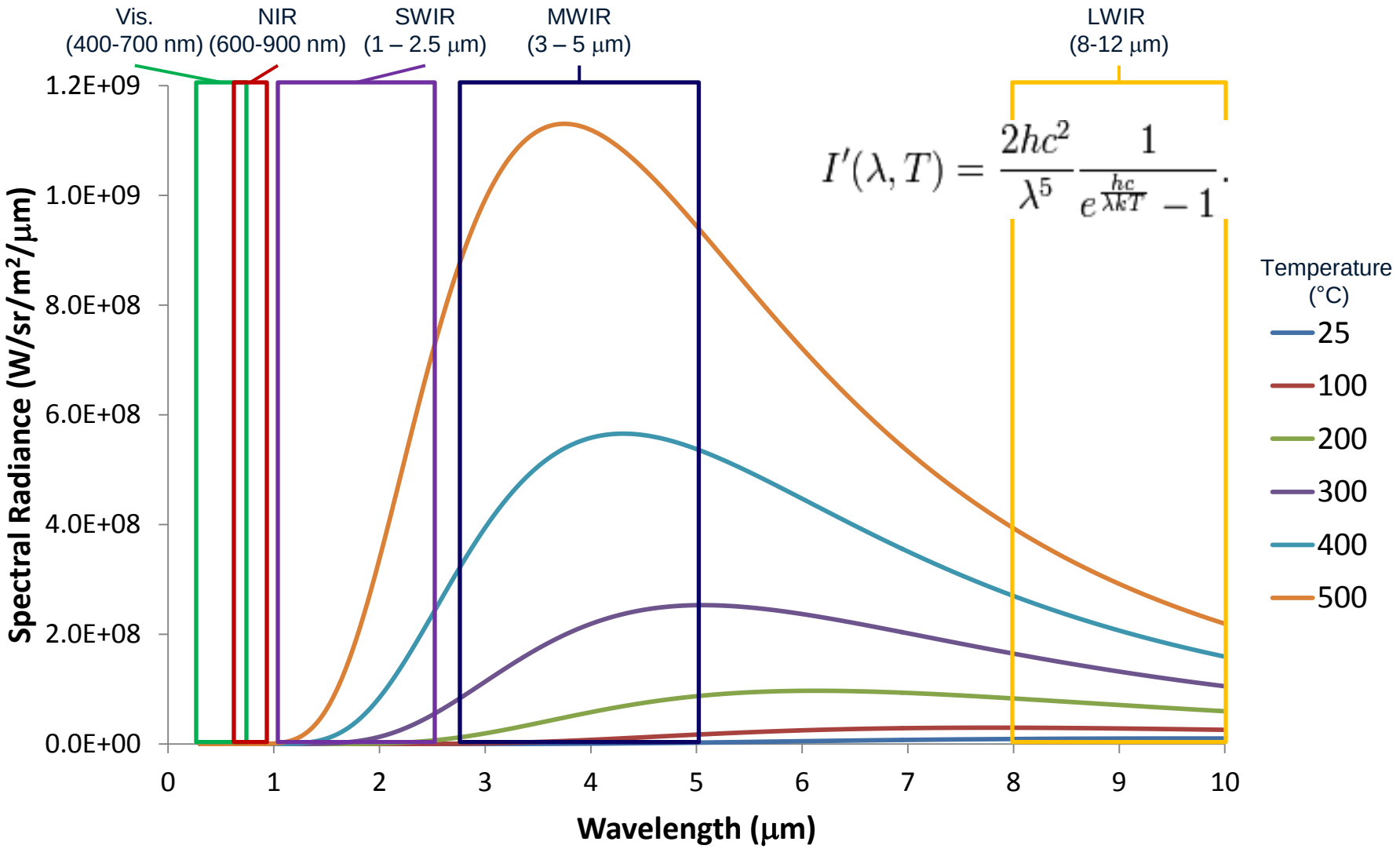
Proposed Thermal Signature Measurement Method:

- Image “hot’ weapons using long-wavelength infrared (LWIR) imagers
  - Focus on “inexpensive,” microbolometer-based, calibratable imagers
- Analyze images to measure radiant intensity
  - Images must have sufficient fidelity to allow quantification
  - Concentration on suppressors due to size and temperature
  - Adapt methods currently in use for IRCM analysis

