Short-Range BioSpectra: Results from the alpha phase

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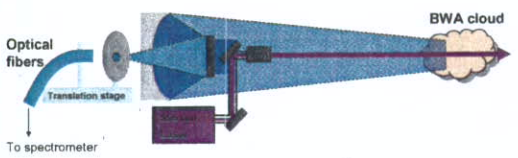
Introduction

- SR-Biospectra is a short-range remote bioaerosol detector.
- It is a scale-down variant of a long-range remote bioaerosol detector also built by INO and MDA for DRDC.
- SR-Biospectra is developed in two phases (alpha and beta). The alpha phase is complete - the technology performed as expected.
- The final beta prototype is being built and will undergo testing during August at Valcartier and October at Suffield.

Objectives of the project

- Sensor designed to be part of a network of sensors
- Detector tailored to the needs of the first responders
  - Short range
  - Small size
  - Lower cost than competing technologies
  - Easy to use
  - Low false alarm rate

Objectives – Sensing concept



- Detection of bioaerosol by laser-induced fluorescence
- Variable focus to optimize detection for short ranges
- Spectrometer + 32 channel PMT allows detection of spectrally resolved fluorescence spectrum in order to do classification
- Time gating allows detection of an atmospheric cell of a given length at a given distance (shortest gate = 65 ns, i.e. 10 m long cell)
- Eye-safe system

Objectives – Partner responsibilities

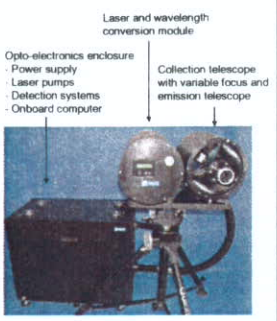
INO:	DRDC:	MDA:
•Defining requirements with first responders	•Spectral exploitation algorithm definition	•Defining requirements with first responders
•Sensor design	•Test plan for Tests and Evaluation (T&E) campaigns	•Command and control (C2) system design
•Sensor manufacturing	•Availability of DRDC Valcartier facilities for T&E	•C2 software and operator interface
•Sensor control software	••Availability of DRDC Suffield facilities for T&E	•Spectral exploitation algorithm programming
•Sensor testing		•Hardware procurements for C2 system

Relevance

- There is a current gap in the defense against CBRNE threats: there is a lack of bioaerosol remote sensing capability
- Most sensors are for military uses that have different requirements than civilian first responders or security agencies
- All sensors on the market are very expensive
- SR-Biospectra is specifically designed to fill this gap

Progress – Alpha prototype design

- Optical Head apart from Opto-electronic enclosure
  - Flexibility of use
  - Smaller visible footprint
  - No optimization of size and weight
- Use of carbon fiber tubes for lighter telescope construction
- Use of multichannel PMT for lower cost
  - 32 channels from 425-700 nm
- Controlled by an onboard PC (introducing network capabilities)
- Eye-safe system



Results – Alpha T&E

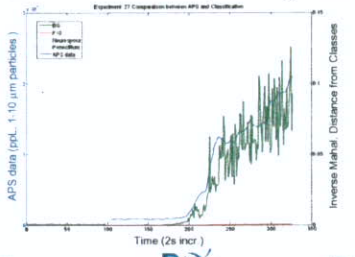
- Alpha T&E held at Valcartier on December 15th and 16th 2008.
- SR-Biospectra was placed at 30 m and 100 m away from the release chamber.
- Data was recorded during 28 releases over the two nights
  - Bacillus Globigii (5 different growths)
  - Cereus
  - Neurospora
  - Penicillium
  - MK III Pepper Spray
  - MK-IX 9005 Pepper Mace Fogger
  - MK-IX 9010 Mace Fogger
  - MK-IX 9020 Mace Fogger
  - MK-IX 9030 Mace Fogger
  - F1015 Pocket Tactical Grenade
  - F1040 Instantaneous Blast Grenade
  - F1016 Pocket Tactical Grenade

Results – BG sensitivity

- Current analysis is not using spectral information for separating BG spectra from background spectra. Only the derivation of sensitivity limits (worst cases) is targeted.
- Current analysis for anthrax simulant "BG", 1 µm size particles, dry release.
  - 992 and 1144 ppL at 100 m (Goal <1000 ppL)
- For BG of 3 µm size as is usual for wet releases, signal will be 9 times higher for the same number of particles and the sensitivity requirement will easily be met.
- Stray light in the spectrometer is increasing the background level. Sensitivity can be further improved for the Beta prototype.
  - Two solutions have been identified and have been implemented

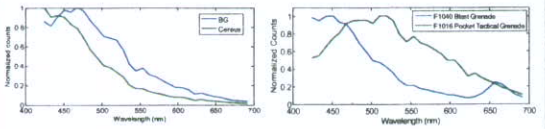
Results – Classification efficiency

- Large number of detection channels and spectral exploitation algorithm allow classification of bioagents
- Classification can be an efficient way of reducing the false alarm rate



Results – Public security products

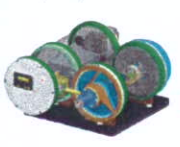
- Public security products also generate fluorescence when shined upon by UV light
- Their fluorescence spectra are quite different from bioaerosols and the classification algorithm can classify them
- Data from several public security products was acquired to populate our database



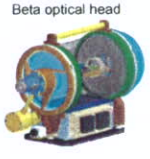
Progress of the Beta prototype

- Beta prototype improvements:
  - Optical head is 60% of original volume (64cm x 30cm x 40cm)
  - Optical head is 71% of original weight (25 kg)
  - Enclosure is 23% of original volume (51cm x 51cm x 28cm)
  - Sensitivity improved by optimizing the spectrometer
  - Sensitivity improved by using a different PMT

Alpha optical head



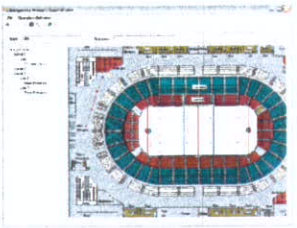
Beta optical head



Beta enclosure

Progress - Operator Interface

- Heavily based on industry standard applications
- Embedded GIS (GlobalMapper). Low licence cost and industry standard
- GIS for spatial interaction and display of information, i.e.
  - Defining surveillance plans
  - Display of system status
  - Geographic display of where alarms are being generated
- GIS supports image layering. This is useful for multi-floor surveillance plans.



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Impact on Canada's ability to respond

- The project will provide Canadian first responders with a novel sensor for the remote detection of biological warfare agents
- Its targeted lower-cost will hopefully make it accessible to first responders
- The sensor will help in protecting key assets from attacks by enabling permanent monitoring
- The sensor will help manage the aftereffects of an attack by providing safe pathways for evacuation
- The sensor will help in decontamination efforts

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Conclusion

- Alpha phase completed
  - Key technological choices were validated
  - The sensor was tested with BWA simulants, public security products, and naturally occurring spores
- Beta prototype construction underway
- C2 system will be integrated with the sensor
- The final prototype will be tested in Valcartier and Suffield before the end of October 2009

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