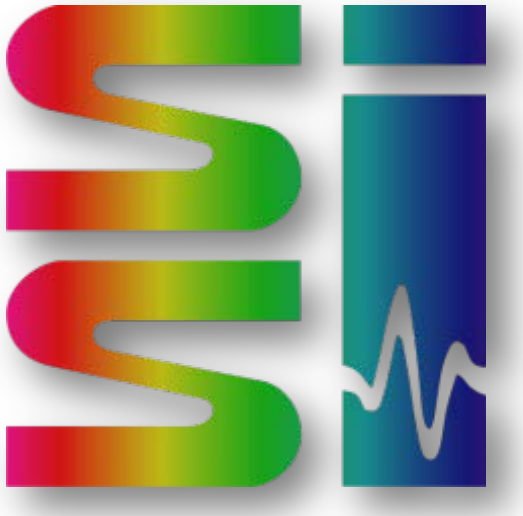
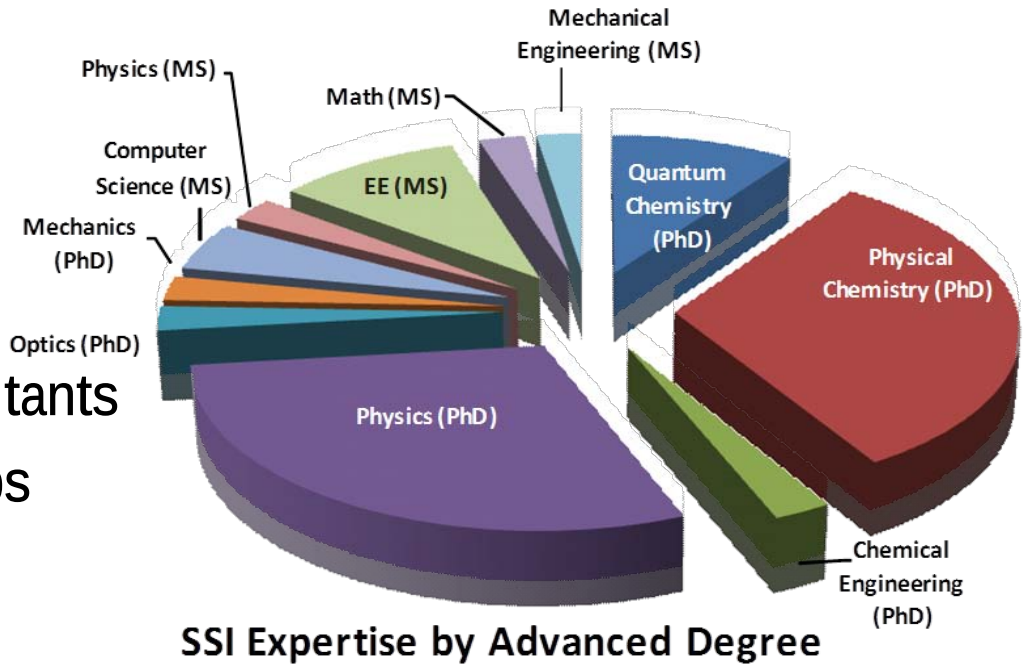
Spectral Sciences Inc.



IARPA Standoff Illuminator for Measuring Absorbance and Reflectance Infrared Light Signatures (SILMARILS)
Proposers' Day Conference
January 20, 2015

Spectral Sciences Inc.
Who We Are

- Formed January 1981
- President – Dr Robert Sundberg
- 46 employees in Burlington, MA
  - 34 PhD, 3 MS, 2 BS/engineers
  - Academic and industry consultants
  - Northeastern University Co-ops
- Revenues of ~$10M/annum



SSI Expertise by Advanced Degree

- C-Corp, 100% employee owned and operated ESOP
- 30K sq ft office building with 3800 sq ft laboratory space
- 200+ node Linux cluster & multiple computing platforms

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Spectral Sciences Inc.
What We do

Research and development aimed at challenging problems in the national defense and commercial sectors

Prototype Instrument Development

New Processing Algorithms

Modeling and Simulation

Field Measurements and Data Analysis

- Revenues
  - 97% Research and Development programs
    - 80% US Government funded, 20% Corporate
    - 50% Small Business Innovative Research (SBIR)
  - Commercial licensing of software
- Customer Base
  - Air Force, Missile Defense Agency, other DoD and intelligence agencies
  - DoE, NASA
  - Government Prime Contractors
  - Collaborative efforts with large and small US companies, major research universities and national labs.