Benefits:

- Enables quantitative performance metrics
- Instrumentation independent intensity values
  - Improves comparison between different test results from different labs
- Consistent with upcoming NATO STANREC procedures

Background: Plank Radiation



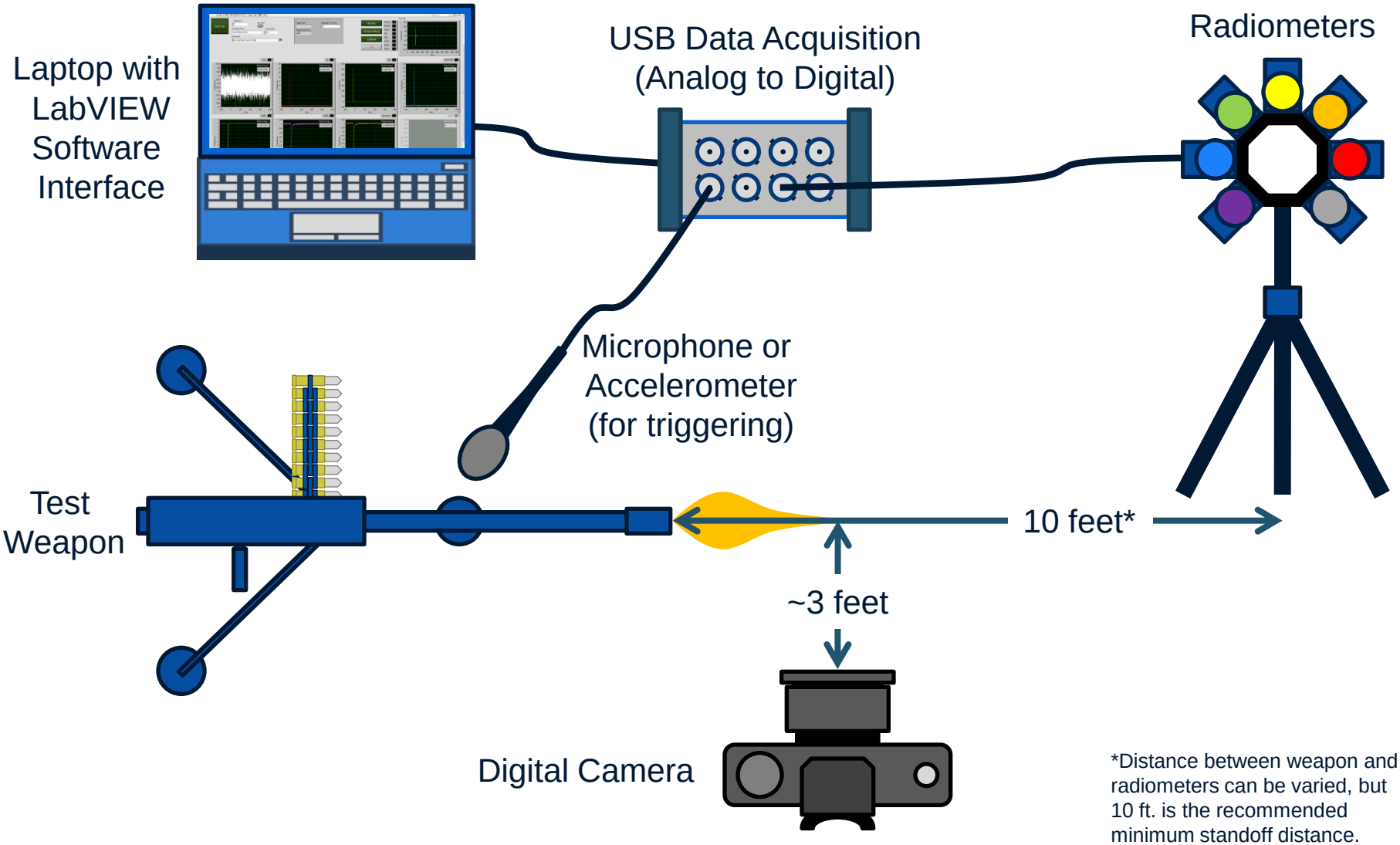
Note: Definition of spectral regions are approximate

Thermal Imager Evaluation

- Continuation of radiometer evaluation
  - Improved acoustic triggering demonstrated

- Thermal imaging capabilities evaluated
  - Microbolometers
  - Dual-band InSb

Simplified Instrumentation Diagram



*Distance between weapon and radiometers can be varied, but 10 ft. is the recommended minimum standoff distance.

Automated Data Acquisition Software

- Simultaneous sampling of 8 channels
  - Up to 100 kHz acquisition rate with external trigger for data synchronization
    - Acoustic, light, or vibration triggering possible
- In-line post processing of data & report generation

FLIR-T62101

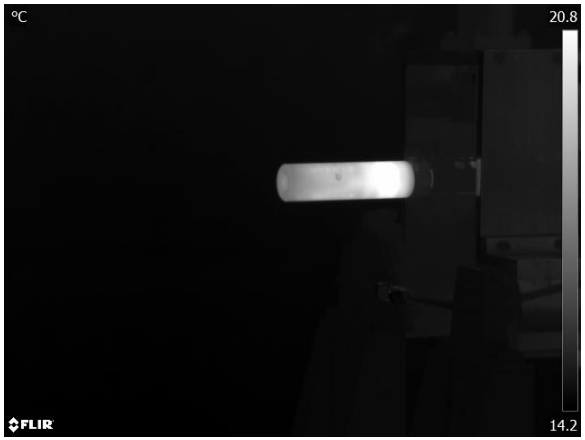
- Designed to be a “point-and-shoot” thermal camera
  - Analysis limited to *.jpg images output from camera

FLIR-T62101

- Disabling auto-gain gives improved thermal differentiation
  - *.jpg output is NOT ideal for quantification

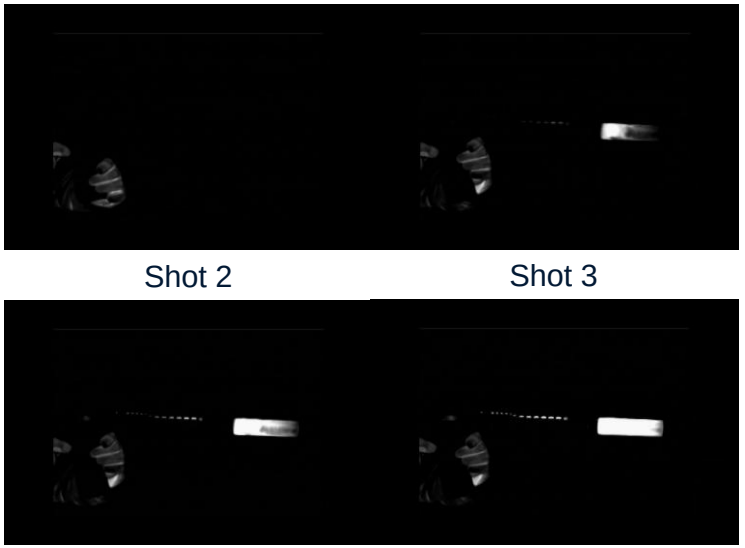
FLIR A-600: “It’s Science Grade”

- Designed to allow improved image/data analysis
  - Software-based user interface & analysis toolkit



Conclusions & Deliverables

- Conclusions:
  - Aircraft signature analysis methods are appropriate
  - “Low-cost” microbolometers provide good images
    - Most commercial software designed for qualitative imaging
    - JPG file format unsuitable for quantitative analysis
    - Raw output necessary—few software packages include this option
- More to come in the next year!