SSI Technologies
Relevant to the SILMARILS program

Standoff chemical sensor

Long–Wave InfraRed (LWIR) spectral imager:

TRACER (Thermal IR, Reconfigurable Analysis Camera for Effluents and Residues)

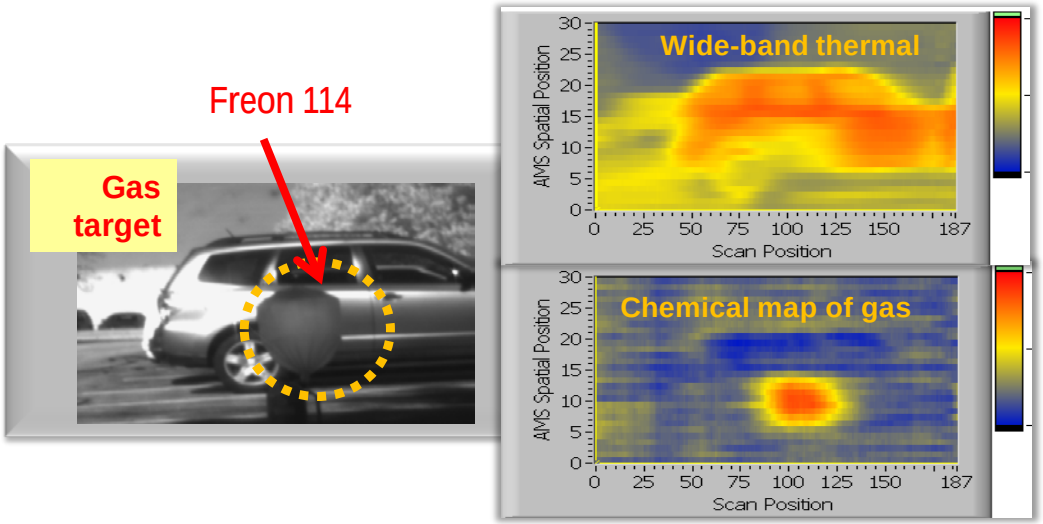
- *Field-ready prototype* of a standoff surface contamination sensor developed under DTRA Rapid Innovation Funding
- Unique multispectral imager based on a *single element LWIR detector*
- Absence of LWIR focal plane array (FPA) results in *large cost and power consumption savings*
- Spectral imaging technology based on *SSI's Digital Micromirror Array (DMA)-based Dispersive Transform Imaging Spectroscopy (DTIS)* (US Patent 8,305,575 B1 "Adaptive Spectral Sensor and Methods Using Same" (2012) and other patents)

Standoff Chemical Sensor

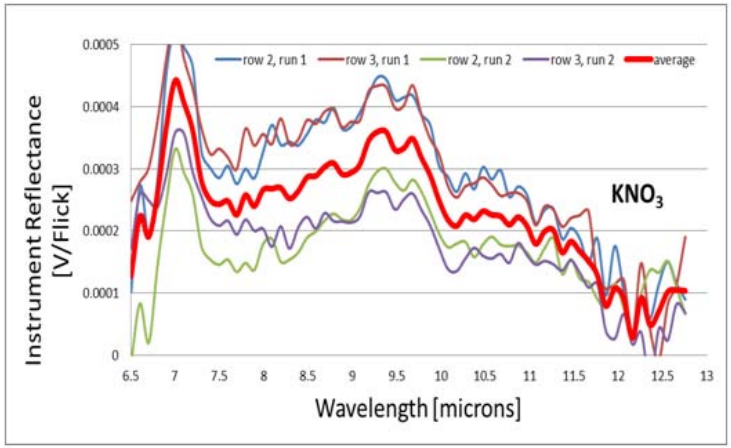
Long–Wave InfraRed (LWIR) spectral imager: TRACER

- Rapid spatial/spectral/temporal *reconfiguration for variety of target detection needs*
- Spectrally encoded, *in-hardware compression (matched filter)* rapidly processes data to form detection map overlaid on wide band thermal image
- Spectral imaging in the LWIR 'fingerprint' region of hazardous chemicals: liquids, solids, gases at *trace levels*
- Superior chemical *discrimination over wide-band* thermal cameras

Standoff gas detection



Surface contamination detection



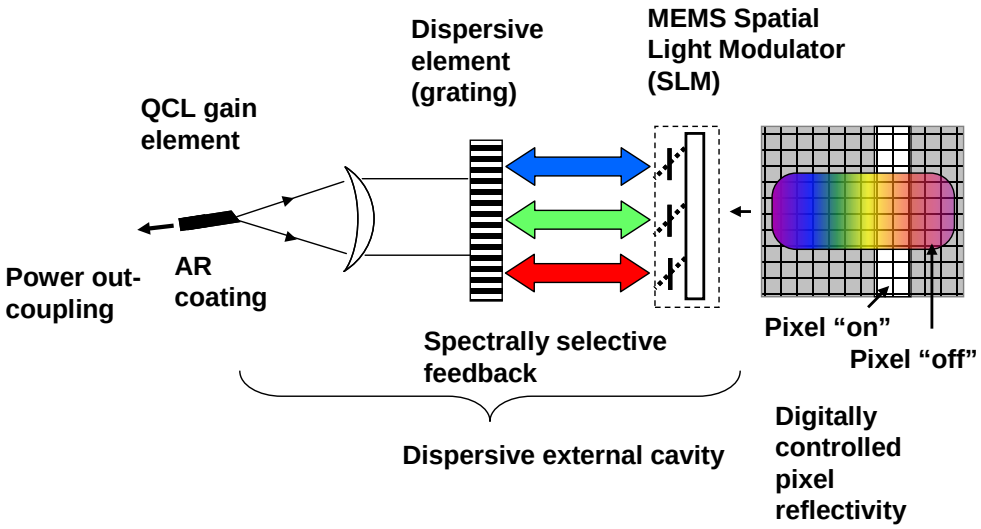
Example: KNO_3 reflectance spectra

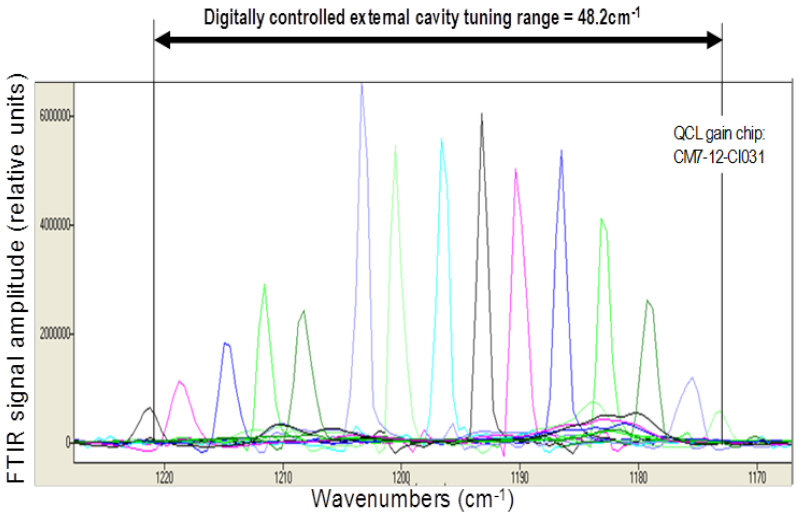
Data analysis of SNR points to sub-µg/cm^2 detection sensitivity for some of the materials of interest for SILMARILS

SSI Technologies
Relevant to the SILMARILS program

Spectrally selective illuminator: Quantum Cascade Laser

- Tuning By Digital Micromirror Array (DMA)-controlled external cavity
- Fast (<50µs switching time*), digitally-controlled random-access wavelength tuning*, stable wavelength locking, >20kHz high-bandwidth modulation
- Output power and tuning range *dependent on the gain element* and equal in performance to that of classical external cavity QCLs.