Acknowledgements

- NAAG LCG-DSS Suppressor Team of Experts
  - Scott Reeve & Ross Colbourne (DSTL, UK)
  - Dr. Morten Huesby (FFI, Norway)
  - Dr. Thomas Svensson (FOI, Sweeden)
  - Adam Jacob (ARDEC)
  - Dr. Rogério Pimentel (DRDC) & CWO John T. Yoshida (DSSPM, Canada)
  - Jason Davis & Dave Long (NSWC Crane)

- Salvatore A. Fanelli (USMC SYSCOM)
- Dr. Barton H. Halpern (Development and Engineering Center Joint Service Small Arms Program, Picatinny Arsenal)

- Financial support
  - NSWC Crane Naval Innovative Science and Engineering Program
  - USMC SYSCOM

Supplemental Material

Acronyms & Abbreviations

Abbreviation	Definition
ARDEC	Armament Research Development and Engineering Center, Picatinny, NJ
cd	candela—a measure of visible brightness
COTS	commercial off-the-shelf—items that are readily available for purchase from commercial vendors
CWO	Chief Warrant Officer
DAQ	data acquisition
DRDC	Defence Research and Development Canada
DSSPM	Director Soldier Systems Program Management
ft	feet
Hz	Hertz
kHz	kilohertz
LCAAP	Lake City Army Ammunition Plant
NAAG LCG-DSS	NATO Army Armaments Group, Land Capability Group, Dismounted Soldier Systems
NATO	North Atlantic Treaty Organization
NSWC	Naval Surface Warfare Center
s	seconds
ms	microseconds
SLR	single lens reflex—a type of camera which uses a single lens for composition and imaging
sr	steradian—the solid angle of a conical projection (A full sphere is 4π steradians.)
STANREC	NATO Standardization Recommendation
SYSCOM	Systems Command
ToE	Team of Experts
USB	Universal Serial Bus
USMC	United States Marine Corps
V	Volts
μV	microvolts
W	Watts

Small Arms Thermal Imaging

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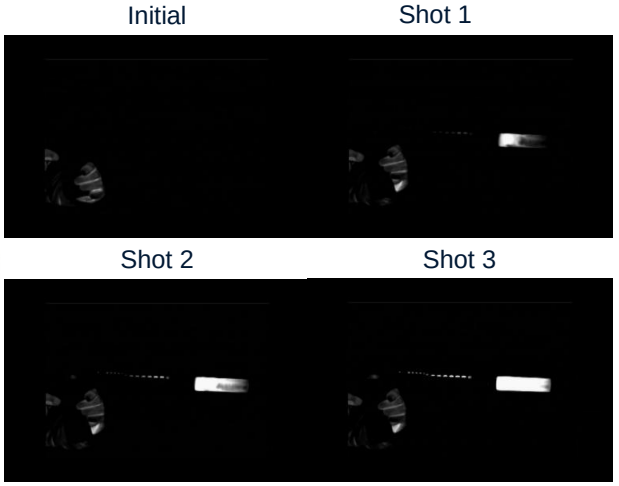
Project Description: The NATO Land Capability Group on Dismounted Soldier System Weapons and Sensors Sub-Group is coordinating an effort to develop an internationally accepted method for quantitative measurement of the signatures of suppressed, small arms weapons. Crane's continued leadership in this group, unique insight into current and emerging small arms user requirements, and electro-optics test experience uniquely positions us to define, develop, and demonstrate these test methods. With the shrinking size and proliferation of electro-optic sensors, the ability to characterize and quantify the signatures of small arms weapons will be of critical importance to future DoD missions.



Project Approach:

- Various COTS infrared cameras will be evaluated to determine the parameters necessary for a low-cost imaging system to quantitatively measure small arms thermal signatures.
- A proof-of-concept test will be conducted vs. a "scientific-grade" thermal imaging system.
- Methods utilizing these instruments will be documented as the basis for a NATO Standardization Recommendation (STANRECs)

Project Deliverables:

- **Demonstration of test methods for NATO**
- STANREC for small arms thermal signature characterization

International Collaborative Standardization Effort : Scott Reeve (DSTL, UK), Dr. Morten Huseby (FFI, Norway), Dr. Thomas Svensson (FOI, Sweeden), Adam Jacob (ARDEC, Picatinny, NJ)

Customers: NATO Land Capability Group on Dismounted Soldier System Weapons and Sensors Sub-Group (LCG-SDD-W&S), Marine Corps PM-Infantry Weapon Systems, US Army Test and Evaluation Command, SOCOM PM-A&W Integral Receiver Group

Navy S&T Strategy Focus Area Alignment: Warfighter Performance, Expeditionary & Irregular Warfare, Total Ownership Cost