- In progress: compact, near-monolithic cavity containing *multiple QCL gain chips* – design developed for 5 chips covering 7.5µm to 10µm spectral region
- Reference: Vujkovic-Cvijin, et al., , "Quantum cascade laser tuning by digital micromirror array-controlled external cavity," SPIE Photonics Europe, Laser Sources and App., 9135 (2014)

SSI Technologies
Relevant to the SILMARILS program

HyperSpectral Image (HSI) data processing

Hyperspectral Imagery
VNIR/SWIR LWIR

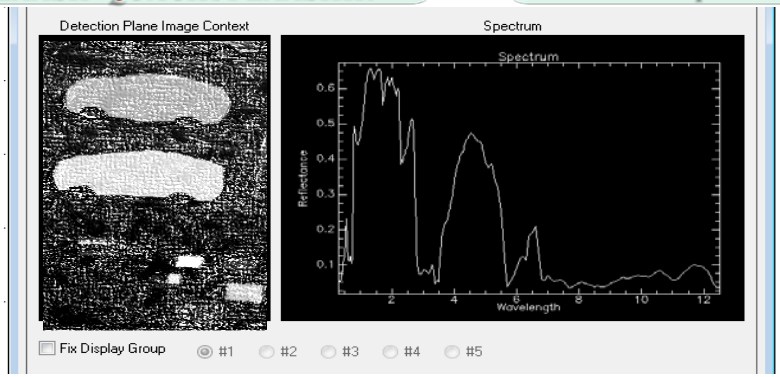
→

Atmospheric Correction
SSI products:
QUAC/FLAASH QUACIR/FLAASHIR

→

Material ID & Detection
ACE Subspaces Fusion BMA

True Color HSI

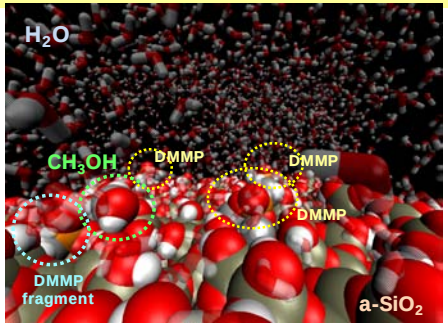


Detection plane Material Spectrum

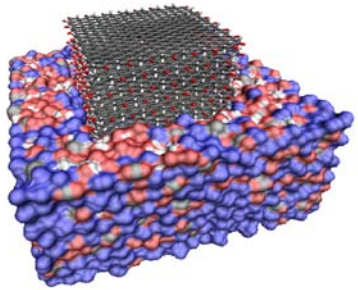
Detection Analysis Window

Physical modeling of surface adsorbed chemicals

- SSI has expertise in modeling the adsorption and reaction of chemical weapons and explosives on environmentally relevant surfaces such as silica, carbon, and metal oxides



Reaction of DMMP on a silica surface in the presence of H_2O using reactive molecular dynamics simulation techniques.



Simulation of the detonation products of TATB explosive. The fluid surroundings are composed of N2, H2O, CO2 and CO

Conclusions

❑**Spectral Sciences Inc.'s technology platforms are available in any and all of the areas described here:**

- ***Spectral imaging***
- ***Broadband spectrally selective illumination***
- ***Spectral image processing***
- ***Modeling surface chemistry***

❑ **Spectral Sciences Inc. welcomes collaboration and joint development aimed at technology maturation and product development related to the SIMARILS objectives and requirements**

Additional information and handouts are available. Please see me after the talk.